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Promoting economic development of an urban area using a web-based GIS

Clifford J. Todd

University of Nebraska at Omaha

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PROMOTING ECONOMIC DEVELOPMENT OF AN URBAN AREA

USING A WEB-BASED GIS

By

Clifford J. Todd

A Thesis
Presented to the
Department of Geography-Geology
and the
Faculty of the Graduate College
University of Nebraska
In Partial Fulfillment
of Requirements for the Degree
Master of Arts

University of Nebraska at Omaha
Omaha, Nebraska
April, 1998
THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Master of Arts, University of Nebraska at Omaha.

Committee

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<thead>
<tr>
<th>Name</th>
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<tr>
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<td>ISA</td>
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<tr>
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<td>Geography</td>
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Chairperson: Michael P. Peterson

Date: Apr. 20, 1999
ABSTRACT

PROMOTING ECONOMIC DEVELOPMENT OF AN URBAN AREA
USING A WEB-BASED GIS

Clifford J. Todd
University of Nebraska at Omaha, 1998

Advisor: Dr. Michael P. Peterson

A GIS (geographic information system) is an excellent tool for spatial data analysis and associated database functions. However, a GIS has long been viewed as being practiced "behind closed doors" and only by those with extensive training. Currently, there are a number of ways to work with GIS data, but very few ways to present the data to large groups of people. Providing information from a GIS to people outside of a group or organization is difficult but essential. For example, urban or regional areas can promote economic development by making this information available to investors or prospective residents from outside the local area. At present, city governments have a wealth of publicly available geographic data, but no easy way to provide it to those who want access. A possible solution to the lack of accessibility to GIS analysis functions can be found in the merging of the Internet and GIS. The purpose of this thesis is to evaluate the present use of the Internet for this purpose and to design and evaluate a prototype Internet-based GIS that would provide specific geographic information to promote economic growth of an urban area.
ACKNOWLEDGEMENTS

I would like to acknowledge the following persons for their help on my thesis:

- My committee members, Dr. Justin Stolen, Dr. Jeffrey Peake, Dr. Charles Gildersleeve and especially my chairman, Dr. Michael Peterson, for their valued opinions, guidance and help regarding my work;

- The City of Omaha Planning Department;

- Brenda Jansa, for her friendship and support, and also for giving me a reason to believe; and

- My parents, Clifford W. and Mary Ann Todd. Without their support and encouragement, I never could have reached this goal.
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CHAPTER 1
INTRODUCTION

Overview

In many ways, we are experiencing a technological revolution. With the expansion of the Internet, or more specifically, the World Wide Web (WWW), people of all ages and abilities are able to go “on-line” and extract information from almost anywhere in the world on nearly any topic imaginable. Many people think of the Internet as a “global library” and justly so. The Internet is the database of the 21st century and the potential for information distribution seems to be unlimited.

Along with the growth of the Internet, Geographic Information Systems (GIS) have changed their appearance and grown in ability as well. While GIS was once thought of as a craft for the few instead of a tool for the many, we are now beginning to see a number of GIS programs that are targeted for the desktop-user. An example of this type of program would be ArcView, from ESRI (Environmental Systems Research Institute). No longer is a GIS only accessible from a mainframe computer or a UNIX-based workstation. These programs are now available for other operating systems such as the Macintosh OS, Microsoft Windows 3.1, Windows 95 and Windows NT.

Internet sites now incorporate many GIS capabilities into their interface, such as the ability to create static and interactive maps and also the ability to access selected on-line geographic database information. It seems only logical that it may be beneficial to use a GIS in conjunction with the Internet to better distribute geographic information to a large number of people. One particularly useful application of a Web-based GIS is to provide information beneficial in identifying economic opportunities within a city to those from outside of the community.
In the nineteenth century, most city planning efforts were geared towards improving the transportation infrastructure, or accessibility to the city.\textsuperscript{1} This was necessary in order to aid in economic growth. The Internet can be thought of as a new part of the city's infrastructure that can also aid in promoting the economic growth of a city.

In the twentieth century, a Web-based GIS could be thought of as a new "road" to distribute information. In 1971, David Smith wrote that "The location pattern of any industry is the product of a large number of individual decisions, made as firms react in different ways to different economic circumstances."\textsuperscript{2} While reading this quote, one can see that obtaining both geographic and economic information is very important, and that a Web-based GIS could be an extremely valuable tool for providing this type of data. Murray Bryce wrote in 1960, that when industrial development is being considered, "The economic study should begin with a thorough analysis of the market for the product to be made."\textsuperscript{3} What would be better suited to perform this analysis than a Web-based GIS? This type of GIS would provide information regarding available land for development, tax and property information, zoning and land use classifications as well as other information that could be used to attract development as well as inform others about a specific urban area. The information provided via the Web-based GIS would be of public record, or in other words, information which is available in paper form "over the counter" from local government offices. The advantage of this GIS is that the information would be available in one place (the Internet) and easily accessible no matter who or where you are, as long as you have Internet access.

\textit{Purpose}

The purpose of this thesis is to design a prototype Web-based GIS that would provide specific geographic information that may be used to promote economic development of an urban area.
Statement of Problem

The problem to be addressed in this thesis is: How can a prototype Web-based GIS be developed to assist in promoting economic development of an urban area? Also, what type of information can or should be made available on this Web-based GIS? As stated previously, a GIS is an excellent tool for analyzing geographic information. A GIS which is constructed to promote economic development of an urban area might contain a wide range of specific geographic data which may be useful in economic decision making. Examples of this may be; availability of land parcels, taxes on specific parcels, proximity to fire services or a combination of many different types of data. An urban area could utilize the Web as a showcase for specific information it wants to make available to others. The Internet is the ideal medium for information distribution to a large number of people. For economic development, the Internet is a tool which can be customized in an endless number of ways so that a city may more effectively communicate economic information to others.

Methodology

The research methodology consists of three separate parts. In the first, a questionnaire containing twenty questions will be mailed out and distributed to a total of thirty individuals. This pool is comprised of City of Omaha employees, City of Omaha elected officials, Douglas County officials, members of the Omaha business community and also, faculty from different universities across the United States. These individuals are in various locations and job positions and are, or have been: involved in city planning, involved in promoting urban development or attracting businesses to an urban area, or teaching and educating others about it. The questionnaire that is to be administered to this group has been designed so that the questions asked will assist in determining and creating
the specific geographic, economic and/or other information that should be made available to interested outside parties via the Internet.

Following the review and analysis of the returned questionnaires, the second part of the methodology will take place. A prototype GIS web site will be created using and incorporating the content, materials and presentation methods which were recommended as a result of the administered survey. For the sake of simplicity, the sample web page will be kept "locally" on a portable hard drive. In so doing, the web page can be shown to anyone during the evaluation phase of this project, whether or not these individuals currently have convenient Internet access. The third part of the methodology includes the evaluation phase. The evaluation phase of the project will involve a hands-on test to approximately 10 individuals from the original group of 30. The questions to be asked here will concern the usability of the page, access to data and the clarity of the design. This prototype will provide an example of how geographic information can be made available via the Internet.

Organization of Thesis

This thesis is comprised of six chapters, a selected bibliography and an appendix. Chapter 2 will begin with definitions and discussions of the Internet followed by a definition of GIS a discussion of economic development and finally, the concept of a Web-based GIS. Chapter 3 will consist of discussion and examples of how different communities across the United States have used the web to aid in distributing information to others and more importantly, how these cities have used the web to help in promoting economic development. Chapter 4 will examine the results of the questionnaire which was distributed, asking for opinions on what type of information should be provided on the Internet for an urban area like Omaha. Chapter 5 will cover the design and creation of a prototype web site for promoting the economic development of an urban area. Chapter 6 will include the summary regarding the topic of this thesis.
CHAPTER 2
THE INTERNET, GEOGRAPHIC INFORMATION SYSTEMS AND ECONOMIC DEVELOPMENT

What is the Internet?

The origins of the Internet with which we are familiar today, can be traced back to a computer network created for the Advanced Research Projects Agency in 1969. This original network was funded by the Department of Defense and was called ARPAnet. It was established for two major reasons: First, the network was created as a means to help scientists from different regions work together. The second reason was that the Department of Defense wanted to establish a computer network which would be sustainable in the event the U.S. was the target of a nuclear attack. The initial Network Control Protocol (NCP) was first implemented between computers at Stanford University, the University of California at Santa Barbara and the University of Utah. ARPAnet switched from the NCP protocol to the TCP/IP protocol (Transmission Control Protocol/Internet Protocol) on January 1, 1983. Most people agree, that this date represents the beginning of the Internet.¹

The Internet has been described in a number of different ways. No single definition can effectively put it into perspective since it is continuously growing and changing. In the very simplest sense, the Internet may be thought of as a system for transferring files between computers. These files may consist of text, pictures, graphics, sound, animations, movies or even complete computer programs. In terms of software, it is a network of computer networks that are based on the TCP/IP protocol. Defined in terms of hardware, the Internet may be thought of as a physical collection of computers, routers and high-speed communication lines. In terms of content, the Internet is a collection of shared resources. Finally, and most importantly, from a human standpoint, the Internet can be
thought of as a large and continuously growing family of people who contribute to its
ccontent and who use its resources.² Figure 2.1 details the growth of the Internet (Table I),
spanning the years 1995-2000.

![PROJECTED INTERNET GROWTH](image)

**Figure 2.1** Projected Internet Growth 1995-2000.

<table>
<thead>
<tr>
<th>Date</th>
<th>Population (in millions)</th>
<th>Annual Change</th>
</tr>
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<tbody>
<tr>
<td>1995</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>1996</td>
<td>37.84</td>
<td>72.00%</td>
</tr>
<tr>
<td>1997</td>
<td>50.6</td>
<td>33.72%</td>
</tr>
<tr>
<td>1998</td>
<td>72.6</td>
<td>43.48%</td>
</tr>
<tr>
<td>1999</td>
<td>94.6</td>
<td>30.30%</td>
</tr>
<tr>
<td>2000</td>
<td>116.6</td>
<td>23.26%</td>
</tr>
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</table>

**Table I** Internet Population, Projected Growth.

Examining the Internet more closely, we see that it contains five unique parts:
Electronic mail (e-mail), Telnet, File Transfer Protocol (ftp), Newsgroups and the World
Wide Web (WWW).³ **E-mail** lets users send and exchange electronic messages to other
users on the Internet. **Telnet** allows the user to log onto a remote computer as if it were
local, ftp allows for the transfer of files between computers and *newsroups* allow for the reading and posting of articles to Internet discussion groups. All four of the parts share the ability to exchange text-based files. The latest addition to the Internet, the *World Wide Web (WWW)*, is the most significant part of all.

**What is the World Wide Web?**

The World Wide Web was initially developed in 1989 by Tim Berners-Lee at the CERN laboratory in Geneva, Switzerland. The idea for the Web came from a concept at CERN referred to as "distributed computing." Since 1995, the Web has been growing annually at nearly a 51 percent rate (Table II).

![PROJECTED WWW GROWTH](image)

**Figure 2.2** Projected Web Growth 1995-2000.

Source: CommerceNet, [http://www.commerce.net/stats/wwwpop.html](http://www.commerce.net/stats/wwwpop.html)

Figure 2.2 summarizes this period of growth. The introduction of the WWW in the early 1990's has been the single most important event in the evolution of the Internet.
<table>
<thead>
<tr>
<th>Date</th>
<th>Population (in millions)</th>
<th>Annual Change</th>
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<tbody>
<tr>
<td>1995</td>
<td>14.3</td>
<td>—</td>
</tr>
<tr>
<td>1996</td>
<td>25.96</td>
<td>81.54%</td>
</tr>
<tr>
<td>1997</td>
<td>38.5</td>
<td>48.31%</td>
</tr>
<tr>
<td>1998</td>
<td>59.4</td>
<td>54.29%</td>
</tr>
<tr>
<td>1999</td>
<td>81.4</td>
<td>37.04%</td>
</tr>
<tr>
<td>2000</td>
<td>110</td>
<td>35.14%</td>
</tr>
</tbody>
</table>

Average annual growth rate: ≈ 51.26%

**Table II**  WWW Population, Projected Growth.

The introduction of the Web addressed many previous usability problems. Files could now be accessed using a graphical "browser" instead of UNIX text line commands. Using a new computer language called HTML (HyperText Markup Language), a "link" automatically made a connection to a remote computer and downloaded the document which was selected. This could be a text, graphic, sound, or any other type of file.

![INTERNET HOSTS 1989-1998](http://www.nw.com)

**Figure 2.3** Internet Hosts 1989-1998.
Based on the concepts of hypertext and hypermedia, the Web promoted a logical linking of files, much like the human brain links related pieces of information. The WWW is largely responsible for the dramatic growth of both users and hosts (Figure 2.3, Table III) on the Internet.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Year</th>
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<tbody>
<tr>
<td>Jul-89</td>
<td>130,000</td>
<td>Jul-94</td>
<td>3,212,000</td>
</tr>
<tr>
<td>Oct-90</td>
<td>313,000</td>
<td>Jul-95</td>
<td>6,642,000</td>
</tr>
<tr>
<td>Jul-91</td>
<td>535,000</td>
<td>Jul-96</td>
<td>12,881,000</td>
</tr>
<tr>
<td>Jul-92</td>
<td>992,000</td>
<td>Jul-97</td>
<td>19,540,000</td>
</tr>
<tr>
<td>Jul-93</td>
<td>1,776,000</td>
<td>Jan-98</td>
<td>29,670,000</td>
</tr>
</tbody>
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Table III  Internet Hosts 1989-1998.

Another factor which has helped to fuel this growth has been the introduction of new web-specific technology, exemplified by Java, Shockwave and Adobe Acrobat.

Using technology available today, it is possible to interact with the Web. At the University of Nebraska at Omaha, a student may access his or her grades, transcripts or schedule, by providing a password and social security number in a Internet form. Until recently, this was done using something called a Common Gateway Interface (CGI). A CGI was used on the server-side of the web site to determine how the server and browser communicated. This meant that the user depended on the server to do a majority of the data processing. This all changed with the arrival of Sun Computer’s Java.

Java is a programming language which was patterned after C++, but with many of the excess functions removed. Java is used to create “applets” for the web. An applet is a mini-application that runs inside of a web page. This is the key to Java: a downloaded applet is able to perform tasks and interact with a user on his/her browser (vs. on the server-side) without using resources from the web server. Sun describes Java as “a simple, object-oriented, distributed, interpreted, robust, secure, architecture-neutral, portable, high-performance, multi-threaded and dynamic language.” There are many
benefits to Java, most noticeably the fact that it is architecture-neutral. This means that Java doesn’t care which operating system the computer is using, if the machine is running a Java interpreter, code written on a Macintosh will run on a Intel (processor) box.

Nearly all web browsers today allow for the use of a tool called a plug-in. Plug-ins are software programs that extend the capabilities of the browser in a specific way. For example, plug-ins make it possible to play audio samples or view video movies from within the browser. One such plug-in from Macromedia is called Shockwave.

Shockwave gives a browser the ability to view things such as animated interfaces or to hear streaming CD-quality audio for music and speech. Streaming means that animation and sound files start playing immediately while the remaining part of the file downloads in the background. In the past, a user sometimes had to wait a number of minutes for the media file to fully download before it started to play. Shockwave is available free on the web and is also included with browsers such as Netscape Navigator and Microsoft Internet Explorer. According to Macromedia, over 37 million Shockwave players were successfully downloaded from their web site in 1997.

Adobe Acrobat is a suite of tools which allow for the creation of electronic documents based on Adobe’s Portable Document Format (PDF). These types of files are platform-independent and true to their name, are very portable. A PDF file preserves the fonts, graphics and layout of a document regardless of which platform was used for its creation. In essence, Acrobat takes a picture of the document, capturing it electronically, just as it appears on the screen. This was quite different from HTML since PDF files keep the same appearance when downloaded to a local machine. Due to the way some HTML is formatted, it will look completely different once downloaded. The formatting of a PDF file stays consistent no matter the location or platform. PDF files which were created using Acrobat can now be found everywhere. They can be placed on the web for downloading, distributed via a CD-ROM or floppy disk and also can easily be e-mailed.
One common use of this technology is to produce the owner's manual for a product as a PDF file, instead of the traditional means of sending a printed book. This conserves paper, ink and packing space as well.

What is a Geographic Information System?

There are a number of different ways to define a Geographic Information System (GIS). A simple definition would read as follows: A GIS is a computer system capable of holding and using data which describes places on the earth’s surface. A more complete definition might be: A GIS can be defined as a computer-based system that provides the following four sets of capabilities to handle georeferenced data: data input, data management, data manipulation and analysis, and data output.

In the simplest of terms, data input is the process of getting data into the computer so that it may be used for analysis. It is important to note that there are two types of data which can be entered: First, there is image data. Image data is created either by digitizing maps or scanning photos, imagery or drawings to create some form of digital media. The second type of data is the descriptor data. Descriptor data could be textual information such as feature names, addresses, street names, etc. Both image data and descriptor data can be entered in a number of ways, either by keyboard, digitizing, scanning or even digital photography. Data management refers to the “organizing and accessibility” of the data in a GIS. How easy or how difficult is it to obtain, change, update, correct or delete data within a GIS? In most cases, data management is left in the hands of a system administrator charged with maintaining the information. Data manipulation and analysis refers to the use of the data. What can be determined or accomplished with the data existing within a GIS? In effect, data manipulation and analysis functions determine the information that can be generated by the GIS. Data output is the means by which we “see” the end result of our GIS query. There are a number of ways to obtain output, including:
hard copy reports (paper output such as tables, charts, graphs and maps) and soft copy reports (electronic or digital file formats).

It is very important to remember that a GIS is not just a computer system that makes maps. Even though it is well suited to do so, a GIS is an analysis tool. A GIS has numerous similarities to spreadsheets, statistical packages and CAD (Computer aided design) software, but it has one major quality by which it is different. A GIS can perform spatial queries on its database. A spatial query is the process of selecting features based on their geographic location or spatial relationship. As an example, other software may allow you to determine the number of housing units in a proposed subdivision, but only a GIS would allow you to determine how many housing units are in a proposed subdivision and which lie within the flood plain of a nearby creek. This is the result of a spatial query.

GIS first originated in the 1960’s when government and university researchers looked for a way to accurately represent the earth’s geography using a computer database, display it on a computer terminal and plot it out on paper. In the early 1970’s, ESRI (Environmental Systems Research Institute) was founded in Redlands, California. Their software package ARC/INFO contains a very advanced set of GIS tools and has been widely recognized as the most powerful GIS software available.

There have however, always been two major drawbacks to this package. First, it has a very steep learning curve, literally taking years to become proficient in its use. Second, it is costly and not generally available. A usage license can cost an individual user many thousands of dollars and until recently, ARC/INFO had been available only on the UNIX platform.
Figure 2.4 A sample screenshot of ESRI’s ArcView.

In recent years, desktop computers have surpassed the power and speed which, in the past, only mainframe computers were able to match. Now, there is an entirely new market that is developing and people can do more with a home computer than with their computer at work. ESRI addressed this new desktop market by introducing a new GIS package in 1992 called ArcView. With this introduction, a new revolution in GIS had begun.

ArcView is a desktop GIS package which lets the user create maps and analyze data in countless ways. The main selling point of ArcView, however, is its interface. Unlike its big brother ARC/INFO, which primarily uses text line entry to execute commands, ArcView uses a “GUI” or graphical user interface. This opened the eyes of many who were used to using the friendly interface of the Apple Macintosh operating system, or even the Windows operating system for PC’s. A GIS package with a friendly interface which
could be used on desktop machines instead of UNIX terminals was just what users had wanted and more importantly, had needed.

With the introduction of ArcView, there finally was a GIS program for the masses. Today, GIS has become a $3 billion per year industry with an annual growth rate of nearly 20 percent.15

Economic Development of an Urban Area

In almost any settled area, regardless of population size, economic growth usually will be the key to that area’s ultimate survival. If jobs are available, it is common to see an influx of new prospective workers. If tax rates are favorable and if prime property is available, new industries may come to that area as well. Today, it is common practice for cities to have a plan developed for the sole purpose of encouraging economic development. These plans have not been developed just to bring another factory to town, but instead, to promote any and all forms of economic activity which would benefit the area.16 Examples found in these plans could be: thinking of ways to better develop or make use of existing infrastructure, creating specialized zoning classifications to attract unique types of business or industry, planning and development of a new civic arena or creation of a new “attraction” which may bring tourist revenue into the city. City planning agencies, business, industry and others watch and monitor economic development very closely.

How does someone know if economic growth is taking place or not? There are many ways of determining this, but here are a few examples. A very good indicator can be found by examining the number of building permits issued for housing, business and industrial units during a given year versus the previous year(s). Value added in housing (median house prices) is also good. Other data to examine would be payroll increases for workers in the city as well at the increases in shipments (business and manufacturing) coming from the city. Another theory is that the measure of the economic performance of a
city is the rate of change in per capita income.\textsuperscript{17} Regardless of the measure used, there is no doubt of the significance and importance of not just increasing economic growth for an urban area, but also promoting the economic growth of an urban area.

Many cities feel frustrated because the process of promoting economic development is not easy. Too often they see their areas bypassed by a company without the hoped for meeting of minds between city officials and site-seeking management ever taking place.\textsuperscript{18} There is however, a solution to this problem. It is a Web-based GIS.

\begin{flushright}
\textit{Putting it all together: A Web-based GIS for Economic Development}
\end{flushright}

After reviewing the ideas and concepts of the Internet, GIS and economic development, I believe they can be used as the foundation for the creation of a Web-based GIS. What is a Web-based GIS? My definition is as follows:

A set of on-line geographic physical and socio-economic data provided in some organized manner to the end-user on the Web via an Internet browser, for inspection and analysis, which allows for the input, output and manipulation of geographic data.

While this definition appears to be similar to the one suggested earlier for a traditional GIS, the difference is reflected in the way the data are served and provided. A Web-based GIS will provide the user with a dynamic and user friendly interface. In recent years, emphasis has been put on the importance between the user and the interface. This is especially important because a Web-based GIS site will not only be visited by individuals who are quite accustomed to working with GIS information, but by a great number who have little or no experience with either computers, or a GIS. As noted earlier, one of the biggest complaints people have had with GIS software is the interface, which as we have seen with ArcView, has been addressed by the way companies design their GIS products.

The Internet, much like GIS, was at first, only accessible by entering commands through text line entry. Today, as a result of the WWW, users work with a graphical
interface. Currently, the market is dominated by two browsers, Netscape Navigator and Microsoft Internet Explorer. The two products are very similar, providing the user a variety of navigation control options (see Figure 2.5).

![Image of Netscape Navigator 3.0 browser](http://www.netscape.com)

**Figure 2.5** The Netscape Navigator 3.0 browser.  

While a Web-based GIS may not offer the levels of complexity and multiple layers of functions relative to a traditional GIS, it can provide a simple, easy to use “front end” and it can serve geographic data very easily to large groups of people via the Internet, on a local, national and global basis.

There are currently a number of different Internet sites on the Web which let the user select information to create the interactive maps. A closer examination of two of these types of web sites are included here.
These two sites are examples of what we might define as a limited Web-based GIS. This is because of the interaction of the user and the data which is made available to create the map. Each of these allow for different levels of interaction and data manipulation to occur.

![Image of Xerox PARC map viewer](http://pubweb.parc.xerox.com:80/map/)

**Figure 2.6** The interface for Xerox PARC.  

The interactive Xerox PARC map (Figure 2.6) was the first one of its kind available on the Internet. By allowing the user to enter specific data (Latitude and Longitude, for example), it would draw a map on the screen which would then be centered on the coordinates you had entered. With the Xerox PARC map you not only can create a map from lat/long, you also can pan “out” into space, or zoom “in” closer to the Earth’s surface.
The second example was created using the U.S. Census Bureau Tiger Mapping Data (Figure 2.7). This map is considerably more complex than the Xerox map in that in addition to drawing a map based on latitude and longitude coordinates, this interactive map offers the user a choice of 21 different layers in which a custom map can be created (Figure 2.8). This map site, along with the Xerox PARC, show just a small amount of the potential that exists for providing, examining and analyzing geographic information with the Internet.

Figure 2.7 The interface used for creating interactive TIGER maps. Source: http://tiger.census.gov/cgi-bin/mapbrowse-tbl/
When the goal of an urban area is to promote economic development, the key is distribution of information. Equally important to this is the ease for others to acquire information and, of course, the type of information that is made available. Promoting economic development through a Web-based GIS would seem to be a perfect solution. The examples of interactive maps discussed previously could prove to be very valuable to an urban area as an aid in attracting and encouraging economic growth.

A city could create a web site which could include data and maps that could provide important geographic data (such as zoning of property, public transportation routes or sewer information), all of which could be distributed over the Internet. With regards to
economic growth, this type of information could be very valuable to those unfamiliar with the city and who are considering possible investment in the area. This could be very valuable for small businesses who may not have the time or resources to do extensive research on an area far from their location. When considering whether or not to invest funds or to propose development in an urban area, the ability to obtain some insight into the local economic and geographic data can indeed prove to be very valuable. A Web-based GIS can be an ideal tool for promoting economic development of an urban area.

In the following chapter, there will be discussion and examples of how different communities across the United States have used the web to aid in distributing information to others and also how it has been used to promote economic development.

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2 Ibid.
4 Source: http://www.w3.org/WWW/
5 Source: http://www.cn.cern.ch/pdp/ns/ben/TCPHIST.html
6 An Internet host is any machine that has an IP address associated with it. This would be any computer system that is connected to the Internet either full time, part time, over a direct connection, or over a dial-up connection.
8 Source: http://java.sun.com
9 Source: http://www.macromedia.com/shockwave
In the not so distant past, when someone needed to obtain information referring to a specific parcel of land, such as how a piece of property was zoned, it was necessary either to call, or visit his/her local planning agency. Similarly, if a company was interested in expanding its business into a new region or location, it was common practice to hire outside consultants to acquire the necessary information. These individuals would be responsible for performing the footwork necessary to obtain the requested information. As a result of the Web, in many areas this time-consuming process is no longer necessary. Many regions across the United States are beginning to use the Web as a means to more easily distribute geographic information. Some of these cities are also beginning to use the Web to assist in promoting economic development. In this chapter, we will look at four different implementations from across the United States and examine how they are using the Web to effectively deliver information.

York, Nebraska

The City of York, Nebraska, is located approximately 100 miles southwest of Nebraska’s largest city, Omaha. Although there is a considerable population difference between the two (8,000 vs. 354,000), thanks to the global realm of the Web, York can be considered nothing less than an equal when visited on the Internet.

With the accessibility of information through the Web, a community such as York has the opportunity to attract attention to itself just as effectively as a larger city. By using the technology, a city of this size has a better chance of reaching out to more people. In the past, it may have been easily overlooked in a small trade paper or real estate journal.
The City of York’s web site ([http://www.ci.york.ne.us](http://www.ci.york.ne.us)) was designed to have a very simple and easy to understand interface. When the user sees the welcome page (Figure 3.1), they are greeted with a brief “yesterday and today” history of York and given six main categories from which they may choose information. These are; Economic Development, Community, Medical, Business & Industry, Education and Recreation. (Source: http://www.ci.york.ne.us). By dividing the information into these six groups, the City of York recognized what information is especially important to those from outside of the community.

![Image of the City of York's homepage](http://www.ci.york.ne.us)

**Figure 3.1** The homepage of York, Nebraska.
Source: http://www.ci.york.ne.us

The most informative section of the York site is the category “Business & Industry.” In this category, a wealth of information is provided. Included is information on different utility types, such as electricity, natural gas and water, and the technical aspects
of each. The site also includes a listing of other services available in the city, including telecommunications, freight services and package delivery. Information is also given regarding the accessibility of newspaper, radio and the television markets (local and otherwise). The key to this section however is the sub-category “Available Industrial Sites.”

![Figure 3.2 Available industrial land, City of York, Nebraska. Source: http://www.ci.york.ne.us/120p.htm](http://www.ci.york.ne.us/120p.htm)

In this category, York provides information to the user regarding industrial land which is available for development. Presented to the user is a color airphoto (Figure 3.2), a plat map (Figure 3.3) and detailed information regarding the site (Source: http://www.ci.york.ne.us/site.htm#avail). Included in this list of information is a site description which gives location, size, characteristics and the present land use of the area. A listing and description of utility service is also included, with much attention paid to specific details and site requirements. A listing of transportation options is also described.
Available rail service is noted as well as descriptions of access to U.S. Highways, Interstates and airports.

**Figure 3.3** Site map for York industrial property.
Source: http://www.ci.york.ne.us/site.htm#avail
The City of York has created an effective web site that is very user friendly, as well as informative. With its simple interface and detailed information, this site helps to show just how effective the Web can be when used to collectively distribute information and promote economic development.

Ontario, California

Ontario, California is a city of 150,000, located approximately 30 miles east of Los Angeles. The City of Ontario (http://www.ci.ontario.ca.us), has created a web site which provides information to a broad variety of people. On the greeting page (Figure 3.4), visitors are met with a pleasant looking interface which keeps navigation simple.

Figure 3.4 The homepage of Ontario, California.
Source: http://www.ci.ontario.ca.us
Hyperlinks are given which provide information for Ontario residents as well as businesses. There also is a special link for those who are prospective visitors to the city. Upon further inspection, a large amount of additional information is offered. Information about Ontario’s infrastructure, school system, health care services, transportation services, and government agencies are just a few examples. Information is also available on Ontario’s weather as well as brief economic overviews of projects and developments that may affect the city. Overall, this page does a very good job of assisting the user in collecting general information regarding the city. The link that makes this page unique, however, is the Ontario GIS map source.

As noted earlier, the City of Ontario is a fairly large community of nearly 150,000 people. This is somewhat deceiving, however, because it also makes up a part of the greater Los Angeles metro area, which has a combined population of over 14.5 million. Situated near such a large population base, Ontario has created a web-based GIS map source which is easily able to distribute data to a large number of people. This site is officially referred to as the “Geographic Information Web Server.” The server provides the user with four unique geographic operations and each is very detailed. The four applications to choose from are: infrastructure utility, parcel search, development status, and site selector (Source: http://158.61.82.251/gis/apps.htm).

The *infrastructure utility* provides the user with a street map of Ontario, and once an area of interest is defined, the map regenerates and displays the water, sewer or storm drain lines within the selected area. This would be beneficial to those considering construction or site location in Ontario. The *parcel search* allows the user to input an address, an owner’s name or an assessor’s parcel number to locate and list certain characteristics about the parcel. The *development status* is used to determine the status of current development projects within the city. The projects are separated into three classes:
commercial, industrial and residential. The data provided to the user gives a map reference point, a description of the project, a general location, the builders name and the current work status of the project.

Figure 3.5 City of Ontario Site Selector.
Source: http://158.61.82.251/gis/apps.htm

The final application included is the site selector (Figure 3.5). A site selection tool is extremely valuable to any city interested in, or is trying to promote economic development. Many individuals or businesses from outside the local area have neither the time nor the resources necessary to make trips to potential new locations for their enterprises. If the City of Ontario were a candidate for a new business, a prospective company with adequate resources may pay a visit to examine available sites which may suit their individual needs. By including a site selector on the Web, it now can offer assistance to prospective investors from both in and outside of the area.
The primary function of the site selector is to locate potential site locations for users based on a set of user defined parameters. When preparing a query, the user is asked a number of questions. First, the type of search: vacant land or a vacant building? The user is then prompted for information regarding the required acreage, desired zoning and minimum distance from transportation access (freeways, railroads and air). Once these parameters are submitted by the user, the map is redrawn and all sites meeting these criteria are displayed.

The City of Ontario has created a site which is easy to use and contains very valuable information. The applications used to present data are good and the interface is easy to follow. Resources are easily accessible and the applications made available to the user are very simple, but powerful. This is a site which very effectively distributes information.

*Cabarrus County, North Carolina*

Cabarrus County, is located just Northeast of Charlotte, in south-central North Carolina (Figure 3.6). The county ([http://www.co.cabarrus.nc.us](http://www.co.cabarrus.nc.us)) has designed a web site which includes links to various government offices and sources of information which refer to Cabarrus County. The significant section of this site, however, is the GIS Public Access.

The Cabarrus County GIS Public Access allows tax maps and the associated data regarding a land parcel to be accessed via a browser on the Internet. Users of this site are asked to provide one of three sets of information: A parcel identification number, the land owner’s name or the street address of the parcel in question.
Figure 3.6  Cabarrus County, North Carolina.
Source: http://www.cabarruscvb.com/map.html

Figure 3.7  Sample query map, Cabarrus County, North Carolina.
Source: http://www.co.cabarrus.nc.us/
A query to the county database can provide the following information: owner’s name, parcel address, zip code, municipality, parcel number, deed book and page, legal description, deeded acreage, front footage, sale month/year/price, total value, land value, building value, year built, elementary school district, high school district, voting precinct, fire district, parcel census tract, flood zone, soil type, zoning, as well as other items of interest (Source: http://www.coxabarrus.nc.us/pages/maphelp.html). Submitting a query with the address “10293 Hastings Plaza” returned the results shown in Figures 3.7 and 3.8.

All of the information used in creating the map and the data displayed, come from recorded deeds, plats and other sources of public information in Cabarrus County.

### Parcel Information:

| Owner: Conrad Denton P & Wife Dorothy H | Total Value: $223,720 |
| Address: 10293 Hastings Pl | Land Value: $32,000 |
| City: County | Building Value: $189,120 |
| Zip Code: 28075 | Build Sqft: 3137 |
| Real ID: 1-025C-11 | Year Built: 1995 |
| Parcel Number: 5505-88-0972 | Elementary School: Rocky River |
| Tax Map: 550502 | High School: Central Cabarrus |
| Deed Book-Page: 1319-0354 | Township: 1 |
| Legal Desc: Lot 11 Britlay Subdiv Phase | Voting Precinct: T1-B2 |
| Deeded Acreage: 0.78 | Fire District: Harrisburg |
| Front Footage: 37 | Census Tract: 0415 |
| Sale Month: 10 | Flood Zone: |
| Sale Year: 94 | Soil Type: EnB EnD |
| Sale Price: $30,000 | Zoning: MDR |

**Figure 3.8** Parcel information from sample query, Cabarrus County, North Carolina. Source: http://www.co.cabarrus.nc.us/

As you can see, the information provided here could be extremely beneficial to a large number of people. A property owner in Cabarrus County would have access via the Web to information identifying how their property was zoned. A real estate agent may now have an easier time assessing the value of a vacant parcel of land. A family from out of
town may be moving into this area, and would like to determine what school district their new home will lie in. These are just a few very simple examples of how this data could be used. Cabarrus County utilizes a very broad spectrum of geographic information and it is able to distribute both graphical data (the map) and tabular data (the parcel information). The interface which is presented to the user by Cabarrus County is very simple and straightforward, but the information distributed is solid and effective.

**Omaha, Nebraska**

In this section we will look at not one, but two web sites devoted to the City of Omaha, Nebraska. One is the “official” city web site (Figure 3.9), created and maintained by the city, and the second is a site created and presented by the Greater Omaha Chamber of Commerce.

**Figure 3.9** The City of Omaha, Nebraska homepage.
Source: http://www.ci.omaha.ne.us
The City of Omaha has a base population of around 354,000 people. The greater Omaha metropolitan area however consists of over 680,000. This makes Omaha a community which, in the eyes of others, may be large enough to support growth in business and industry, but also still small enough to attract people who do not want the hassles of living in a large city. To some, Omaha could be the best of both worlds. In order to promote itself as a viable location for both family and industry, a city must provide information which will foster this impression.

The City of Omaha’s official web site (http://www.ci.omaha.ne.us) could be thought of as a municipal reference guide, since it contains a large amount of data related to the working of Omaha’s local government. It provides very little geographic information that would be useful for purposes of economic development. Upon arrival to the site, the user is presented with some very generalized information. The page gives a short overview of Omaha and the surrounding area, presents a list of job postings available with the city and a copy of the next City Council meeting agenda. Located on the left side of the page is a sub-menu which allows the user to link to certain city documents and also to specific departments within the city. One of these choices is the City of Omaha Planning Department.

The planning department page contains a skeleton amount of information on a number of different topics. Here, the functions of the planning department are described, as are the separate department divisions and the seven planning department boards (planning board, zoning board of appeals, etc.) For the most part, however, the page offers no valuable information; nothing that would truly help to encourage economic development in any form. The Master Plan on the City of Omaha Planning Department page provides some vision for future development.

The plan is a made up of separate parts, called elements. An element is an individual document that helps to build an outline for a specific aspect of Omaha’s
development. Each element makes up one portion of the greater master plan. The plan consists of six parts: land use, transportation, urban development, parks and recreation, housing and community development, and public facilities. Each of these sections are studied extensively by realtors, developers, homeowners and others.

In many ways, the future of Omaha lies within these pages. Providing information like the master plan to the public is critical because the data contained in these documents create the base on which the foundation of Omaha's future development will be built. The City of Omaha has decided to use the Web as an outlet to distribute information that is important to the future development of the city. The master plan can be downloaded as a Microsoft Word document, or can be viewed on the Web using hypertext (Figure 3.10).

Figure 3.10 City of Omaha Master Plan file options. Source: http://www.ci.omaha.ne.us/depts/planning/masterplan2.htm
By providing material such as this on the Web, the City of Omaha is helping to promote its future growth. This information serves as a template for future development and people from outside Omaha can get a glimpse of the city's future plans. From this, they can begin to plan for the future, for development or otherwise, based on these principles and guidelines provided on the Web as a service of the city. However, this offering does not provide the specific geographic or economic information that would be necessary for development.

In contrast to the official City of Omaha web site that provides information about the functions and responsibilities of the city government, a pool of economic information can be found on the web site of the Greater Omaha Chamber of Commerce, which is entitled “Access Omaha” (http://www.accessomaha.com) (Figure 3.11).

Figure 3.11 Greater Omaha Chamber of Commerce homepage.
Source: http://www.accessomaha.com
Access Omaha has a number of links from its main page. By selecting the visitors guide (Source: http://www.accessomaha.com/Visitors/visitors.html) the user can find out information on how to get around Omaha, or may obtain suggestions on where to stay or dine in the city. The main emphasis for the page as a whole however, is on economy.

If the user selects the “economy” link from the main page, a table entitled “Metro Omaha Statistical Overview” is displayed. Here, summarized data can be found reflecting Omaha’s population (population by county, population distribution), economy (economic indicators, employment distribution), taxes, cost of living and a informative section on non-farm wage and salary employment. A significant source of information provided by Access Omaha is the section “Omaha Business Indicators” (Figure 3.12).

**Omaha Business Indicators — January, 1998**

<table>
<thead>
<tr>
<th></th>
<th>Dec. '97</th>
<th>Nov. '97</th>
<th>Ago</th>
<th>Dec. '96</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labor Force</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>387,915</td>
<td>391,115</td>
<td>-0.8</td>
<td>372,053</td>
</tr>
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<td>Unemployment</td>
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<td>383,774</td>
<td>-0.6</td>
<td>361,649</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>6,602</td>
<td>7,841</td>
<td>-10.1</td>
<td>10,404</td>
</tr>
<tr>
<td><strong>Omaha</strong></td>
<td>1.7</td>
<td>1.9</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Nebraska</strong></td>
<td>1.6</td>
<td>1.7</td>
<td></td>
<td>2.7</td>
</tr>
<tr>
<td><strong>United States</strong></td>
<td>4.4</td>
<td>4.3</td>
<td></td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Figure 3.12** A portion of the Omaha Business Indicator table.

Source: http://www.accessomaha.com/Economy/indicators.html

As stated in chapter two, some of the key indicators of economic development are: the number of building permits issued for housing, business and industrial property and another indicator is the value added in housing. All of this information can be found in this
table. Making this type of data available for distribution on the Web is a tremendous benefit for both Omaha and any group or individual considering investment in the area. If a city wishes to attract investment from outside the local area, it is vital that information such as this be made both easily and readily available. The way to succeed at this is to put this information on the Web and, to a great extent, the Access Omaha site has done that. It is however, still missing the geographic element, i.e., parcel data, industrial sites, and other information that would be necessary to attract businesses to the city.

Are these sites effective?

Four examples of how communities are using the Web to distribute information have been examined. The City of York, Nebraska, used a simple link on its site to show visitors a listing of industrial property available for development. Ontario, California has created an extensive Geographic Information Web Server which provides the user with four operations which can be used to extract information from the city’s GIS database. Cabarrus County, North Carolina has created a service called GIS Public Access. Here, a user enters select information regarding a parcel of land and from that information, a map can be created showing its location and 27 other unique characteristics. Overall, these three have utilized the Web in a very positive and effective manner. Information is easily accessible on these sites and all have a very simple and friendly user interface. They all use maps in one way or another to benefit the user and, although the amount of detail varies between these sites, the content is all pertinent to the user. In other words, these three sites do not simply clutter their pages with “filler.” On the other hand, the City of Omaha, with two separate web sites, offers different amounts of information which could beneficial to some people, depending on their goal. There are, however, problems with both of these sites.
In the case of the Greater Omaha Chamber of Commerce, the information provided is excellent—but there are no maps to reference the user to locations. For example, the page may contain data regarding economic growth of the city, but with no map, how does one determine where this growth is taking place? Overall, however, the site is well designed and does in fact provide very good data. The City of Omaha’s “official” site unfortunately offers very little in terms interaction or information. As discussed previously, the site provides access to some city documents, including the master plan, but the data contained in these does little to aggressively promote any level of economic development in the area. The site has no maps, no data, and only trivial pieces of information of the structure of the city government. It would be beneficial for the City of Omaha to rethink its Internet strategy because the potential audience which they have access to is very large.

Information on the Web serves a double benefit. First, the different communities are promoting themselves to a very large number of people, therefore increasing the chances of attracting someone’s attention. Second, and potentially more important, by promoting themselves in a professional manner on the Web, communities also instill an air of confidence into others. One may think: “If a community takes such great pride in promoting themselves, think about what they can do for me.”

Summary

Even though these communities are in different geographic locations, there are similarities among them. All have developed ways to use the Web for information distribution, and while the methods used by each may be different, the ultimate goal of self promotion is a commonly shared theme. In three of the communities examined, the use of the Web to distribute information was handled effectively while in the fourth, the methods used were less than convincing. If used properly, the Web is a tool by which these communities will be able to reach their goal.
In the next chapter, we will examine the results of the questionnaire which was distributed asking for opinions on what type of information should be provided on the Internet to promote development in an urban area like Omaha.
CHAPTER 4
SURVEY QUESTIONNAIRE: RESULTS AND ANALYSIS

Review of the Methodology

The methodology of this thesis consisted of three separate parts. In the first, a questionnaire containing 20 questions was distributed to a total of 30 individuals. These 30 included: City of Omaha employees and elected officials, Douglas County officials, members of the Omaha economic community and educational faculty from across the United States. The questionnaire administered to this group was designed so that the questions asked would assist in helping to determine the specific geographic, economic or other information that would be beneficial to promoting economic growth of an urban area via the Internet.

Following the review and analysis of the returned questionnaires that are described in this chapter, a prototype Web-based GIS was created and is presented in chapter five. It used and incorporated the content, materials and presentation methods which were recommended as a result of the administered survey. Once the prototype was completed, the sample web page was kept “locally” on a portable hard drive. Thus during the evaluation phase of this project, the web page could be shown to anyone participating in the evaluation, whether or not those individuals currently had convenient Internet access.

The final section of the methodology is the evaluation phase. The evaluation phase of the project involved a hands-on test to 10 individuals from the original group of 30. This group was asked questions which concerned the usability of the page, access to data and the clarity of the design. This prototype provided an example of how geographic and economic information can be made available via the Internet.
Survey Background

A questionnaire comprised of 20 questions was distributed to a group of 30 individuals. This was done to obtain a broad spectrum of opinions about what information should be included as part of a web page for economic development. This is why the survey was presented to the variety of groups listed in the previous section. The City of Omaha Planning Department was chosen because it is in many ways, the governing body over development within the city. Elected officials from the City of Omaha and Douglas County were selected since they contribute greatly to the policies that are implemented within the metropolitan area. Members of the Omaha business community were chosen since it is not uncommon for their opinion to contrast with that of city officials. Finally, the various members of academia which were selected, at one time or another, centered their research around economic or urban geography.

The survey was accompanied by a letter from myself which contained a brief overview of the thesis, listing the title as well as specific objectives of the research. Finally, if the survey participant wished to obtain more information, a web address was provided that linked to my initial thesis proposal. Also, information was given which provided a means to contact myself or my advisor, Dr. Michael Peterson, if they had any questions. The survey was divided into two sections, each containing 10 questions. The first section was entitled “Making information available to the public through the Internet” and the second, “Promoting economic development of an urban area.” While completing the survey, the participant was asked to answer questions based on the following scale: 1 - Strongly Agree, 2 - Agree, 3 - No Opinion, 4 - Disagree, and 5 - Strongly Disagree. Also included was a blank page for comments. The initial information letter was dated February 2, 1998 and it was requested that the survey be completed no later than February 12, 1998. Of the original 30 questionnaires distributed, 24 of them were returned, representing an 80
percent return rate. A copy of this letter as well as the full questionnaire can be found in its entirety in Appendix 1. Table 4.1 presents a summary of all of the responses.

Presented in the following section is an examination of the survey questions and results. All of the questions were asked with a single unifying theme: Providing specific information to the public through an Internet web site.

Survey Questions and Results

Section One: MAKING INFORMATION AVAILABLE TO THE PUBLIC THROUGH THE INTERNET

1. Information showing how a parcel of land is zoned within an urban area should be made available to those who request it.

   - Strongly Agree (92%)
   - Agree (4%)
   - No Opinion (0%)
   - Disagree (0%)
   - Strongly Disagree (4%)

   Mean = 1.21
   Standard Deviation = 0.833

2. The assessed value for tax purposes for all land parcels within an urban area should be made available.

   - Strongly Agree (79%)
   - Agree (13%)
   - No Opinion (0%)
   - Disagree (0%)
   - Strongly Disagree (8%)

   Mean = 1.46
   Standard Deviation = 1.141

3. In an urban area, information describing the legal description of a land parcel (such as subdivision name, address, lot number, lot dimensions and owner) should be made available.
4. Relevant information that would list land parcels for sale and/or which are available for development within an urban area, should be made available.

- Strongly Agree (42%)
- Agree (25%)
- No Opinion (25%)
- Disagree (8%)
- Strongly Disagree (17%)

Mean = 2.42
Standard Deviation = 1.530

5. In an urban area, crime statistics throughout the city should be made available to anyone requesting them through the Internet.

- Strongly Agree (29%)
- Agree (25%)
- No Opinion (25%)
- Disagree (8%)
- Strongly Disagree (13%)

Mean = 2.50
Standard Deviation = 1.351

6. On an Internet web site, information should be made available in an easy to understand graphical form such as maps as opposed to numerical tables.
7. All geographic information in the public record for an urban area (such as maps as well as the other examples listed above) should be made available for review.

8. In an urban area, the local government should decide on what information is made available to the public via Internet access.

9. All documents and materials from public meetings, such as the urban area's city council or planning board, should be made available to those who request them.
10. Public information pertaining to an urban area should be made available for a fee, to those requesting it who are not taxpayers of the urban area in question.

Mean = 1.63  
Standard Deviation = 1.245

11. In order to promote economic development of an urban area, information describing local taxes (such as property tax), should be made available on-line.

Mean = 1.54  
Standard Deviation = 0.833

12. To assist in promoting economic development, an urban area should make available information regarding different utility costs (such as gas, water and electric) to those who request them.
13. A description of the average local wage rates in an urban area should be made available in order to promote economic development.

14. In order to promote economic development of an urban area, a summary of construction costs should be made available to anyone requesting them through the Internet.

15. In order to promote economic development of an urban area, the local government should make available for review, a copy (or summary) of the city ordinance to anyone requesting it through the Internet.
16. In order to promote economic development of an urban area, the local government should make available a map showing residential growth areas to anyone requesting them through the Internet.

17. In order to promote economic development of an urban area, the local government should make available a map showing the city’s future projected growth areas to anyone requesting them via the Internet.

18. The local government of an urban area should make available a summary of zoning regulations to those who request them.
19. The local government should provide information describing the median household size as well as the median income, in order to assist in promoting economic development of an urban area.

20. As a tool to assist in promoting economic development of an urban area, the local government should create and maintain an Internet site which would allow the user to create interactive and dynamic maps of the city, based on the criteria determined by the user and/or determined by the information provided by the local government, or by both.

END OF SECTION TWO.
### QUESTIONNAIRE RESULTS

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**Table IV** Survey responses

Note: The column on the left represents the survey number while the top row represents the survey question number.
Survey Analysis

Of the 30 questionnaires distributed, 24 were returned, representing a return rate of 80 percent. There seemed to be general agreement among the participants for many of the questions asked on the survey. Of the twenty questions asked, seven of them (1, 3, 11, 12, 13, 16 and 18) recorded a standard deviation (SD) of less than 1, and the range of the SD was .70 (Question 8 = 1.53 - Question 13 = .83). When examining the results of the two survey sections as a whole, participants recorded a mean of 2.00 in section one and 1.78 in section two. Let us examine each section more closely.

Section One Analysis

Section one of the survey contained questions which related to making geographic and economic information available to the public through the Internet. This section recorded a mean of 2.00. A mean of 2.00, when compared to the survey answer scale, states that the participants generally “agreed” with the questions, but there were a number of individual questions that had wide variability in responses. While reviewing these responses, remember that all of these questions were asked with the intent of providing this information on the Internet.

- 1. Information showing how a parcel of land is zoned within an urban area should be made available to those who request it. \( \text{mean} = 1.21, \text{SD} = 0.833 \)
- 2. The assessed value for tax purposes for all land parcels within an urban area should be made available. \( \text{mean} = 1.46, \text{SD} = 1.141 \)
- 3. In an urban area, information describing the legal description of a land parcel (such as subdivision name, address, lot number, lot dimensions and owner) should be made available. \( \text{mean} = 1.38, \text{SD} = 0.942 \)

Questions 1, 2 and 3 were asked about information which the City and County keep in a database. All of this is public information and, as shown in chapter 3, many communities across the U.S. already provide this data on the Web. For these questions, the mean fell within the “strongly agree” category.
• 4. Relevant information that would list land parcels for sale and/or which are available for development within an urban area, should be made available. (mean = 2.42, SD = 1.530)

When question 4 was initially written, I had reservations regarding whether or not it would receive a positive response, even though many other cities (also noted in chapter 3) had information on the Web which listed specific property (City of York, Nebraska), or which allowed you to use a “site selector” (City of Ontario, California) to help locate a piece of property. The question did indeed receive a mixed response with a mean of 2.42 and the highest SD of all questions with 1.530, putting it between “agree” and “no opinion.” One respondent (questionnaire 158) noted that perhaps the Board of Realtors or MOBA (Metro Omaha Builders Association) would be better suited to provide this type of information.

• 5. In an urban area, crime statistics throughout the city should be made available to anyone requesting them through the Internet. (mean = 2.50, SD = 1.351)

Question number 5 involved the release of crime statistics. Crime statistics traditionally have been a source of major controversy when discussions arise as to whether or not they should be made available to the public. I was, however, surprised at the response to this question. With a mean of 2.5, and a SD of 1.315, while not showing strong support for this idea, at the very least, it was not strongly opposed either. Concerns were raised, however, that by releasing crime statistics to the public over the Internet, areas of a city which were already crime-ridden would deteriorate further, with new development being scared away by these numbers (Source: Questionnaire 158).

• 6. On an Internet web site, information should be made available in an easy to understand graphical form such as maps as opposed to numerical tables. (mean = 1.96, SD = 1.042)

From a personal standpoint, I had always felt that maps were a very beneficial, if not necessary tool to help in the distribution of information over the Internet. This is not to say, however, that tables are not significant either. Most respondents agreed that a
graphical source of information should be provided, but a combination of the two would be effective. One respondent noted that "tables as well as maps are useful" (Source: Questionnaire 163).

7. All geographic information in the public record for an urban area (such as maps as well as the other examples listed above) should be made available for review. (mean = 1.92, SD = 1.213)

Question 7 received a mean of 1.92, which showed strong support for the question. There were, however, a number of concerns regarding this initiative. The main problem with this idea regarded the limits of funding. One respondent wrote: "cost and availability of staff resources are a significant limitation for local government to maintain updated information" (questionnaire 154). Another noted that there was concern within the city as to whether "adequate funds" (questionnaire 153) would be available to do so.

8. In an urban area, the local government should decide on what information is made available to the public via Internet access. (mean = 2.96, SD = 1.398)
9. All documents and materials from public meetings, such as the urban area's city council or planning board, should be made available to those who request them. (mean = 1.63, SD = 1.245)
10. Public information pertaining to an urban area should be made available for a fee, to those requesting it who are not taxpayers of the urban area in question. (mean = 2.58, SD = 1.381)

The final three questions of this section relate to the government's role in providing information. Question number 8 recorded the second largest SD of all questions with 1.398, and the mean was almost a 3.0, giving it "no opinion" status. It appears as if the survey participants do not have a strong idea about who should provide the information. One comment received stated that "while your survey continually says 'local government,' I would strongly suggest local government and local developmental agencies should jointly discuss and develop the tools that the marketplace requires. Successful area development programs require the close partnering of the public and private sectors" (questionnaire 175).
Question 9 received a “strongly agree” from the survey participants, while question 10, received a 2.58 mean, putting it near “no opinion.” This was a curious response, however, since this question generated the most comments. Of the respondents who made comments, the general feeling was that there should be a fee charged for information which was provided to developers, contractors or Realtors. “All information, not just for ‘out-of-city’ users, should be fee-based” writes one individual (questionnaire 173) and another states that “Fees should be charged for some data provided to the public and certainly to developers. Information must be open, but not always free” (questionnaire 174).

Section Two Analysis

Section two of the questionnaire was titled: “Promoting economic development of an urban area.” The questions which were asked in this section were intended to help determine what type of information should be put on the Web to promote economic development.

• 11. In order to promote economic development of an urban area, information describing local taxes (such as property tax), should be made available on-line. (mean = 1.54, SD = 0.833)

Tax information, much like crime statistics often cause a stir when discussed. In this case, however, the question was received very positively, as represented by a mean of 1.54 and a very low SD of 0.833.

• 12. To assist in promoting economic development, an urban area should make available information regarding different utility costs (such as gas, water and electric) to those who request them. (mean = 1.54, SD = 0.833)

Question 12 asks whether or not utility expenses reflected in a specific community should be made available over the Web. Making these numbers available may have either a beneficial or prohibitive effect on development depending on what outside developers may
find to be reasonable costs. Overall, with a mean of 1.54 and a SD of 0.833, the respondents felt as if it was a good idea.

- 13. A description of the average local wage rates in an urban area should be made available in order to promote economic development. (mean = 1.54, SD = 0.830)
- 14. In order to promote economic development of an urban area, a summary of construction costs should be made available to anyone requesting them through the Internet. (mean = 2.13, SD = 1.154)

Questions 13 and 14 make reference to wage rates and construction costs, both major factors affecting urban development. The inclusion of wage rates (Question 13) on the Web would help industry officials gain insight about whether or not a city like Omaha may be a profitable location for their enterprise. This question received a mean of 1.54 and recorded the lowest SD of all questions with 0.830. The issue of providing a summary of construction costs on the Web (Question 14), however, received a slightly different response. With a mean of 2.13, this question was “agreed” upon, but not as strongly as wage rates. The SD was also higher (1.154), which reflected slightly more disagreement than on question 13. One respondent spoke very strongly in suggesting that “Much of the information in questions 11-14 should be jointly provided by the City of Omaha and the Omaha Chamber of Commerce” (questionnaire 152).

- 15. In order to promote economic development of an urban area, the local government should make available for review, a copy (or summary) of the city ordinance to anyone requesting it through the Internet. (mean = 1.96, SD = 1.083)

Question 15 was rather generalized because not all cities have a city ordinance or charter to make available; therefore, this question was included to obtain a generalized feeling towards how people felt about the local city government providing more information on the Web. From the mean (1.96) and the SD (1.083), results were generally positive.

- 16. In order to promote economic development of an urban area, the local government should make available a map showing residential growth areas to anyone requesting them through the Internet. (mean = 1.88, SD = 0.947)
17. In order to promote economic development of an urban area, the local government should make available a map showing the city’s future projected growth areas to anyone requesting them via the Internet. (mean = 1.79, SD = 1.021)

The question of providing information with maps is discussed in questions 16 and 17. Question 16 asked whether or not a map showing residential growth should be provided on the Internet and the question received a mean of 1.88 and a very low SD of 0.947. Question 17 asked if a map showing the city’s future projected growth area should be provided on the Internet and again, the mean of 1.79 and the SD of 1.021 indicated that both questions received a “yes” response and support from the respondents.

18. The local government of an urban area should make available a summary of zoning regulations to those who request them. (mean = 1.33, SD = 0.868)

A summary of zoning regulations is already available from the City of Omaha for free on paper, but based on the responses to this question (mean 1.33, SD 0.868), it would be very beneficial to place it on the Web as well.

19. The local government should provide information describing the median household size as well as the median income, in order to assist in promoting economic development of an urban area. (mean = 2.13, SD = 1.296)

20. As a tool to assist in promoting economic development of an urban area, the local government should create and maintain an Internet site which would allow the user to create interactive and dynamic maps of the city, based on the criteria determined by the user and/ or determined by the information provided by the local government, or by both. (mean = 1.92, SD = 1.060)

Question 19 received a mean of 2.13 and a SD of 1.296, placing it in the “agree” category. By placing this data on the Web, it may help to serve as economic indicator to others, perhaps showing that Omaha has a strong and expanding economic core. On the other hand, question 20 asked the participant if they are ready to take the concept of information distribution on the Web one step further. By creating an interactive web site, the city would allow interaction between the user and the data. This would also allow customized interfaces much like the one seen exhibited by the City of Ontario, California or by Cabarrus county, North Carolina. The mean for this question was 1.92 and the SD
was 1.060. This reflects a positive response to what I believe is the most important question on the survey.

Survey Conclusions: Creating the Web Prototype

As stated in Chapter 1, the purpose of this thesis was to design a prototype Web-based GIS that would provide specific geographic information that may be used to promote economic development of an urban area. The distribution and analysis of this survey was a key element towards reaching this goal.

Upon reviewing the results of this questionnaire, it was now much easier to begin assembling the pieces needed to create the prototype. The survey indicated that there were a number of items which the participants felt positively about, and of course, there were others that were met with less enthusiasm. As a result of the questionnaire, the following conclusions can be made regarding the content of the prototype Web-based GIS.

Although the primary intent of the site will be to promote economic development, a portion of the page will be dedicated to providing general information regarding Omaha. Here, information will be given which provides an overview of the city's history, weather, and other characteristics such as culture and recreational activities. Also included in the prototype will be maps of Omaha, so that others from outside the area can more easily familiarize themselves with the city.

Respondents indicated that both geographic and economic data should be made available on the Web. To accommodate this request, the prototype site will provide sections covering both of these topics. In the case of geographic data, a favorable response was given towards the idea of including a feature which will allow users to perform a query on land parcels. This tool will provide information regarding the legal description, tax rates and the zoning of selected properties. Since zoning designation will be listed as a part of the query, a zoning summary will be provided on the site as well. Also to be included is a
section on transportation information. This section will inform others from outside Omaha to the extent of Omaha's accessibility to air, rail, water and ground transportation.

In terms of economic data, the results of the survey showed that a mix of economic information would be beneficial. A description of local wage rates, income tax information and a summary of the workforce will be included, as will a listing and summary of business indicators which influence the economic growth of a community. A section describing tax incentive plans for businesses will list tax rates and offer information on how industry can make use of tax breaks by locating (or re-locating) into areas within a city's enterprise zone (blighted area).

Finally, since economic development is dependent on both geographic and economic factors, a tool called the "economic site selector" will be featured. This will be the key element on the site. Although the initial idea of a site selector received mixed reviews on the questionnaire, I believe the response to this will be quite different once the users have had a chance to examine it. This tool will give the user an opportunity to designate a set of criteria which, when submitted, would query a database in order to assist in finding the type of site they are looking for. This tool is aimed at helping prospective businesses obtain the vital information which is needed in order to determine if Omaha is a viable site.

It is important to keep in mind that this is a prototype site and not all of the features described will be fully functional. The user will, however, be provided with detailed examples of how this site would work if it were actually connected to a database. Ultimately, it will be the evaluation of this site which will decide if it is deemed to be effective or not, so until that time, all one can do is work with the initial suggestions given, and construct the best site possible given the resources available.

In the following chapter, the design, construction, and evaluation of the prototype Web-based GIS will be described.
CHAPTER 5
THE PROTOTYPE WEB-BASED GIS

Part 1: Putting information on the Web for economic development

In the previous two chapters, a number of different ideas associated with the Web and economic development were examined. In Chapter 3, four different examples of web pages from different cities across the U.S. were discussed. Each community used the Web in a different way, but all shared the common goal of using the Web for self-promotion. Looking at the sites in depth, we were able to see that all of them used the Web to help promote economic development.

Chapter 4 concerned the questionnaire that helped determine the content of a prototype web site. The goal of this site was to help in promoting economic development in an urban area like Omaha. After reviewing the results of the questionnaire, a number of conclusions were made regarding the content of the site. These conclusions were discussed in the summary of Chapter 4. In this chapter, the prototype web page is designed and evaluated. Part 2 of this chapter will describe the design of the individual pages, which together, make up the site. Part 3 of this chapter will contain the results from the evaluation of the site. For the review, 10 of the 24 individuals who returned questionnaires from the initial survey agreed to evaluate the prototype.

Part 2: Construction of the site

Before beginning the design of the web page, a fictional outlet for this information needed to be created. The result was the “Omaha Center for Economic Development.” This was chosen since, at this time, it is not clear whether or not an undertaking like this would be developed by the City of Omaha, Chamber of Commerce, by a local business, or by a combination of all of these.
Once the idea for an outlet was established, the next step was to take the suggestions made in chapter 4, and turn them into a usable prototype. The results of the survey indicated that a variety of geographic and economic data should be included. With that in mind, the prototype was developed with four main links: Economic Overview, Omaha Overview, Development Overview and the Economic Site Selector. “Economic Overview” displays basic economic characteristics for the region. “Omaha Overview” provides the basic, general information about Omaha, including a city map. The “Development Overview” provides geographic information related to development. The fourth section is called the “City of Omaha Economic Site Selector” and serves as the main feature of the site. The main page is shown in Figure 5.1.

![Image of main page for the prototype Web-based GIS site.](image-url)

**Figure 5.1** Main page for the prototype Web-based GIS site.
"Omaha Overview"

This section on the main page provides those who are not familiar with Omaha a brief overview of the community. In the prototype site, the users can find information detailing the city’s history, climate, population, culture and recreational activities. Also included in this section is a link to an interactive map of the city (Figure 5.2). Although not active in the prototype, if it were fully functional, users would be able to click on a section of the map and view a new map showing more detail, such as streets and street names. The map and information regarding Omaha are both important because they provide basic background information on the community.

Figure 5.2 Interactive City of Omaha map.
"Economic Overview"

The results of the questionnaire indicated that to help promote economic development of an urban area, a mix of economic information should be provided. To facilitate this, a variety of economic information has been included, all of which is presently available through the Greater Omaha Chamber of Commerce.

The "economic overview" is divided into four sections:

1. Business Indicators
2. Workforce Statistics
3. Tax Information
4. Income Distribution

The section "business indicators" contains summarized information regarding many of the key economic indicators for Omaha. Examples of these include: employment distribution, new construction (permits for both residential and commercial construction), and home sales. "Workforce statistics" contains information which describe Omaha's employment base, summarized by industry. "Tax information" provides a brief summary of the city sales tax as well as information regarding the State income tax rates. The section "Income distribution" summarizes the City of Omaha's median household effective buying income, also known as "disposable personal income" (DPI). This DPI is especially important to businesses who may be considering moving to Omaha. Before any business opens, they need to be sure that there will be a base of people who have money to spend on their product; or, have income for investment in developing products.

"Development Overview"

The title "Development Overview" was chosen because the goal of the page is to promote economic development. The development section included hyperlinks to the following information: Land Parcel Query, Zoning Summary, Transportation Information, and the Economic Site Selector (Figure 5.3). The example of a land parcel query function
was included to show how the City of Omaha could provide basic geographic information to the public. The user was informed that if the site actually was configured to access the City of Omaha’s database, they would be prompted to enter one of the following characteristics regarding a parcel of land: The owner’s name, the property address, or the Douglas County assigned land parcel identification number (PIN). The result of the query would give the user a number of different pieces of information: The owner’s name, address, legal description of the property (including lot number, block number and subdivision name), lot dimensions, assessed property value, as well as the zoning designation applied to the property.

Welcome to the Omaha Center for Economic Development

Geographic Information Database

Please select one of the following:

- City of Omaha Economic Site Selector
  - Land Parcel Query
- Current Development Summary
- Transportation Data
- City of Omaha Zoning Ordinance

Figure 5.3 Links available under “Development Overview.”

This type of information is valuable for a number of reasons. Often the party living on a parcel of land may not be the owner. By allowing easy access to this information on the Web, individuals who need to contact property owners can do so simply by providing
one of the characteristics listed previously. This type of information is also beneficial because of the inclusion of the zoning designation (Figure 5.4).

![Welcome to the Omaha Center for Economic Development](image)

**City of Omaha Zoning Ordinance**

Please make a selection:

- Review the full City of Omaha Zoning Ordinance
- Review a summary of a specific zoning classification

![Figure 5.4 Options available for obtaining zoning information.](image)

Zoning information should be included for a number of reasons. Two examples follow. First, a property owner may be considering building an addition to his or her home and before doing so, must determine what is allowed under their zoning designation. Second, if a land owner wishes to provide a service from their property, they must first determine if it would be allowed—a prime example of this would be a child care facility in the home. Of course, having a zoning designation listed but not knowing what it means would be useless. Therefore, a zoning summary is provided on the site as well. Since the actual City of Omaha Zoning Ordinance is over 200 pages long, the user is greeted with a message explaining that (since this is a prototype) the full ordinance is not available. However, the second choice offered to the user does provide them with a summary of a pre-selected zoning designation, in this case AG (agricultural).
Transportation information was included in the prototype because the issue of accessibility to an area is a very important factor to land developers, as well as industry. The link on this page provides the user with a summary of the transportation options available within the City of Omaha. These include a description of Omaha’s access to ground, rail, air, and water transportation.

![Sample map of residential housing starts, Feb. 1998.](image)

**Figure 5.5** Sample map of residential housing starts, Feb. 1998.

The “Current Development Summary” link takes the user to a page which offers two choices: Residential housing starts, February, 1998 and Commercial construction starts, February, 1998. Each of these links present the user with a semi-fictional map which depicts the locations within Omaha which have experienced growth during the month of February in 1998. The maps are shown in Figures 5.5 and 5.6.
While presented with these maps, the user is told that if this site was connected to the City of Omaha’s building permit database, they could click on one of the dots on the map, and attribute data of that site would be provided (address, builder, square footage, etc.). These two maps were included because, as discussed previously, the type and number of building permits issued are an excellent measure of economic development in a community.

**Figure 5.6** Sample map of commercial construction starts, Feb. 1998.

"City of Omaha Economic Site Selector"

The economic site selector was created to be the cornerstone of this site. In order to use the web effectively as a means to promote economic development, a considerable amount of information needs to be provided. The economic site selector was designed to
enable the user to easily define a group of parameters which would represent their ideal needs or wants. This type of utility was inspired by the site selector tool which was provided on the Web by the City of Ontario, California.

When the user links to the economic site selector, an interactive form appears (Figure 5.7).

<table>
<thead>
<tr>
<th>Does your search require?</th>
<th>Doesn’t matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you interested in an Enterprise zone?</td>
<td>Yes</td>
</tr>
<tr>
<td>Size in acres:</td>
<td>Minimum: Doesn’t matter</td>
</tr>
<tr>
<td>Utilities desired:</td>
<td>Full Utilities</td>
</tr>
<tr>
<td>Distance from Interstate:</td>
<td>Doesn’t matter</td>
</tr>
<tr>
<td>Distance from air transportation:</td>
<td>Doesn’t matter</td>
</tr>
<tr>
<td>Distance from rail or water transportation:</td>
<td>Doesn’t matter</td>
</tr>
<tr>
<td>Land Use Zoning:</td>
<td>AG</td>
</tr>
</tbody>
</table>

**Figure 5.7** Economic site selector menu.

At this point, the user has a number of choices to make regarding the desired outcome of the query. The economic site selector offers 7 different variables which the user will need to complete in order to define the query parameters. These variables are as follows:

1. Vacant land or vacant building (Does your search require?)
2. Are you interested in an Enterprise Zone?
3. Size in acres
4. Utilities required
5. Distance from Interstate
6. Distance from air transportation
7. Distance from rail or water
8. Land use zoning

Each of these variables are accompanied by “pop-up” buttons; interface control objects that allow the selection of an option from a predetermined list of choices. Once the user clicks on the button, a list of options are displayed and the user then makes a selection.

Under “Does your search require,” two choices are provided: vacant land or vacant building. This question helps to streamline the search for the user, based on their criteria and is especially important to the city because it has the opportunity to bring new life to facilities which have been vacated previously, therefore possibly leading to a downward development trend in the area. By reintroducing these properties to developers and industry, it may be the spark necessary to instigate development again in a blighted or forgotten area.

The second option asks whether or not the user is interested in locating within an Enterprise Zone. An enterprise zone is an area of a city which has been designated as being underdeveloped or blighted. If a business agrees to locate within one of these zones, they are usually eligible for a number of types of assistance. Some benefits are: reduced state or federal income taxes; reduced motor vehicle use, equipment, or inventory taxes; modification of the zoning code or the elimination of some other restrictions that discourage business.

The next two variables take into consideration the size and utility requirements of the parcel. With regard to the size requirements, the user is asked to fill out a minimum and a maximum value. The choices for these values range from 0-500 acres, and there is also a default or “doesn’t matter.” The “Utilities required” variable prompts the user to decide what types of utilities they would like the site to have. The choices are: full utilities, water, gas, electricity, storm and sanitary sewer.
The "distance from" variables all deal with the issue of accessibility to ground, air, rail and water transportation. The user is prompted to select one of the following values from the pop-up menu for their query: Less than 1 mile, within 5 miles, within 10 miles, and "doesn’t matter."

The final variable defines land use zoning designations. From this menu, the user will select one of the 25 zoning classifications available within the City of Omaha.

If the economic site selector was an actual working program, the user would then click on the "Locate my site" button at the bottom of the form, or they could click "Reset my choices" to clear their choices and re-enter them again. However, since this is a prototype, the user is given a link at the bottom of the page which informs them to "Click HERE to see the results of a sample query."

The results page provides the user with a large amount of information regarding their site (Figure 5.8). In the example that is given, the query returns a photograph of the site, the address, a comparison of the returned values versus those that were submitted initially by the user, as well as a link at the bottom of the page which displays a map of the property location (Figure 5.9). The economic site selector was designed to have a very simple and easy to use interface. At the same time, it also was designed as an outlet for providing significant types of development information. The important thing to remember here is that this tool is able to easily serve powerful data to groups of people. This is what makes the economic site selector so important as part of this site.

All of the information which was included in this site was influenced by the outcome of the questionnaire. The economic site selector was added at the discretion of the author, even though the survey indicated mixed reviews towards the idea. At this time, the construction, design and content of the prototype Web-based GIS is complete. It is now time to perform the evaluation.
Here is the site whose characteristics best meet your criteria:

1500 SOUTH RIVER BASIN ROAD, OMAHA, NE, 68146

<table>
<thead>
<tr>
<th>QUERY RESULTS</th>
<th>YOU REQUESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Property type: Vacant building</td>
<td>• Vacant building</td>
</tr>
<tr>
<td>• Size in acres: 375.51</td>
<td>• Min. &gt; 200, Max. &lt; 500</td>
</tr>
<tr>
<td>• Requires: No new utilities</td>
<td>• No new utilities</td>
</tr>
<tr>
<td>• Distance from Interstate: 1.5 mi.</td>
<td>• From Interstate: Within 5 miles</td>
</tr>
<tr>
<td>• Distance from Air: 6.7 miles</td>
<td>• Distance from Air: Doesn't matter</td>
</tr>
<tr>
<td>• Distance Rail/Water: .754 miles</td>
<td>• Distance Rail/Water: Doesn't matter</td>
</tr>
<tr>
<td>• Zoning: HI</td>
<td>• Zoning: HI</td>
</tr>
</tbody>
</table>

Figure 5.8 Results of a sample query.
Figure 5.9  Sample query site location map.
Part 3: Evaluation of the prototype Web-based GIS

The evaluation of the prototype took place in two separate phases. First, from the 24 individuals who returned a completed questionnaire, 10 were asked to participate in this evaluation part of the project. A number of requests were made by telephone to the various individuals from the Omaha area who participated in the survey; however the 10 individuals who ultimately completed the survey all worked for the City of Omaha. The 10 participants were gathered into a room which included myself as well as two computers with the prototype loaded onto each machine’s hard drive. In other words, the information was “local” and not on a network. An introductory period took place where each of the individuals were thanked for being a part of the project, both for completing the initial survey and then for participating in the evaluation. A talk was then given to the group about how the prototype was designed and created, and also, about the content which it included.

At this point, an evaluation sheet (Appendix 2) was distributed to each member of the group and they were asked to each take their time exploring the site, then to complete the evaluation. Time was not a factor for the group, as each person had time to go through the prototype for as long as they felt necessary to do so. The group was asked to evaluate the site on the following set of criteria: What do they think about the interface, the type of information made available, and the form in which it is made available. They were, of course, also encouraged to include any type of comments.

Evaluation Results

In general, the prototype was viewed very positively. The most common comment received was that the participants wished there would have been even more information provided. Here is a closer examination of the evaluation results, based on the criteria which was set.
What are your opinions about the interface?

• "The site has a well thought out and effective interface. It was easy to move around the homepage." (Source: Evaluation 3)

• "I thought the interface was nice. It was something that seemed 'natural.' It was easy to view the page." (Source: Evaluation 1)

• "Overall aesthetic layout is well done -- clean, simple and orderly, but could use a little pizzazz." (Source: Evaluation 2)

• "The interface was easy to use." (Source: Evaluation 4)

• "The interface was simple and not too 'busy'." (Source: Evaluation 6)

• "The interface to the site was very good. Having a limited number to links is always good because it makes things seem more organized. Logically, it makes sense to have it designed like this because the people who visit this site will seem less overwhelmed than they would by being bombarded with a bunch of links. Sometimes too much is too much." (Source: Evaluation 5)

• "Good. The interface was very good. I liked it a lot. It seemed to work great." (Source: Evaluation 10)

• "The 'look' of the site was great. I thought your interface was nice and simple. It was easy to use, even for someone like me who doesn't use the Internet that much." (Source: Evaluation 7)

• "It was easy to use. Nothing spectacular, but it doesn't have to be." (Source: Evaluation 8)

• "I liked your interface. The color choices were good and the layout was simple. It seemed to be well organized. I would have liked to see how some of the dead links would work." (Source: Evaluation 9)

After reviewing the evaluations, nearly all of the participants felt as if the interface was effective. When it was being constructed, every attempt was made to keep it simple and easy to use. By judging these responses, it would seem as if an actual page such as this may have a great deal of success by following a similar formula; Keep things simple and easy to use because not everyone is an Internet "expert" and novices seem less intimidated by something when it isn't as imposing.
What are your opinions about the information that is made available?

- "I like the site selector. It seems as if it would really work! It was easy to use, almost self-explanatory. I was really impressed. I can see how this would be eaten up by people." (Source: Evaluation 7)

- "The economic site selector would be a great addition. It seems as if the idea is simple enough, the only downside would be the time necessary to compile the information. It is something that I wish we had long ago. More pictures about the site would be good too. Who would maintain this? Residential housing starts and commercial starts. It might be hard to map these because there are so many of them, but I have seen it done by other cities. I think it would be a good idea. Something else that may be beneficial would be the number of lots platted per month. Developers and business groups find those numbers to be significant. Overall, I liked the information that was included. Of course, in your site was the real thing, then there would a lot more to do, but I understand that this is just an example. If funding was available, a lot more information could be shown and it would help out a lot of people." (Source: Evaluation 1)

- "The balance of information is good. One thing I would like to see is more information put on the Web by the City of Omaha. I helped provide the Master Plan information that the planning department has on the Web, but they don’t show the maps? What good is the master plan if the maps are not featured? The Internet would be a great way to distribute city documents, but only if all the graphical elements are included. I think that the business indicators were good. You probably could fine tune this information a bit. Economic information can be prickly. It would also be nice to tie some form of economic information into the property selector." (Source: Evaluation 6)

- "The development overview is very good. The site selector was neat. It is a no brainer. I have seen other cities do this, but I can’t remember who. It would work. How could it not? If gives a ton of information. I liked the maps showing housing and commercial info, although I don’t believe they are entirely accurate due to the sheer number of permits issued per month. It is a good idea though because once you see the permits as they are issued per area, you can really see where development is taking place. Do you really intend to put the entire zoning ordinance on line? I think a summary would be better, with perhaps a phone number to call for questions. Your information is very interesting to look through and I think others would find it to be the same. I think it would make people look at Omaha in a different light. There are a lot of things going on here. Good job." (Source: Evaluation 2)

- "This prototype web site includes many of the factors needed to forecast development in the metro area. More detailed information would be appreciated, but I understand the circumstances. Its framework is good, now it needs a commitment. It would be nice if Omaha possessed such a site for use by the public." (Source: Evaluation 9)

- "Your information is good, but it serves as just a base. Your ‘geo’ information was good, but the economic information was a bit thin. This would work though. Either the city or a private firm (depending on who maintains your site) should hire an economist to select the economic information for publishing." (Source: Evaluation 5)

- "I don’t think you could ever have enough information. I like the idea here and some of the information is good. To make your data more comprehensive, you should include some of the following:"
  - Types of industries & employment base
• Incentives for business development
• Per capita income levels
• Enterprise zone / Community Information
• Land use information, available industrial land
• Utility cost information
• Strength of financial community (i.e., # of banks and size of banks)
• Type and variety of insurance companies (Source: Evaluation 8)

• “Overall appropriate information.” (Source: Evaluation 4)
• “Very good content. Some suggestions however: Under transportation, you could also include traffic counts for some of the major intersections here in town. Regarding construction starts, it would be great to have links for each site to where a user could view the project--i.e., residential subdivision name, commercial project specifics--office, commercial space available. Overall, I liked it a lot. The economic site selector was good. I wish we had this stuff now.” (Source: Evaluation 10)
• “Really comprehensive and informative. I thought it was effective. I can imagine this (site selector) happening and it would be so wonderful. No longer would every department here be on different pages--we all could have access to the same shared data and, like you stated, this same information could be used to invite economic developers to Omaha.” (Source: Evaluation 5)

Reaction to the content was very positive. The main issue here was the amount of information being put on-line. Most of the reviewers felt as if more information should be made available and it should also be more comprehensive. The reviewers seemed very pleased with the content from an overall standpoint, especially with the site selector. This type of format should be effective if it were actually placed onto a functional web site. The demand for information appears to be strong, and the Web would be the perfect outlet.

**What are your opinions about the form in which this information is being made available?**

• “I like retrieving information off of the web. I download Arc datasets all of the time. The web is super easy, fast and it is just ‘right there.’ I think that the web should be used more often for providing data. I’ve done it, I’ve done things for other people and the web is easy. As it is anymore, everyone has web access too. I have it at work, at home and my children have it at school. I think your page should have an area where you can download datasets regarding economics and demographics in Omaha.” (Source: Evaluation 8)
• “It would be cool to have something like the ‘Omaha Development Center.’ The site selector is awesome, it has such great potential. Something like that could be modified and tweaked as so to shell out any type of information you would want. If you are
running Oracle I don’t think it would be a problem. I believe that if Omaha would create something like the site selector, we would see an increase in development here. It is just too easy for people not to use.” (Source: Evaluation 9)

• “At first I was rather cautious about putting things on the Internet, because it seems so jumbled up. It seemed difficult to me—like ‘how can I get this info from A to B and have the other guy understand it?’ I always felt like in order for someone to understand a document, you needed to mail it—you had to mail a copy of the original. I was totally backwards. I use Microsoft Exchange and I can send Acrobat files between my office and MUD with no problem. We now link our Acrobat files on our department webpage to that we don’t have to spend that extra time e-mailing things now. It is all out there to get on our site. I think that the Internet is great for passing out data.” (Source: Evaluation 10)

• “The way the site selector worked was super. I think that something like this on the Internet would be very beneficial to Omaha. It is so easy, it would be right on the net.” (Source: Evaluation 4)

• “I believe that in some cases, paper documents should still exist. I do however think that the Internet will continue to advance and someday, perhaps it will be the accepted way to hand out information and paper will be secondary. I think you have the right idea.” (Source: Evaluation 6)

• “I like the idea of using the Internet for communication. Distributing things to others here is now much easier. If your site was used for a different purpose, like a bulletin board, your idea would work out well. It is a simple concept of transferring information that works. The Internet has changed the way individuals can do things tremendously.” (Source: Evaluation 7)

• “The Internet is the wave of the future here. Time will prove that and you will see that a lot of the things we scheduled meetings for will someday take place on your monitor. I think that what you have put together is a perfect example of what we could be doing. This is possible now!” (Source: Evaluation 1)

• “The site is super. It was intriguing to see all of this on one machine. I thought it was a lot of information, but what it people from all over could see it. I think it would be a hit with people from out of town.” (Source: Evaluation 5)

• “You could use your site to link with other places or cities in Nebraska. You could turn this into a ‘site server.’ In addition to talking about Omaha, you could use the Internet to create a joint project between Omaha and the State of Nebraska.” (Source: Evaluation 2)

• “Overall I liked how you used the Internet as a data warehouse. I think it would work out really well. I think that the number of people who use the Web daily is rising faster than those that use a phone. In all seriousness, I believe that the Web would work fantastic for the purpose of economic development.” (Source: Evaluation 3)

Once again there seemed to be general consensus with regard to using the Web as a means to distribute information. The individuals who took part in this evaluation all contributed thoughts and ideas that were very similar to one another. The Web seems to be
an effective means by which to promote economic development of an urban area. In the following chapter, the summary of this thesis will be presented.

CHAPTER 6
CONCLUSIONS

Overview of Thesis

This work was comprised of six chapters. In Chapter 1, an initial overview of this thesis was given. The overview contained a number of significant items including the purpose of the thesis, the statement of problem, and also the methodology to be used. Once again, the purpose of this thesis was to design a prototype Web-based GIS that would provide specific geographic information that may be used to promote economic development of an urban area. Chapter 2 contained definitions and detailed discussions of the Internet, World Wide Web, Geographic Information Systems, the economic development of an urban area as well as the concept of a Web-based GIS for economic development. Chapter 3 examined how cities use the Web for the dissemination of information as well as to promote economic development. In this chapter, four different web sites from different cities in the United States were discussed (The City of York, Nebraska, The City of Ontario, California, Cabarrus County, North Carolina and The City of Omaha, Nebraska). Chapter 4 contained information regarding the analysis of a questionnaire which was used to help in creating a prototype Web-based GIS. The results of the survey were used for the design and construction of the prototype web page to promote economic development. The content and purpose of the site were discussed in the first part of Chapter 5. The second section of chapter 5 covered the steps taken to perform the final evaluation of the site. The methods used to conduct the evaluation are discussed, as are the interpretations of the results. In this final chapter, the conclusions of this thesis are presented.
Major Findings of Research

While performing research for this project, a number of different unexpected findings came to light. The best example of this may be in comparing individual responses from the initial survey and the responses given on the prototype evaluation form. The contrast in attitudes between the two surveys was quite different. After the initial questionnaire was collected, most of the responses were found to be in the lower “strongly agree” to “agree” categories. Generally speaking however, after many of these same individuals had an opportunity to review the prototype Web-based GIS, their attitude had changed considerably. Responses to the prototype evaluation were very positive. After having hands-on experience with the prototype, people seemed to have a change of heart. Prior to seeing the prototype, many individuals seemed apprehensive or cautious, but after performing the evaluation, the underlying concept of this prototype was strongly supported, often with suggestions for specific additions.

After receiving and analyzing the results from the initial questionnaire, I felt that I had a fairly good idea of what individuals would want to see on this prototype page. However, as construction the site began, this researcher felt that the questionnaire was somewhat incomplete and lacking detail. The site selection tool came to mind in the process of designing the web page. I felt it would be better to have a number of strong and effective tools, rather than just a collection of basic items. Therefore, the construction of this site was completed using a very simple interface, but one that included links to good, solid information to hopefully be used by those who are interested in Omaha as a geographic site/area.

Future Work

With such a seemingly high probability of success, what would it take to turn this prototype into a reality? To determine this, there are a number of factors to consider. As a
result of the questionnaire responses, one could safely assume that many would like to see a project like this materialize. However, the institutions responsible for providing the data or creating the material may not be responsive, simply due to cost and time constraints. Unless the groundwork for a project like this was started years ago with a set of long term goals, it would take cities years to first organize and prepare their data for inclusion on a web site. Other cities, like some of those discussed in Chapter 3, have shown that these ideas can become a reality.

While reviewing the results of the evaluations of the prototype web site, it was clear that the participants held strong beliefs towards certain components. Most individuals felt the interface to the prototype was both clear and concise, and that the content included was good. Finally, there was a general consensus among the respondents that the Web would be an effective means to promote economic development of an urban area.

As stated previously, resources are the main problem associated with creating a Web-based GIS. In order for a community to put their information on-line, a great deal of planning is necessary. Some key decisions at this point would be: the design of the software, the evaluation of hardware needed, and the collection of manpower that will be responsible for creating, updating and maintaining the site. In some cases, smaller communities may not have available resources to operate a full-featured GIS program on-line. Therefore, they might deem this project as being unattainable. Such would be an incorrect judgement. As seen in the examples from the different communities examined, there are many different extents to which information can be provided. It should be remembered, however, that providing some information is better than providing no information at all. Larger cities may feel slightly overwhelmed by the prospect of developing an on-line GIS simply because of the large amount of data that they would be dealing with. If the community has the foresight to look beyond just tomorrow, and see further into the future, they would understand the benefits of adapting to a Web-based GIS.
By developing an on-line package like the one here, these larger communities
would then be more efficient at providing geographic information to a larger group of
people. Also, by creating this site and putting the information on-line, a city would be able
to greatly simplify the process by which information requests by the public are fulfilled.
Economic information would be made more easily accessible as well. Positive public
opinion is one major benefit of providing this information. To the general public, the
government involved would appear to be very efficient and visionary. This could very
realistically increase the citizen’s confidence in the city administration.

What is the best way to provide information through the Web? The key is through
interaction. Although the prototype Web-based GIS was relatively small and somewhat
limited in its ability to perform operations, the general concept is a solid and attainable one.
By creating a site on the Web, individuals are able to incorporate text, graphics, sounds,
and animations into their pages, therefore allowing any city or community the opportunity
to design and customize almost any interface with which they would like to greet their Web
visitors. The potential for information distribution through the Web is seemingly
unlimited.

The introduction of new and more advanced GIS software such as ArcView, is
another reason an interactive web site is now the best way to provide information. These
new packages allow the user more power and freedom over the currently existing set of
functions. A very good example of how ArcView could be used on the Web is exemplified
with ESRI’s ArcView Internet Map Server. The ArcView Internet Map Server is an
extension to ArcView GIS Version 3.0 that makes it easy for cities to publish ArcView GIS
maps on the Web. The IMS extension provides a ready-made, generic front end called
MapCafe, a Java applet with which individuals can view, browse, explore, and query
interactive maps on the Web.¹
Another option, perhaps for larger cities, would be the more powerful MapObjects IMS, also from ESRI. With MapObjects IMS, cities can create a Web-based map or GIS application with MapObjects, a collection of mapping and GIS tools. This package makes use of ESRI shapefiles as well as ARC/INFO coverages.\(^2\)

With these new software packages, a number of more sophisticated queries can be undertaken. This benefits the user by improving database searches, allowing the web site to return the most minute, critical details regarding, for example, a prime land parcel in a developing area of the city. The technology available for creating an interactive web site continues to push the technical envelope even further than we have seen before.

Finally, a basic question needs to be asked. Was this thesis successful in creating: "A prototype Web-based GIS that would provide specific geographic information that may be used to promote economic development of an urban area?" If the definition for a Web-based GIS is reviewed, it reads as follows: "A set of on-line geographic physical and socio-economic data provided in some organized manner to the end-user on the Web via an Internet browser, for inspection and analysis, which allows for the input, output and manipulation of geographic data." Upon reflection, the methods used to create the prototype, and the uses of the finished product indicate that the answer is yes. The prototype Web-based GIS served geographic and economic data through an Internet web browser and the material was organized in a readable manner. Through the web site, the data were available for inspection and analysis. The site selector allowed the user to select specific criteria for desired database queries, and through the results, all were able to analyze the query and potentially come to a conclusion based on the parameters which they had set.

As stated previously, a Web-based GIS is not the same as a traditional GIS, but it does share many of the same characteristics, and when used properly, it can be a very
effective and successful tool to aid in promoting the economic development of an urban area.

Mr. John Doe
Omaha Economic Foundation
123 Main St.
Omaha, NE 12345

January 30, 1998

Dear ________,

My name is Cliff Todd and I am a Graduate Student in the Department of Geography and Geology at the University of Nebraska at Omaha. The intent of this letter to you is to ask your help in completing a short survey which forms a part of my research for my thesis. The title of my thesis is “Promoting Economic Development of an Urban Area using a Web-based Geographic Information System.”

The thesis has a number of objectives. First, I want to discuss and introduce the concept of both the Internet as well as a Geographic Information System (GIS), and then most importantly, discuss the importance of Internet/GIS integration. I then would like to show how different cities across the U.S., as well as locally have been able to create Internet sites which present geographic and economic information in an easy to interpret manner. Finally, I would like to present a prototype Web-based GIS (based on your and others input), showing that by providing information on the World Wide Web, the Internet and GIS can serve as the ideal set of tools which can be used to promote economic development of an urban area. A complete review of my initial thesis proposal can be found at the following Internet address:

http://maps.unomaha.edu/Peterson/CliffTodd/Presentation/Proposal

I would greatly appreciate it if you would participate in this survey as it will be used to complete research materials used for my Masters thesis. I have assigned your survey a number (xxxx) and only I will know who you are, therefore, your responses to my survey will not be attributed directly to you. I sincerely appreciate your time and I have enclosed a survey form, instructions as well as a self addressed stamped, or return envelope. If you would have any questions or comments, please feel free to contact myself or my thesis advisor, Dr. Michael P. Peterson at 554-4805 or via his e-mail at geolib@cwis.unomaha.edu.

Thank you and please complete your survey no later than February 11, 1998.

Sincerely,

Cliff Todd
c todd@cwis.unomaha.edu
SURVEY INSTRUCTIONS:

When answering the survey, please indicate your response by circling the appropriate letter which best describes your opinion:

1 - Strongly Agree
2 - Agree
3 - No Opinion
4 - Disagree
5 - Strongly Disagree

IMPORTANT!
Please note: As you read my survey, please keep in mind that there is a single theme that is consistent for all of the questions: These questions are asked with the premise of providing specific information to the public through an Internet web site.

Section One:
MAKING INFORMATION AVAILABLE TO THE PUBLIC THROUGH THE INTERNET

1. Information showing how a parcel of land is zoned within an urban area should be made available to those who request it.

   Strongly Agree 1 2 3 4 5 Strongly Disagree

2. The assessed value for tax purposes for all land parcels within an urban area should be made available.

   Strongly Agree 1 2 3 4 5 Strongly Disagree

3. In an urban area, information describing the legal description of a land parcel (such as subdivision name, address, lot number, lot dimensions and owner) should be made available.

   Strongly Agree 1 2 3 4 5 Strongly Disagree

4. Relevant information that would list land parcels for sale and/or which are available for development within an urban area, should be made available.
5. In an urban area, crime statistics throughout the city should be made available to anyone requesting them through the Internet.

6. On an Internet website, information should be made available in an easy to understand graphical form such as maps as opposed to numerical tables.

7. All geographic information in the public record for an urban area (such as maps as well as the other examples listed above) should be made available for review.

8. In an urban area, the local government should decide on what information is made available to the public via Internet access.

9. All documents and materials from public meetings, such as the urban area’s city council or planning board, should be made available to those who request them.

10. Public information pertaining to an urban area should be made available for a fee, to those requesting it who are not taxpayers of the urban area in question.

Section Two:
PROMOTING ECONOMIC DEVELOPMENT OF AN URBAN AREA

11. In order to promote economic development of an urban area, information describing local taxes (such as property tax), should be made available on-line.
12. To assist in promoting economic development, an urban area should make available information regarding different utility costs (such as gas, water and electric) to those who request them.

13. A description of the average local wage rates in an urban area should be made available in order to promote economic development.

14. In order to promote economic development of an urban area, a summary of construction costs should be made available to anyone requesting them through the Internet.

15. In order to promote economic development of an urban area, the local government should make available for review, a copy (or summary) of the city ordinance to anyone requesting it through the Internet.

16. In order to promote economic development of an urban area, the local government should make available a map showing residential growth areas to anyone requesting them through the Internet.

17. In order to promote economic development of an urban area, the local government should make available a map showing the city’s future projected growth areas to anyone requesting them via the Internet.

18. The local government of an urban area should make available a summary of zoning regulations to those who request them.
19. The local government should provide information describing the median household size as well as the median income, in order to assist in promoting economic development of an urban area.

   Strongly Agree  1  2  3  4  5   Strongly Disagree

20. As a tool to assist in promoting economic development of an urban area, the local government should create and maintain an Internet site which would allow the user to create interactive and dynamic maps of the city, based on the criteria determined by the user and/or determined by the information provided by the local government, or by both.

   Strongly Agree  1  2  3  4  5   Strongly Disagree

Thank you for taking the time to complete my survey. Please feel free to add any comments you would like to below, or attach notes as necessary.

Again, thank you.

COMMENTS:

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________
APPENDIX 2

PROTOTYPE WEB SITE EVALUATION

The prototype presented here is titled "The Omaha Center for Economic Development."

This site is the result of the input received from the questionnaire you had previously filled out. The page contains information which was suggested by yourself and others, as well as a choice of information included at my own discretion.

Since this is a prototype, some of the links and tools which are included are not functional—the intent of the information on this page is to ask your opinions about the interface (is it aesthetic and/or functional?), the type of information that is made available, and the form in which it is made available.

The overall intent of a page such as this would be to promote economic development.

Thank you and please include any comments below:

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REFERENCES


City of Omaha, Nebraska, http://www.ci.omaha.ne.us.


------------. *Site Selector*, http://158.61.82.251.

City of York, Nebraska, http://www.ci.york.ne.us.


