Managing Customer Services Using GIS in Banks: A Case in Chinese Competitive Environment

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### Titel
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### Författare
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### Sammanfattning
In recent years, Geographic information system (GIS) is becoming a useful tool for location related analysis and decision making. Linking huge data using space, as in a GIS, is a new way to help any bank understands better its data and its customers. China's banking industry opens to full foreign competition in 2006; banks in China have to focus on developing their strengths in the competition. Chinese local banks need to improve their abilities by providing high quality services and using information technology more intelligently. GIS technology can help this.

The thesis from two aspects investigates how GIS can help bank for customer services, one is site selection of bank branches or ATMs and another is providing bank loan to customers. We choose case study as a research strategy for this thesis. The research is based on the theoretical frameworks starting with GIS analysis methods, GIS processes, customer service management and GIS applications in banks. We learn from previous author's experiences and use Norrkoping spatial data for analyzing as methodology demo to acquire an understanding of how to utilize GIS to support customer services for banks.

As a result, GIS can help banks to improve customer services management. The general processes are data collection, data analysis, and data display. Building a GIS support system based on "customer focus" in a bank is a good choice under the pressure of commercial competitions. Nevertheless, for offering better service to customers, bank can combine web in GIS support system. How to optimize Web GIS for customer query from World Wide Web could be one opportunity for the future research.

### Nyckelord
GIS, customer service, banks,...
Abstract

In recent years, Geographic information system (GIS) is becoming a useful tool for location related analysis and decision making. Linking huge data using space, as in a GIS, is a new way to help any bank understands better its data and its customers. China’s banking industry opens to full foreign competition in 2006; banks in China have to focus on developing their strengths in the competition. Chinese local banks need to improve their abilities by providing high quality services and using information technology more intelligently. GIS technology can help this.

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Chapter 1

Introduction

This chapter gives background and some key aspects related to the study. Then the research problem and research question are indicated to provide the overall aim of this study.

1.1 Background

In the recent years, the computer technologies develop rapidly, new forms of analysis and modeling methodologies become feasible commercial issues, and spatial analysis technology is becoming a main area for a new computational marketing period. It is required to find better ways of using unlimited and cheap computing power to improve what you do in the market. Based on Openshaw’s opinion[23], in 21st century there are more challenges in business environment, it is necessary to establish an appropriate and cost-effective technological framework that is able to integrate and manage such business intelligence. He points out there are three key aspects concerning the significant changes of IT in marketing which are: computing hardware and software, database and emerging new marketing technologies.

Nowadays Geographic information system (GIS) is becoming a useful tool for location related analysis and decision making. Yeh[38] says ”The increase in the use of GIS in business is partly because of the availability of data and partly because many companies see the advantage of using GIS in their work”. The cost and ease of transferring many types of data which business may need is also another
1. Introduction

contributing factor in the flourish of the use of GIS in business[35].

"Banking is a knowledge-intensive business" says by Simon Thompson.[7] According to his parlance, record keeping, data management, process monitoring, and business intelligence are really important for banking industry, because huge data is generated during daily financial activities. Linking the data with space, as in a GIS, is a new way to help banks or financial organizations understand better their data and customers.

In the environment of globalization of the banking industry, competitions in the banking sector increase rapidly. Customer service center is a product that conforms to this trend. By linking up with banks business, customer service center provides convenient and efficient services to the customers, such as financial inquiries, operation inquiries, address inquiries and other services. The quality of its service directly relates to the bank's service quality. Since bank customer service center started to operate, according to the statistics that about 40% of the calls are related to geographic information. The consultations include the locations of bank network and ATM, travel path and so on. As there are many bank branches, ATMs and self-service banks, it may prolong the waiting time of the customers by relying on the memories of service people and inquiries files. With customer services center gradually expands service area, providing convenient and efficient geographic information inquiries becomes one of the most important factors affecting customer service quality. To improve service quality, bank customer service center considers using GIS to solve the problem of unfamiliar location name. Furthermore a great number of business use related geographical data by GIS to know their customers living places. Accessing to reliable data is good for an enterprise's strategic decision-making, and it is compulsory for competitions to attract and keep customers in banking industry [22].

1.2 Research purpose and research question

The purpose of this thesis is to acquire an understanding of how banks use GIS for improvements in customer services management.

Based on the research purpose, the research question is following:

RQ: How to utilize GIS to support customer services for banks?
1.3.0. Frame of reference

After formulating the research problem and research question, then the frame of reference should be conceptualized for this study. This frame of reference is presented graphically in Figure 1.1, and it can help us to answer the research question. The framework guides us to find out how to use GIS to improve customer services in banks.

Figure 1.1. Relationships of GIS and Bank customer services

1.3 Frame of reference

After formulating the research problem and research question, then the frame of reference should be conceptualized for this study. This frame of reference is presented graphically in Figure 1.1, and it can help us to answer the research question. The framework guides us to find out how to use GIS to improve customer services in banks.
1.4 GIS and bank industry in China

1.4.1 GIS development in China

GIS in China develops quickly recent days. In Asia, GIS has developed quite rapidly since 1991. Japan is one of the early starters of GIS. It is the most advanced user of GIS, and many systems and data are available. However other Asian countries including China are just starting to use GIS and developing their digital data.[38]

GIS technology in China is utilized in many sectors such as land suitability analysis for the spatial development planning of Wuhan city, or forecast and evaluation of disaster. Currently many enterprises and parts of government start to attend GIS. GIS data can help in business development, especially the development of the service industries. More people and industries get benefit from the GIS technology. Making GIS technology to be able to serve the people and economic development of China is the role that GIS should play in modern society.

However the availability and pricing of GIS data are the main encumbrances in GIS development. When the needed data for private sectors are available at an easily affordable price, GIS will be more useful.

1.4.2 Bank industry in China

There are four leading and popular local retail banks in China:


Industrial and Commercial Bank of China (ICBC) http://www.icbc.com.cn

China Construction Bank (CCB) http://www.ccb.cn

Agricultural Bank of China (ABChina) http://www.abchina.com

The biggest state-run commercial bank, Industrial and Commercial Bank of China, has 18,000 branches and deposits totaling about 700 billion dollars. The other also operate on a similarly grand scale.

In China, the banking industry appears some new optimistic changes. The overall increase in loans and financing instruments has fallen. Capital adequacy ratio, asset quality and set aside level have increased. New progress in credit risk assess-
ment and prevention have been made, which is a better support to the national economic development. Currently, the accounts receivable and the growth of inventory financing occupancy rate of enterprises are over the loan growth of same period, declining the efficiency in the use of funds, and thereby declined the operational efficiency. In addition, changes in interest rates, exchange rates and other changes have led to the increasing of market risk.[14]

China’s banking industry officially opens to full foreign competition on 2006-12-11. This change was agreed under the conditions which were set when China joined the World Trade Organization in 2001. Previously foreign banks were only allowed to offer services in a limited scale. Localities where foreign banks are allowed to conduct renminbi (RMB) business have been expanded from originally the two cities, i.e. Shanghai and Shenzhen, to currently 13 cities. Foreign banks are allowed to provide RMB business to Chinese enterprises from December 1, 2003.

Being an important component of the Chinese economic reforms and open-up, the opening of the banking sector has made remarkable progress, which has contributed significantly to the banking industry reforms and innovation. Opening China's banking industry to foreign banks will give them access to the local currency retail banking business, which lifts all geographic and customer restrictions on operations. Foreign banks can challenge local Chinese banks by expanding their branch networks and aggressively targeting wealthy clients with private, foreign currency banking services. Foreign banks have a chance to capture some retail banking business and corporate business in larger cities, while those changes are going to unfold more gradually, people may not see any changes immediately.

Shanghai is the financial center of China. In recent years, Chinese government is working to develop Shanghai into an Asian or even global financial center. Now Shanghai is becoming the most concentrated region for attracting foreign financial institution in China. According to government figures, most of the foreign banking business is located in Shanghai, 55 percent of total foreign banking business amount and 30 percent of all outlets. Till the end of October, 2006, the total number of operating branches of foreign banks in Shanghai reached 94, comparing five years ago the number of increased branches is 42. The total assets of foreign banks in Shanghai exceeded 60 billion U.S. dollars in 2006, the proportion of the total assets of foreign banks in Shanghai banking industries increased by 1.1 percentage points, from 13.1% in 2005 raise to 14.2%. With more comprehensive business
development of foreign-funded banks in Shanghai, the share of the total assets of the banking sector is expected to achieve around 20%-30% in the medium to long term.

To face the fierce competitions, it is necessary to innovate business and services. The developing trend of Chinese banking industry is towards intensive operation based on the deep understanding of the industry’s demand. The local banks have sought out the strategic ways and means to obtain better management skills, control risks and improve their services. At present the service of local banks is slow and just passable, for example waiting an hour for just a simple transaction is not uncommon, or finding a bank branch in a residential area is difficult even impossible. However in some other countries as varied as Russia, Brazil and the United States, market opening has not resulted in a mass of customers drop out from local banks to foreign ones. Chinese banks should focus on developing their strengths and working around with their weaknesses to compete. Chinese domestic banks are basically local banks, so their understandings of the customers and sensitivity of local market are going to be better than any foreign banks. They are rather weak in retail banking areas; they need to improve their abilities by using information technology more intelligently to manage their retail business. GIS technology can help this.
Chapter 2

Methodology

In this chapter, the adopted research methods for the research question will be explained and justified.

After designing the research question, we need to choose the research methods. Qualitative research is a set of research techniques, used in marketing and the social sciences to enable to study social and cultural phenomena. It investigates the why and how of decision making[36]. Qualitative research is also eclectic in using multiple strategies and methods.

Qualitative data sources include observation and participant observation, interviews and questionnaires, documents and texts. The qualitative data are obtained from a relatively small group of respondents and not analyzed with statistical techniques. This differentiates it from quantitative research in which a large group of respondents provide data that are statistically analyzed. In qualitative research, the structure of the design and data are not organized in advance, but are developed as the empirical work proceeds.

2.1 Case study research

A case study is one of several ways of doing social science research. Other ways include experiments, surveys, multiple histories, and analysis of archival information[41]. A case study is the most common qualitative method used in information systems[36]. A case study is an experiential investigation. The basic
2. Methodology

idea of a case study is that use whatever appropriate methods to study one case in detail[26]. A case study aims to understand that case in depth and also aims to preserve and understand the wholeness and unity of the case. Therefore a case study is more used as a strategy than a method[26]. A case study is a strategy for doing research by using multiple sources of evidence to investigate a particular contemporary phenomenon within a real life[27].

The research purpose of a case study is classified generally in three different kinds—exploratory, descriptive and explanatory[40]. Exploratory purpose is the one that investigate a whole new area of research. Conducting exploratory research may change to get a result of new data appearing and new insights occurring[28]. The object of descriptive research is to describe an accurate profile of persons, events or situations[27]. This is an extension of exploratory research. Before doing this kind of research, data should be collected in a condition of having a clear picture of the phenomena first. The aim of explanatory study is to make clear relationships between variables by studying a situation or a problem.

Yin[40] recommended the designs of a case study can be classified in four types due to different design situation and the units of analysis, they are: single-case (holistic) design, single-case (embedded), multiple-case (holistic) design, and multiple-case (embedded) designs.

Wikipedia[36] also concludes several types of case study, they are:

a) Illustrative case study- illustrative case study describes a domain by using one or two examples to analyze a situation. This kind of research serves to make readers from unfamiliar about a topic to familiar.

b) Exploratory case study- a case study helps to identify questions, select measurement constructs, and develop measures. The researchers may undertake this kind of case study before implementing a large-scale investigation.

c) Critical instance case study- a case study examines one or a few sites for one of two purposes.

d) Program affects case study- this kind of case study can determine the impact of programs and provide inferences about reasons for success or failure.

e) Prospective case study- the researcher formulates a set of hypotheses in respect to the evolution of a social or cultural process and then tests there hypotheses.
2.2.0. Methodology

f) Cumulative case study- a case study aggregates information from several sources collected at different times.

g) Narrative case study- a case study presents findings in a narrative format.

h) Embedded case study- a case study contains more than one sub-unit analysis[41].

According to Yin[40], archival records in computerized form are ways of collecting data for case studies, some examples are as follows:

a) Maps and charts- geographic characteristics of a place

b) Survey data- such as census data

c) Service records- those lists show the number of customers served in a given period of time.

d) Organizational records- organizational charts or budgets in a given period of time.

2.2 Methodology

Using qualitative method is because the fact that we want to find out how GIS create value for banks and convince banks to use GIS in the customer service management.

Our research question is of "How" character. The question relates to operational links. Hence, the data is collected and analyzed in order to compare with the existing literatures.

Based on the research question, a case study is the preferred strategy because "how" question is being posed. The research purpose is exploratory because we want to indicate a better understanding of how people use GIS to manage customer services in banks. We conduct this study by searching the literatures in the library, database and internet. Also we want to portray the process, the system and the value and then try to draw a conclusion after the findings of the research question, so our research purpose is also descriptive and explanatory.

In this research, archival records are very helpful to present the process of how GIS improve customer services in banks. To complete the data collection and gain as more information as possible, documents and websites are also used. This research
methodology is developed for widely usage of a variety of banks who want to know GIS process for improving customer services and we don't want to contribute it to commercial use, therefore we use spatial data of Norrkoping as methodology demo. The Norrkoping data in this case is provided by neptunus server where can be found in Linkoping university's computer system "My computer- swigis-neptunus". The data collection is done by using secondary research due to cost, time, and quality.

The analysis are basically done by using ArcView GIS software to show the processes and results. ArcView which is developed by ESRI, is one of the most widely used commercial GIS packages. It is primarily designed for the manipulation of spatial vector data.

Below in Figure 2.1, there is a graph that displays a general view of our research methodology.
Figure 2.1. A whole view of research methodology
Chapter 3

Theoretical frameworks

This chapter presents the theoretical frameworks related to the research question mentioned in chapter 1.

3.1 Geographic information system

Geographic information science is a science which provides specialized knowledge about spatial data collection, data processing, and data modeling for analysis purposes. It uses spatial methods based on mathematics, statistics, and modern numerical and computation tools.

GIS systems have been developing for many years on the basis of geographic data applications. In the early 1960's, GIS started its innovation of the academy, and took its first step in the 1970's and became a completely commercial technology during the 1980's. Currently GIS is becoming more and more significant in many related fields. It can improve the efficiency of transaction systems, enhance precision of many types of decision-making, and influence building organizational strategy.

3.1.1 Geographic information system: a definition

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." [4]

Star and Estes in 1990 define GIS as

"an information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well as a set of operations for working with the data"[30].

GIS is generally defined as an information system that processes geographic data. GIS is a computer system for capturing, storing, integrating, manipulating, analyzing and displaying all forms of geographically referenced information. The GIS is a device for standardizing and storing the data, then offering analysis and modeling tools for the data to create new output, and displaying the output in map or report form. Results of GIS are always output in different kinds of visual and tabular displays. GIS is a system that comprises of structured data containing information about geographic features as well as the hardware, software, and people used to analyze those features in an organizational environment.

### 3.1.2 Principles of GIS

Generally, GIS is used for processing geographical data on maps. It is represented as several different layers. Each layer holds data about a particular kind of feature which is linked to a position on the graphical image on a map and a record in an attribute table[16]. GIS data is not only made of points, but also lines and polygons. Coordinates make the instrument to integrate any data and convert them into one model of the reality. GIS is not only 2D; 3D models and virtual realities can offer an interesting alternative for a traditional guide map[16]. It is clear that data collection, with transformations and conversions from one projection and coordinate system to another, is one of the strengths of GIS. Without these abilities, no geographical application can run.

GIS is a tool for managing data on the issues that where features are (spatial data) and what they are like (attribute data), and it is also used for querying, manipulating and analyzing those data.
Spatial Data. Spatial data represents features that have a geographic location. It has three basic symbol types as its entities: points, lines and areas. These entities should be located by a referencing system. Generally there are several categories of spatial referencing: geographic co-ordinate systems, rectangular co-ordinate systems and non co-ordinate systems. The geographic co-ordinates are latitude and longitude. The location on the earth’s surface can be described by latitude and longitude references. To choose an appropriate referencing system is not easy because there are a large number of different spatial referencing systems in use. Moreover spatial data may be stored as unprojected data. For displaying data on a paper map or computer screen, the spatial data must be projected. Map projection transfers the round earth into the two-dimensional surface. The categories of map projection are cylindrical projection, azimuthal projection and conic projection.

Attribute Data. Attribute data is non-spatial data. It is the information that describes the features. It is independent of all geometric considerations, for example, a height, a mass, and an age of a person is non-spatial data because they are independent of the person’s location; or attributes of a river might include its name, length, and sediment load at a gauging station. Non-spatial information is usually stored in a table and linked to the feature by a unique identifier. Non-spatial databases are a set of tabular data records, and each record contains multiple data fields. In the context of spatial databases, one of these fields is the Unique ID Number of a corresponding map feature.
In another perspective, GIS can be viewed in three ways:

**The Database View:** GIS is an information system for geography. Fundamentally, GIS is based on a structured database that describes the world in geographic forms. See Figure 3.1

The Map View: GIS is a set of computer based maps and other views that show features on the earth. Maps of the underlying geographic information can be constructed and used to support queries, analysis, and editing of the information. See Figure 3.2
The Model View: GIS is a set of information transformation tools that derive new geographic datasets from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets. See Figure 3.3

GIS is basically used to respond questions and support decision making. To use GIS properly, it is necessary to know what the question is and follow procedures for getting the result.

a) State the problem

In this step, following aspects should be concerned

—What are you trying to do? What questions are you trying to answer? What problem are you trying to solve?

—Design the data gathering phase of the project with the end product (answer to the questions) in mind.

—The final product needs to integrate the spatial and attribute data with the idea of displaying spatial relationships.

—Design the database such that you have enough information to answer the necessary questions.

To start GIS analysis, it is required to figure out what kind of information should be collected. This is often made by bringing forward a question. The question should be as specific as possible. Having a good question may help to decide how to process the analysis, which method to choose, and how to present the results.
b) Select the data

*Design the Database*

- What spatial data do we need to collect?
- What attributes do we need to collect?
- What format does the data need to be in?

The right choice of data types and features for analysis using may help people to determine working with which method. Data always comes from these sources—databases in the organization, the Internet, commercial data providers, government organizations, and so on. The decisions of choosing what kind of data and where to get the data depend on the needs and budgets. The most critical thing is to get good quality and accurate data.

*Collect the Data*

- Census and survey data
- Remote sensing
- Satellite navigation
- GPS

c) Choose an analysis method

- Interrogate the spatial data to retrieve attribute characteristics
- Interrogate the attribute data and display the associated spatial data
- Query the spatial and attribute data
- Create new data files from the queried data

The decision of using proper analysis method is based on the original question and how the results of the analysis will be used.

d) Process the data

After selecting the analysis method, it is time to process the data. For mapping where the things are located, geographic coordinates, for example latitude and longitude or address, or zone code, should be assigned to the data. For mapping quantities, classifying scheme and deciding how many classes will represent the
3.1.0. Geographic information system

data are needed.

e) Describe the solution and analysis

The final step is to write a description of what you determined from the analysis and create output maps. The GIS software is flexible, so the results can be displayed in the format that best suits the needs. The results are always displayed as a digital map with tables or charts. [5]

3.1.3 Common GIS analysis methods

There is a wide range of functions for GIS data analysis including measurement techniques, attribute queries, proximity analysis, overlay operations and network analysis[13]. Pick says GIS analysis consists of spatial analysis, modeling, and statistical analysis[25]. Spatial analysis includes analytical techniques that emphasize the map layers or layers of geographic boundary files. Modeling and statistical analysis always take into account spatial relationships, these two methods are based on attribute and spatial data.

Measurements in GIS-lengths, perimeters and areas

Calculating lengths, perimeters and areas is a common analysis method of GIS. Using what kind of measurements is depended on the type of GIS data (raster data which are approximated using a grid cell representation and vector data which are made up of straight line segments).

In a raster GIS, normally the Euclidean distance is calculated by drawing a straight line between the end points of a line, and creating a right-angled triangle so that Pythagorean geometry can be used.

\[ AB^2 = AC^2 + CB^2 \]

\[ AB = \sqrt{AC^2 + CB^2} \]

Another three methods respectively are Manhattan distance which calculates along raster cell sides from one point to the other; proximity which uses concentric equidistant zones to calculate the distance between two points; and perimeter measurement that cell sides make up the boundary of a feature is multiplied[13].

Queries

Queries offer a method of data retrieval[13]. Queries play a significant role in ge-
3. Theoretical frameworks

Geographic analysis and problem solving. There are two general types of query that can be performed with GIS: spatial and non-spatial. Non-spatial queries are questions about the attributes of features. Spatial queries can be made more complex by combination with questions about distances, areas, and perimeters. Boolean operators for example AND, NOT, OR, and XOR are often used to combine queries.

Reclassification

Reclassification is a variation on the query idea in GIS. Reclassification always results in a new image. It reclassifies the old value and gives a new value to the data layer by Boolean or Weighting[13].

Buffer analysis

Buffer analysis can create new polygons by expanding existing polygons or by creating polygons from point, line, or other polygon features. In buffering, GIS software performs analysis within creation of a zone of interest around an entity. A simple example about buffering is to assign 800 meters buffers on all sites of a certain bank to query how many its bank competitors are within the buffer. Creating buffer zones around a point feature is the easiest operation that just makes a circle of the required radius around the point. Buffer zones are often created for the use of one command or option in GIS.[13]

Overlay operations

This function has the ability to integrate data. Using GIS can overlay one on top of another one for two different thematic map layers of the same area. Map overlay can be used for the visual comparison of data layers[13]. Overlay can also creates a new output data layer by merging two or more existing data layers. There are two basic overlay ways-vector overlay and raster overlay. In raster overlay, the GIS analysis is quick, straightforward and efficient, but in vector overlay, the operation is time-consuming, complex and expensive[13].

3.1.4 Process model in GIS

Heywood et al.[13] points out there are two general reasons for constructing a process model. On one hand, decisions need to be made regarding spatial phenomena. Models help this process. On the other hand, a process model may be the only way of evaluating our understanding of the complex behavior of spatial systems.
3.1.0. Geographic information system

Modeling the decision-making process

Information system can help manager in strategic decision making. The purpose of the information system is to support decision making by providing analysis and modeling tools[20].

GIS can be effectively applied in organizational restructuring, site selection, and competitive analyses[15]. Some organizations use GIS to support strategic decision making. Companies such as Dayton Hudson and Belks use GIS in order to do corporate research and planning, including site location, trade area analysis, and competitive analysis[20]. McDonald’s uses GIS to plan for and locate new franchises as well as company owned stores. Marks and Spencer, the large British retailer, uses GIS as a tool to support marketing analysis for finding new retail locations[29].

Heywood et al.[13] says map overlay is the traditional technique of integrating data for use in spatial decision making. They also say MCE (multi-criteria evaluation) is a better method than map overlay for combining data in making a given decision. MCE methods involve qualitative or quantitative weighting or ranking of criteria to reflect a set of objectives.

Geocoding

Geocoding is a process that the information like a list of addresses can be placed as points on a map. The process assigns geographic coordinates to the original data. It is also called address-matching when the information is address-based and is being assigned to a street map. The result of geocoding would be a point placed somewhere.[2]

Two sets of data are needed for the geocoding process- the data that can place on a map, e.g., a list of addresses, and the GIS data layer that will be used as the reference layer, e.g., a city’s street centerlines layer. For preparing the address data, the information has to be formatted correctly so that GIS software like ArcGIS can process it. The data set should be in a database-compatible format like tab-delimited (.tab) text file or dBase (.dbf)[2]. The address layer should contain the street number and street name; the street’s prefix direction, prefix type, street type, or suffix direction.

A simple method of geocoding is address interpolation[36]. This method makes use of data from a street geographic information system and then takes an address,
matches it to a street. Geocoding can interpolate the position of the address.

### 3.2 Customer services management in the bank

To implement a strategy regarding customer services management can affect the enterprise's profitability. To survive in the competition, the enterprises at the market place have to show vision, persistence and obsession to benefit their customers. Enterprises are the winners in the market due to their differences. These enterprises have unique capability to provide superior value to customers on a continuous basis. They are the winners because they ensure they have the ability to provide things that others can't do. Differences in the value of competitors, provide to the customers, are based on differences in capability and resources and business systems. These differences may include special knowledge about technologies or markets, or the attitudes about the importance of the customers.

In today's situation, banks need to be market driven and market responsive. This success needs to rely on data management and customer relation management. Banks need to manage information about customers, customer profiles, and customer lifestyles and so on. To add locations of customers in banks' database, banks can gain vast tangible benefits.

It is better for banks to develop a customer-driven marketing and service system, raise marketing capacities aimed at the best customers in the target market, improve technology application and management and promote product and service innovation.

Customer is the core of banks business systems. For establishing the winner position in the market place, the commitment of banks is to meet and exceed customer satisfaction, and question theirselves about how to fulfill customers' needs and expectations. Customers have different levels of requiring services. Service quality is the major reason if customers switch banks. A recent research study from Colgate and Hedge[1] suggests that bank customers are more likely to change banks also due to denial of loan applications. Customers are always very sensitive about differences of both functional and emotional benefits. They are very much conscious of bank's financial products, services, and acquisition cost. They are highly concerned with the superior benefits such as the quality, service courtesy, and feedback of customer complaint. Banks can lose their place in the market if they ignore
their customers' needs and don't show any distinctive competence. Banks should understand the changing market environment and importance of delivering values to the customers.

Banks need to create and deliver superior values to customers. Value is created by providing a benefit, solving a problem, meeting a need or helping a customer. Banks that can provide greater benefit to a customer is the winner in this market area. Banks should believe that it is only through acquiring business systems knowledge and improving technology skills that these banks can plan their corporate strategy and satisfy their customers. Investments on these areas can give banks a competitive advantage and help them gain victory in the market. The bank should focus on customer needs, improve the process of product and service innovation, clearly define responsibilities of various departments involved in the process and enhance the product development and service innovation mechanism.[10]

Under today's powerful market forces, the success of banks depends on the capability to understand what customer needs and turn that understanding into a competitive advantage. From customer service aspect, banks can improve the quality of services which includes branch location, ATM location, sanction of loan, Internet services, call centers and so on.

For giving customer good services, it is necessary to build and manage customer relationship. Geib et al[10] define CRM as an interactive approach that accomplish an optimal balance between enterprise investments and the satisfaction of customer in order to get maximum profits. An important issue of CRM is its orientation to customer process which performs the activities about satisfying a customer need or solving a specific problem.

Geib et al[10] point out three different types of customer relationship management (CRM) approaches in the banks service industry: customer satisfaction management which aims at giving customer high quality service and proximity to improve customer satisfaction; customer contact management which aims at accelerating process and using media-based communication channels to reduce costs; and customer profitability management that aims at increasing customer loyalty and exploiting the potential customers to build long-lasting profitable relationships with customers.

Below is a graph to explain how to communicate and satisfy the customer from IT
3. Theoretical frameworks

aspect.

**Figure 3.4.** Customer relationship management
3.3 GIS and bank

GIS enables better service planning and optimization; extends the effectiveness and profitability of customer management; improves customer retention; brings customers to the ATM and branch network. Bank should generate maps depicting the geographic distribution of loans and to correlate that information with income demographics. GIS can help bank perceive market geo-demographics and to correlate loan and deposit data with demographic information. Then bank can see where the customers, the competitors, and the prospective customers are, and compare this data to build new branch locations, or marketing focus, etc. In the opinion of Mohammad et al[22], GIS plays a crucial role in various functional areas by providing support in decision-making and strategic planning, thus banks can achieve the business objective. Below are the roles that GIS may play in the bank industry. These roles are always used in some major areas such as market analysis, customer analysis, and competitor analysis and so on.

a) Expansion of customer base
b) Improvement in quality of the services
c) Increase customer satisfaction
d) Consistent business growth
e) Increase in profitability

Market analysis

In today’s enormous competitive environment, marketing is a customer-orientated operation for bank’s successful. For what banks face the problems are fully understanding their markets and the potential customers for the finance products and services. GIS based market analysis can support to solve these problems.

In general, marketing for bank industry is also a question of demand and supply which indicates the relation between customers and financial products or services such as customer services through branches and ATMs[22]. Using GIS can help to analyze the relationship between demand and supply easily because the information is based on geographical location. GIS technology can define all kinds of market segmentation precisely for target group customers. For example, GIS can help bank to reduce large advertising bills. Using GIS technology can help bank to target more appropriate group for advertising in region media rather than na-
3. Theoretical frameworks

Geospatial media campaigns. GIS also provides those target groups spatial distribution information.

a) Business expansion planning

Finding the best new bank location for bank business expansion is not an easy job. It requires substantial capital investment and much money to make bank manager feel sure that they select the right expansion location.

b) Retail banking services

Bank management is looking for innovative and better ways to achieve the demands of retail banking service delivery. Retail location analysis always deals with the collection, analysis and distribution of spatially referenced information which is ideally handled by GIS. The future of retail banking is to give the customer power to choose the way they want to carry out their financial affairs. GIS based solutions may help the bank to hold the customers by adopting innovative methods of automations to deliver the most efficient retail banking services.

Customer analysis

Using GIS can answer the queries of the analysis like Where are the customers located? What are their market segmentation and classification of residential areas?

"One of the main market research applications of geo-demographics is the ability to profile existing customers into geo-demographic classifications and then to use these categories to target potential new customers in areas of low market share"[19]. The banks need to produce a list of account holders of various types. GIS can assign a spatial data for customers to each of a set of financial records like postal code, address, or census tract. "This can allow the user to view the results of any data query on a map and then know the spatial distribution of data records or attributes"[19]. Using GIS can find new potential customers by searching for the areas which contain the similar geo-demographic like existing customer profile, especially where the existing market share is low. Also using spatial queries of GIS, market analyst can buffer an area. GIS provides a summary of the variety geo-demographic classifications within the locality. This may show bank a picture of the variation of customer types. The overlay function of GIS can be used to add financial information relating to shareholders to the standard population geo-demographic system.

In the customer relationship management, as spatial information, the core of GIS
application is the visualization analysis of spatial phenomena, process and rule. GIS technology can be used in the CRM. Customer service is provided by enterprises in the Earth’s surface, so it has the spatial characteristics and spatial scales. Using GIS in CRM can achieve the aim of spatializing the information of service providers, customers, and services. Essentially, GIS in CRM applications is an application of geographic analysis. For example, there is one system that applies GIS in spatial distribution analysis of customer and market decisions. This system uses SQL Server and SuperMap 2000 whole module GIS for the development, also adopt Visual Basic 6.0 as language development. The main function of this system is customer management. It achieves from graphic to inquire the customers in a certain region, show customers located graphics and produce the client distribution thematic maps.
Chapter 4

Previous experiences of GIS applications in banking industry

This chapter indicates the previous experiences of other authors related to GIS applications in banking industry for learning more knowledge regarding this area.

4.1 Application of GIS in bank industry in recent years

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.

Below are some basic areas are applied by GIS

a) Market analysis

Using GIS can transfer data from the customer information database, provide a
visual view of commercial transaction area, and thereby find commercial activities in branches.

b) Customers digging

GIS can help to process the data of existing customers, identify their needs and financial types, and then discover potential growth of new market.

c) Site analysis

To build new branches or new ATMs, GIS provides an important tool for analysis of commercial section and market decision making.

d) Branches/ATM orientation

Customers can obtain location information of available branches or ATM outlets on the website, thus they can also find out the drive routes, distance, time and other information from their home or current place to branches/ATM outlets.

4.2 Previous experiences of using GIS in bank

The usage of GIS in business areas increased in Western countries these years[11][17]. 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[18]. According to MacDonald, in 1998, Canadian evaluate the country's largest banking institutions mergers by using GIS[18]. 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[18]. In his paper, he uses spatial analysis for analyzing, for example he uses selected features to identify the closet branch pairs, or creates buffer zones around the selected branch pairs. For the market share estimation, he uses a particular model. The market share estimations are derived from the "production-constrained spatial interaction model" that the objective is to estimate the percentage of the market
in an area for banks. GIS software is greatly utilized to perform many required
distance calculations between areas and bank branches, and to generate the ge-
ographic areas for this model[18]. This paper allows such a GIS program to run
for not a long period of time to obtain results. In the end, he summarizes GIS
analyses can provide valuable knowledge about markets and customer behaviors.
And using GIS can help in merger planning, it can save time and provide accurate
information to the organization.

In Miliotis et al’s research, they are cognizant of importance of GIS for most
banks reorganizing their service network. They try to demonstrate how demand-
covering models combining with GIS can determine the optimal location of bank
branches in Greece. The essence of the model is to use GIS to represent various
criteria concerning the demand for bank services as well as the competition in
each particular area.[21] They employ GIS to achieve following goals:

a) Partition the population centers of the region. They use GIS to calculate the
classification of high and low population densities.

b) Create zones around each population center. In this step, they use GIS to cal-
culate the distance from center.

c) Define the demand points by overlaying the terrain map. The demand points are
obtained automatically by means of the GIS that take into account the population
density. They also use GIS to determine the class of overlapping zones which
demand points belong to.

d) Choose the service points from those demand points.

The result of this paper concerning GIS is the use of GIS can help in organizing a
large amount of data and in transforming all the useful information to input files
for the covering models very efficiently. The GIS system can also produce useful
displays for the efficient planning of financial work.

Also Hanbali in 2003 made a research in site location for Bank of Jordan in Am-
man. His paper discusses the criteria used in the spatial analysis and reports the
success of the resultant GIS analysis to suggest proper locations for ATMs[12].
In this project, the first phase is data collection. He collects data from all avail-
able resources such as digitized hardcopy cadastral maps, digital satellite images,
GPS, and statistical data. For his analysis, these underlying layers are needed:
Jordan boundaries, governorates boundaries, Amman districts and sub-districts,
4. Previous experiences of GIS applications in banking industry

main and sub-main streets in Amman, blocks and city-blocks, government organizations, commercial areas and trading centers with cinemas and theatres, commercial companies, insurance companies, restaurants, hotels and hospitals, gas stations, Jordan Bank branches layer, and the branches of all other banks with their ATMs in the entire city of Amman. After preparing required geospatial data layers, he uses spatial analysis like spatial queries to show the trade area or the distributions of all banks in one district. Also making a buffer zone can show area that there is no bank branches coverage within a zone of certain distance. In his conclusion, using GIS technology is a powerful tool to help banks in planning since digital maps can be used in defining the best positions for banks, ATMs, new restaurant and new stores and so on. Likewise via GIS web mapping, people who want general information about location can get help on the internet. [12]

Panigrahi et al[24] 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 methodologies in this report are following steps:

a) first prepare the city map and road map of the city,

b) then use GPS to locate ATM centers,

c) locate customers using Geocoding 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,

d) 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" [24]. The banks who don’t want to loss money from payments of defaulters should have proper strategic planning and good operation managements that the collection management system follows.
China also starts to use GIS in bank applications. Esri China[6] reports that after comparing variety of GIS platforms, branches of Traffic bank in Shanghai finally choose ArcGIS software as the development platform for "bank branches integrated with geographic information system". The platform includes ArcSDE, ArcInfo, ArcIMS, MapObjects and NetEngine and so on. This system will build a new graphic user interface for bank businesses; it has many functions like selection of banking network optimization site, monitoring ATM and bank network transactions, best path analysis of money-carrying vehicles, resources and environment assessments, and analysis of deposit and loan circumstances. Shanghai Lion Information Technology Co., Ltd. is this project developer after offering the solution of one key technology for ArcGIS-address matching.

Figure 4.1 is an example of how Bank of America used GIS to show the geographic distributions of the bank's network in relation to deposit potential in the New York City market area. From this analysis, Bank of America can know where their segmentation is strong and where is weak. Red dots represent the strong area; no dots means there is not any segmentation in those areas.

Above are the descriptions of previous researches about GIS applications in bank industry. Most of the researches concentrate on market-driven models regarding site selection. They take into account market segmentation, competition situation, demands in the market and so on for site selection by using GIS. Because bank industry always provides services to customers, a very important factor for deci-
sion making is that banks are conscious of the needs of customers. Applying GIS in support decision making, bank should attach importances to customer view. Moreover, for improving customer services, banks can match each customer’s address on the digital map via GIS to know more information of customers.
Chapter 5

Results

In this chapter we analyze the data in accordance with the conceptualized theories and frame of reference.

5.1 Outcome of literature review about GIS for site selection and sanction of loan

5.1.1 GIS and decision making regarding site selection of new branches or ATMs

"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[3]

Banks have to take into account different spatial issues to establish new bank branches or ATMs. GIS tools can help to pinpoint where the customers, competitors are with address locating, database management and query tools. Then banks may examine the demographic attributes of the customers with the census data. Finally having this knowledge banks can identify underserved areas, analyze the competitor's market, and create acceptable new branches or ATMs.

For business expansion planning, banks need location-relevant data, and cost-effective site analysis to select a new bank branch or ATM location confidently
5. Results

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[22].

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.[22] 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.

**ATM**

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 importances 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.

**New branches**

According to Thulasi[32], 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.

**Branch performance monitoring**

Banks can analyze the performance by using GIS. Spatial components can offer greater advantages for monitoring the branches performance. The spatial distri-
5.1.0. Outcome of literature review about GIS for site selection and sanction of loan

bution 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.[22]

In Figure 5.1 there is a site selection example. Using GIS system can understand the spatial relationships relevant to the location decision. The figure displays the potential locations for new stores.

![Diagram](image_url)

**Figure 5.1.** Sample maps for retail site selection


5.1.2 GIS and decision making regarding sanction of home loan

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
5. Results

current land valuation, the size of the house and so on.

There are three different models of urban land use. These models are Concentric Zone Model, Hoyt Sector Model and Multiple Nuclei Model. Three models are useful in a general way in which land is devoted to different use within the city. In China, the urban land use is basically classified in several districts which are central business district, industrial district, and residential district. Furthermore the lower-income people always choose the residential area that is close to industrial district due to price of the apartment, and the high-income people choose the residential area that is far away from the industrial district and near the central business district due to the surrounding environment of the apartment. Considering the situation of urban land use in China, the Hoyt sector model is introduced for land valuation in this case. The sector model is put forwarded by Homer Hoyt in 1939. He found out that it was common for low-income household having an apartment close to manufacturing or warehousing sector which is less desirable location to live due to traffic, noise and pollution[31]. Middle and higher income households locate the apartments away from industrial sites. This suits the actuality in China.

![Hoyt sector model](image)

**Figure 5.2.** Hoyt sector model

SOURCE: Department of Geography and Earth Sciences, University of North Carolina at Charlotte.[31]

According to Hoyt model, the population density should be high in the residential areas which include low-, medium-, and high class residential comparing industry and CBD areas. Bank should consider provide a loan to the apartment in the residential areas.
Also a basic purpose of real estate analysis is to find the relationship between supply and demand in a target market. Demographic is the main factor to affect the demand of housing[37]. Other factors such as consumer preferences, price of housing, socio-economic factors also influence the demand[37]. So bank should take into account the price of housing, income-level of households, as well as the future value of the apartment when provide the home loan.

GIS is an useful tool for the real estate analysis. Thulasi points out[32] banks can complete many tasks by GIS such as:

a) Calculate the land value of the area by analyzing the surrounding area for example the amount of schools, hospitals, shopping and entertainment centers and so on which may influence the market value.

b) Create a database system to prevent the double loan takers use same plots.

c) Estimate the apartment valuation.

d) View the values of the neighborhood such as quality of roads, public transport, water and power supply, and other socio-economic factors.

And banks may need the following information for these analyses, such as:

a) Property location

b) Owner name

c) Distance from the main road

d) Present land use

e) Land value

f) Population of the area

A GIS based system allows the use of information specific to the geographic location and the neighborhood of the house being evaluated. Most of these data can be derived from the digitize map of an area. Others can be collected from field survey. Bank can build a GIS-based automated appraisal system that integrate spatial data to provide information on the physical, socioeconomic, demographic as well as comparables characteristics of the neighborhoods where properties are located.

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[34]. 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.

5.1.3 GIS and customer query

For implementing above analysis, building a GIS support system is essential. This system is based on "customer focus" and designed by integrating GIS. Designing the system is not only from technical point of view but also customer requirement is taken into account as an important factor. This system has other applications of GIS such as answer bank's customer query. The primary module of this system is indicated in Figure 5.3
5.1.0. Outcome of literature review about GIS for site selection and sanction of loan

Figure 5.3. GIS support system
5. Results

As shown in the above graph, we need web services technologies to provide the necessary standards for applications integrating GIS data and services. Web services for GIS are always represented by map services. Map services provide market information for finding locations. Many organization use GIS for decision supporting to provide good services to Web-based clients and this behavior can be improved by high performance computer hardware and software, broadband networks, and huge data stores.

The systems for GIS web using need to provide efficient, on-demand access to the data sets over the Internet, so that end users can access and utilize data a variety of GIS data easily and quickly. Developing GIS functionalities on the Internet enables users to access GIS transparently, reduces the system costs and simplifies the operation.
5.2 Using available data to display the analysis

After reviewing other authors’ experiences, we can know most of them utilize GIS as an accessorial tool for site selection, collecting management or banks merger processing. In this paper, we focus on customer services, especially in bank branches or ATMs site selection and bank loan. We use GIS to solve these two areas for improving bank customer services quality in a strategic way.

In Figure 5.4, there is a general process of AreView GIS that consist of spatial database, spatial analysis and map display. Below are detailed explanations of each component.

![ArcView GIS process](image)

**Spatial data collection**

For building a GIS application system, bank customer service center needs to have database system first. This database system includes basic spatial database and integrated database of all kinds of bank network. To implement data collection processes, generally the bank should use the below methods.

a) Scan

b) Digitize

c) Survey

d) GPS

Below are general data that are used in the analysis.

a) Census data or population data
5. Results

b) Land map of the city
c) Road map
d) Location of branch and ATM centers using GPS data
e) Location of customers using geo-coding

In the analysis thereinafter, we use the data of Norrkoping, Sweden as a demo. First we use those data to prepare the city map and road map. We assume there is a bank called X bank, and there are other competitors in this city.

5.2.1 Preparation of the map

Preparation of zonal map and road network map of a city is necessary in our analysis. Generally the zonal map and road map can be digitized, and the attribute data pertaining to the road map should be updated. In our analysis, we use the collected data layer make the map. The city map for analyzing in this report is displayed in Figure 5.5

Figure 5.5. Map of the city
5.2.0. Using available data to display the analysis

First we apply a projection to our map layout. Basically we need to choose a coordinate system for the map. The choice of coordinate system is lied on the map present which realistic geographic place. We choose RT90-25-gon-V for the map.

![Coordinate system]

**Figure 5.6.** Coordinate system
5. Results

5.2.2 Data analysis-choosing best location of new branch/ATM

Locating branch/ATM centers

In general, GPS is used to find the exact location of the branch/ATM centers of the bank. In this case, we freely create a point shape file as branch/ATM as an example. In Figure 5.7 the branches of X bank and competitors are displayed in pink points and blue points. You can see most of the branch/ATMs are in the center of the city, but there are some residential areas that have few branch/ATM centers. How to utilize GIS to find a reasonable location for opening new branch/ATM? Below indicate that.

![Figure 5.7. Bank branches or ATMs](image)

Buffer

First differentiating those branches/ATMs distribute to whom should be done. We use different color to present them. Then we classify the layer of population to find the most density place. And then as in the Figure 5.8 shown, we use GIS buffers the branches that the buffer area has the radius of 600 meters.

Keeping away from the buffer, there are some other residential areas that need to construct new bank branches or ATMs. We set four of them for analysis that is covered by shadow. It is an opportunity for X bank to build a branch/ATM there. Figure 5.9 displays these residential areas.
5.2.0. Using available data to display the analysis

Figure 5.8. Buffer of branches

Figure 5.9. Residential area
5. Results

Build a model

Now we use ArcGIS spatial analyst to find a site for a new branch/ATM. For implementing this analysis, it is better to build a model that finds suitable locations for a new branch/ATM. The steps to produce such a suitability map are outlined below.

Step 1. First we need to create a new model. A model is built by stringing tools together inside a ModelBuilder window. Those tools are all in Spatial Analyst Tools toolbox. Now we start to build the model. For deriving distance from property sites, we must calculate the Euclidean (straight-line) distance from property sites. This task is done by drag the Euclidean Distance tool into the ModelBuilder window from Distance toolset in Spatial Analyst Tools toolbox. The distances from existing banks are also required to derive because the location of new bank should be away from those banks.

Step 2. After deriving the necessary datasets, it is ready to reclassify each derived dataset to a common measurement scale, give each range a discrete, integer value between 1 and 10. Higher values are given to attributes within each dataset that are more suitable for locating the branch/ATM. The bank branch/ATM should be located as close as possible to a property facility. So we reclassify the distance to property sites output, giving a value of 10 to ranges of values that represent areas closest to property sites and giving a value 1 to ranges of values that represent areas far from property sites. We can expand the Reclass toolset, and then drag the Reclassify tool into the ModelBuilder window. It is necessary to reclassify the distance to existing banks layer too. We give a value of 10 to areas farthest from existing banks and give a value of 1 to areas near existing banks. By doing this we can find out which areas are near and which areas area far from property sites and existing banks branches/ATMs.

Step 3. At this moment it is ready to combine datasets to locate suitable sites for the new bank. It is preferable to locate the new branch/ATM close to property facilities and away from existing branches/ATMs. We should weight all the inputs and give each input a percentage of influence. The higher the percentage, the more influence a particular input will have in the suitability model. By doing this, we use Weighted Overlay tool. We give the inputs the following percentages of influence:

Reclassed distance to property sites: 65%
Reclassed distance to banks: 35%

Figure 5.10. Weighted overlay

Step 4. Subsequently, we use a conditional expression in the Con tool to extract only the optimal sites. The sites that are considered optimal must have a suitability value of 9. In the conditional expression, all areas with a value of 9 will retain their original value (9), and areas with a value of less than 9 will be changed to NoData.

Step 5. Finally we use Majority Filter tool to remove the small areas that too small for the branch site and Raster to Polygon tool to reduce the "stair-step" effect.

Below Figure 5.11 to Figure 5.16 are the model and details that represent the workflow procedure.
5. Results

Figure 5.11. Workflow

Figure 5.12. Step 1 of workflow

Figure 5.13. Step 2 of workflow
5.2.0. Using available data to display the analysis

Figure 5.14. Step 3 of workflow

Figure 5.15. Step 4 of workflow

Figure 5.16. Step 5 of workflow
5. Results

Map display

After implementing the workflow, the map of the results is created. Below figures from 5.17 to 5.20 are the maps of the results.

**Figure 5.17.** Suitable sites for residential area1

**Figure 5.18.** Suitable sites for residential area2
5.2.0. Using available data to display the analysis

Figure 5.19. Suitable sites for residential area3

Figure 5.20. Suitable sites for residential area4
If we only want to build a new branch that far away from the existing banks, the locations of existing competitors and X bank should be considered as analyzed input feature which is shown in Figure 5.21. When we weight the inputs, the influenced percentages of inputs are:

Reclassed distance to X bank: 65%
Reclassed distance to competitors: 35%

Below Figure 5.22 is the final map for creating. In the fact, these suitable sites should be excluded that are intersected by roads. Also the best sites should be based on area that greater than an appointed scale.

Figure 5.21. Input features

Figure 5.22. Suitable sites that far away from existing banks.
5.2.3 Data analysis regarding sanction of loan

Home loan decision

In the process of making decision regarding sanction of home loan, first we set two locations of apartments. Here are the two apartment places in Figure 5.23, apartment1 and apartment2.

Evaluating if it is doable to provide a loan to the customer for his/her apartment, primarily we need to take into account the land value of the apartment. We can complete this task via calculating the amount of property around the apartment. In Figure 5.24, we use GIS tools to make a buffer for those two apartments. Then open attribute table of buffer, we can see the amount of property in the buffer zone.
5. Results

Figure 5.24. Buffer of apartments
Also for making a decision about providing a home loan, the value of an apartment is an element that should be considered. In absence of real values, we use the population density as a very rough way to demonstrate the GIS technology about finding out the values of the apartments. We calculate the density of population by using Visual Basic language and then use Normalization function to present the rates. Figure 5.25 displays the population density around apartment1 is higher than apartment2.

Figure 5.25. Population density of the buffer area
5. Results

Also the distance from the apartments to the public traffic is also a considerable factor for providing a loan. Below in Figure 5.26, you can see the calculated results.

Figure 5.26. Distance from the apartments to the public traffic
5.2.0. Using available data to display the analysis

Locating customer addresses

In general, GIS is used to find potential customers in a target market. However in this study, we utilize GIS to locate the existing customers by geo-coding. That's because a number of submitted addresses change due to various reasons, then banks have to relocate the customers. This makes the job of collecting customer addresses difficult. We want to find a way to avoid relocating the addresses. An integrated GIS approach can ensure that every customer's location is geo-coded so that locating a customer even a series of customer’ address changes is becoming easy. This can help banks to monitor the services that have provided to existing customers, improve on the services, and offer more services and financial products to existing customers.

After providing a loan, it is better for bank knowing the loan taker’s place in a map. So first we can collect customer data and built customer information database; in Figure 5.27 here is a simple example Customer address table for geo-code customer profile analysis.

![Figure 5.27. Customer address table](image)

We need to create a geo-coding address locator. By doing this, we open Arc Catalog first. Then **Address Locator** is on the left side, and click on that. Then you will see **Create new address locator**, double-click on it. Now choose a geo-coding style. Because we are matching address and zip code information to a street shape file, we choose US Streets with Zone (File).

Then we can find an address interactively. We start ArcMap and create a new empty map. Add the roads feature class to the ArcMap document. We use Find button to locate an address.
5. Results

Figure 5.28. Address locator

Figure 5.29. Finding an address interactively
5.2.0. Using available data to display the analysis

If we have a table that contains address information, we can geo-code all of the address at once and show where are the customers are located. Figure 5.30-Figure 5.32 display procedure, attributes table and created map.

Figure 5.30. Procedure of geo-code a list of address
5. Results

Figure 5.31. Attributes table of geo-coding results

Figure 5.32. Created map
Chapter 6

Conclusions and Implications

In this chapter we answer the research question and provide overall conclusions regarding the findings of the study. At the end of this chapter, implications for management are given.

6.1 Problem discussion

Increasing global competitive pressures in the banking industry result in the more complexity and difficulty of managing bank networks. The design of an efficient branch network, which is achieved by defining the optimal location of banks branches, can provide competitive services to customers. Although this is a significant strategic question for each bank, it has not been cognized adequately and treated analytically. Also loan service is always one of the major bank operations to the customers. For improving its accessibility to the customers, it has been being in competition among the banks that how banks provide loan services.

For opening Chinese banking industry, December 11 of 2006 is the day that China's banking industry's five-year transitional period goes to an end. In accordance with WTO commitments, foreign banks enjoy the national treatment, and will compete equally with Chinese banks. After that, Chinese domestic retail banks face at least five challenges:[8]

a) Firstly, the challenges of market share of RMB and foreign currency deposits and loans business.
6. Conclusions and Implications

After the implementation, the domestic commercial banks and foreign banks are all fully engaged in RMB business. Branches of foreign banks are allowed to participate in RMB business. Consequently, foreign banks will use their flexible operational mechanism, plentiful funds, a good international reputation and the quality of services, in the market competition for deposits and loans in RMB business. Then they may snatch the market share of domestic commercial banks for deposits and loans in RMB business and impact those banks greatly in Chinese banking industry.

b) The second challenge is competition for talent.

In order to obtain a competitive advantage first, these foreign banks will introduce financial talents from abroad to China. Also foreign banks will use high salary, overseas training and superior environment to attract high-quality personnels from domestic banks to join them. This may weaken the competitiveness of domestic commercial banks.

c) The third challenge is competition means.

Foreign banks bring a great challenge to domestic commercial banks through their strong financial innovation capability, multifarious practical financial products, advanced technology network, a super level of risk control and mature service management standards and many other competitive advantages means.

d) Finally is the managing way of business challenges.

Most domestic commercial banks are using separate operations for dealing in bank business, but almost all foreign banks are using mixed operations. Foreign banks will rely on their experiences, according to the actual needs, to develop the mixed operation mode. This will give Chinese domestic banks a tremendous pressure in competitions.

When people have many choices for choosing a bank, stronger customer relationships are the key to a long-term success. How to keep customer relationships is becoming a big issue for banks. In that case, high quality, efficient and convenient customer services may help this.

Comparing foreign banks, Chinese banks have their own advantages in the future competition. Although foreign commercial banks have good reputations of their brands and enjoy their mature management skills, we should be aware of our strengths for competing. Each domestic bank has its own advantage: it has
operated for a long history; it has political ascendancy; it is supported by a government's reputation; it is reliable in local customers' opinions; it has much self-help network sector; it owns broad group of customers; and it has the public foundation. Moreover, the scale and quality of capital assets in domestic banks, and the internal control mechanisms management and risk control also have marked improvements. In general, most of the big domestic banks have three advantages: network, capital strength, and customer base. In fact, in Chinese financial market, domestic banks are still the main players. Chinese banks have distributed networks which spread all over the country, strong financing strengths, and good customers base which means banks have a large number of individual customers and corporate clients, so that banks can maintain good business relationship with their customers.

To face a mass of entries of foreign banks, Chinese banks do not need to be panic; in the meantime, they need to learn from foreign banks for example their internal management, capabilities of using intelligent technology and good quality services. Chinese banks should intensify efforts to upgrade their overall competitive competences, and then they can survive in the new competitive environment.

6.2 Results and conclusions of research questions

In China, GIS is not a common used technology in improving banking service activities. There are not so many studies relate to the fact that banks utilize GIS to improve customer service. This study learns experiences from the other authors, and designs easy methods for helping banks to choose optimal location of the new bank branch. Furthermore this study provides easy ways to evaluate the apartments of customers for providing loans and locate the customers' addresses by geo-coding after providing the loans. The propositional methods and analyzed procedures in this study are easy to learn and follow. The existing staffs that work in banks and have basic GIS knowledge can use provided methods and procedures to complete the analysis and get the results. Accordingly banks don't need GIS expert for implementing the analysis to save cost and manpower.

RQ: How to utilized GIS to support customer services in bank?

In this study, we give emphasis on the investigation of the site selection and loan providing decisions in bank customer services. Our investigation indicates that the
entire process for supporting customer services by GIS can be described in three sub-processes, they are collecting data, analyzing data and presenting data.

**Data collection**

Using GIS for analysis, banks require the map of the targeted area, the demographic data, the roads network of the city and so on. Certainly, in different cases, banks may need other specific data. In this study, the locations of existing branches/ATMs have to be prepared for site selection; and the customer location may be used in sanction of loan services. In general the data can be collected by digitize, GPS, and survey.

**Data analysis**

There are many kinds of methods for GIS data analysis. For site selection, spatial analyst tools play an important role. Using the spatial analyst tools, we can easily perform spatial analysis on the data. We can find answers to more complex spatial questions, such as "Where is the best location for a new facility?" For loan providing analysis, we choose geo-coding with ArcGIS that help us to take an address, match it to a street and then interpolates the position of the address. In this study, the adoption of those analyzed methods has absolutely revolutionized in the process of decision making on site selection and sanction of providing loan for clients.

**Data display**

The results of the data analysis are generally presented by map and attribute table. From the above study, it is very clear that GIS is an effective tool in any discipline relevant to spatial data, it can be used to identify the location of branch/ATM center, location of customers and so on. This is an attempt to utilize GIS technology and software for banking customer services. In general, banks can get many benefit to using GIS in their business activities. GIS can help to save money, time and manpower.

**6.3 Limitations**

In the above narrates, aspects of using GIS technology in banking sector for customer services are highlighted. It is not a full study report. There may be many
other applications where GIS can be useful for banks to improve their performance and customer services.

6.4 Implications and recommendations

6.4.1 Implications for Management

On one hand, it is an urgent matter for banks in China to transform themselves into a "Customer driven organization" in order to meet the global challenges. On the other hand, managing the integration of massive customer information with spatial data successfully becomes more significant and efficient for banks in China. So using GIS in the development of bank customer services field is an inevitable trend. Banks can obtain a lot of advantages by introducing GIS. They can save money, time and manpower which are the target of any business organizations. It is easy to handle large numbers of data.

Often GIS is used only as a tool to query a database or as a vehicle for displaying maps. But in supporting decision making, GIS plays an important role because it provides the decision maker with a powerful function to organize, retrieve, and display data based on its spatial characteristics. GIS possesses robust spatial database management capabilities which are essential for handling amount of location information. The GIS system analyzes location data and takes the consideration of customers’ requirements and then identifies the best location.

For banks who want to be successful in retail banking business in Chinese competitive environment, it is crucial to make the rational distribution of bank branches or ATM networks according to different customers’ attributes and demands.

6.4.2 Recommendations for Future Research

a) This study provides an insight of GIS system for banks to improve customer services. It is interesting to further investigate other functions what GIS system can provide in bank developing.

b) This study provides an insight of some spatial analysis methods that analyze the spatial data for GIS application of bank. It is interesting to investigate more methods regarding GIS analyzing for banks.
6. Conclusions and Implications

c) According to current study, GIS is used in banks for customer services. Evaluating if GIS system is a good investment for bank developing could be one interested topic to investigate.

d) This study provides a general idea and model about Web GIS and GIS support system. How to optimize Web GIS for customer query from World Wide Web could be one interested issue to investigate too.
Bibliography


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