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cartographic perspectives

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in this issue

from the president

At the beginning of 2000 Anno Domini (I am trying to avoid the M-word) we in NACIS have much to celebrate. The information age has ushered in what can best be described as a new golden era of cartography while NACIS flourishes and turns twenty years old. That our society is so youthful is a little surprising, to me, since it has been a constant and influential presence throughout my entire career.

I first heard about NACIS back in 1986 when I got a call from Greg Chu, a fellow alumnus from the University of Hawaii, Department of Geography. With the eagerness of a friend recommending a must-read book or a hot investment tip, Greg urged me to attend the upcoming NACIS annual meeting in Philadelphia. He described NACIS as "a new mapping society with friendly members who hail from a wide variety of backgrounds," or words to that effect. At the time, I was the Cartographic

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www.nacis.org

cartographic perspectives

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about the cover

The cover design was created by Steven R. Holloway. Steven is with the Department of Geography at the University of Montana in Missoula, Montana.

The cover map is the third in a series of four reflecting on the juncture of the Missouri and Marias River landscape near present day Loma, Montana. Scale is approx 1:46,200, with a west orientation. The photo, looking east from near the center of the map series, was taken on the summer solstice 1999. The view is typical of the flat, dryland farming landscape of central Montana.

Laboratory Manager at the University of Utah, overdue for a family visit back east, and so I followed Greg's advice and attended my first NACIS meeting.

As it turns out, the Philadelphia meeting portended a sea change in my career. I presented a paper about what is now quaintly called "traditional" shaded relief production; the virtues of Badger versus Paasche airbrushes, using tortillions, and a revolutionary new drafting film with a rice starch emulsion that could accept graphite with subtlety and satiny smoothness. This was exciting stuff for me. However, in the same session as myself, Ron Bolton presented a paper about NOAA's successful adoption of computer-assisted shaded relief production. Not surprisingly, I was alarmed by what I heard—the digital barbarians were about to sack traditional cartography of its artistic heritage! My reaction was, admittedly, a tad overwrought, but it typifies what everyone experiences when familiar habits are challenged, even when the new ideas are clearly superior. Fortunately, we adapt, and thanks in part to what I learned at Philadelphia, I am now an enthusiastic participant in today's digital terrain visualization renaissance. There is an unused roll of Dupont Cronaflex UC-4 drafting film in my basement if anyone wants it.

Considering the great changes that have affected cartography and its related fields since the inception of NACIS two decades ago, it is remarkable how our society has remained an anchor of relative stability. Other organizations should be so fortunate. While there have been many changes to NACIS over the years, they have tended to be appropriate in scope and implemented in a sustainable manner. Much of NACIS's success in dealing with change can be attributed to our long-serving Executive Officers—Sona Andrews, Chris Baruth, and Susan Peschel (informally known as "the Home Office")—who have provided much needed continuity as elected board members and officers, such as myself, come and go. We owe each of them a debt of gratitude and sincerest hopes that they continue to serve.

The following summarizes recent developments that have shaped NACIS:

Cartographic Perspectives

I'll start with the journal you are reading now, which, you may have noticed, is a little thicker than issues in the past. This is to accommodate the new topics that are influencing our profession: during the past two years sections on cartographic techniques and an essay were added, and, most recently, an online mapping section has been included, edited by NACIS Vice President, Jeremy Crampton. The net result is more pages, which has necessitated the switch from saddle stitch to perfect binding, hence the flat spine on this issue. This not only gives *Cartographic Perspectives* (*CP*) a more refined and substantial appearance, but it makes specific issues identifiable when shelved. Starting this year, one of *CP*'s triannual issues will be published in full color—a logical addition considering our business.

Before moving on I want to acknowledge the many volunteers that make this journal a reality. Mike Peterson particularly deserves our thanks for helping to guide the development of *CP* since 1991, serving as Editor since 1997, and, for graciously agreeing to serve as Editor for yet another year. Mike is assisted by a competent team that includes: a guest editor (following in the footsteps of Pat Gilmartin and Trudy Suchan, Mark Monmonier will be relieving him for one issue this year);

Assistant Editor, Jim Anderson; four section editors; and, the fourteen people who comprise the Editorial Board. Our thanks go out to all of you. Steve Holloway has contributed the third of his series of four custom-designed covers exploring the concept of land tenure / stewardship through maps. Expect to see similar themes, from Steve and others, adorning future covers of *CP*. Finally, and most importantly, I want to express our appreciation to Jim Anderson and Louis Cross at Florida State University for producing and printing *CP*—issue after issue. Like the steadfast presence of the "Home Office," the journeyman's expertise that Jim and Lou bring to publishing *CP* is a key component to NACIS's success.

Awards

The character of NACIS can be gauged by the contributions and achievements of every member. At last year's annual meeting at Williamsburg awards were presented to four noteworthy individuals:

Ron Bolton, who retired last year from NOAA, received the "NACIS Service Award" for his ongoing contributions to NACIS. Ron was one of the earliest members of NACIS, serving as Executive Director and as President twice (his second term was due to most unusual circumstances, ask him about it sometime), and he has had the distinction of presenting 21 papers at 18 consecutive NACIS meetings—society records that may never be broken! Ron, we wish you well in retirement and hope to see you at many more NACIS meetings to come.

Adele Haft, from Hunter College, The City University of New York, received the first-ever "*Cartographic Perspectives* Award" for her article "The Poet and the Map: (Di)versifying the Teaching of Geography," which appeared in *CP 33*, Spring 1999. The $500 *CP* Award, presented annually for the best article in *CP*, was voted on by the *CP* Editorial Board. Congratulations Adele!

In the 1998-1999 NACIS Student Web Map Contest, Jacqueline Shinker, University of Oregon, and, Nathaniel Vaughn Kelso, Humboldt State University, each won $500 first place awards for their entries in Animation and Interactive Mapping categories, respectively. If you didn't see the "live" demos of the winning websites at the Williamsburg meeting, the url's will be posted on the NACIS website. Jacqueline and Nathaniel's work in this pioneering medium is quite exceptional, which leads me to the next subject, www.nacis.org.

Website

Today, the benefits of NACIS membership are manifested primarily through traditional means; attending the annual meeting and by receiving issues of *CP*. In order for NACIS to touch our professional lives on a more continual basis, we are looking beyond the "bricks and mortar" concept of a professional society and exploring ways to add value to the NACIS website. Thanks to the efforts of Jeremy Crampton, who serves as the NACIS Webmaster, Chris Baruth, and Mark Harrower, new content has been added to the site. Perhaps the most useful item is the membership list (http://leardo.lib.uwm.edu/nacis/memrept.html), which is complete with names, titles, street addressees, telephone and fax numbers, and email addressees—a kind of online Rollodex for NACIS members only. The *Cartographic Perspectives* section (www.nacis.org/cp.html) has been expanded to include an index of issues, abstracts, and links to selected articles. Finally, the aforementioned Student Web Map Contest (www.geog.psu.edu/~harrower/NACIS/intro.html) will enter its second year under the direction of Charlie Frye, with Mark Harrower and Trudy Suchan serving as judges again. Students can enter the contest at any time by simply sending url's by email. The contest is designed to promote student design and technical excellence in this dynamic new mapping medium, while at the same time introducing tomorrow's cartographers to NACIS.

Membership

The results of last year's membership drive are encouraging. Individual and student membership jumped 19 percent from 292 to 347 between 1997 and 1999. Moreover, the Williamsburg meeting set new participation records with 50 papers, roundtables, and workshops offered, and, 170 registered attendees, 70 of whom were first timers! At Williamsburg, when I wasn't coaxing laptop projectors to work, I informally polled the new attendees about how they became acquainted with NACIS. Most, but not all, said that they learned about the society through word of mouth, which helps to explain why NACIS is such a congenial organization—our friends and colleagues come to the meetings. Most heartening of all, the diversity of mapping interests represented at Williamsburg was broader than ever. Many members have contributed to bolstering NACIS's membership, apparently on a person to person basis, and deserve acknowledgement for your efforts. I would particularly like to thank my predecessor, Cindy Brewer, who has been an effective advocate for increasing the society's membership for many years.

Knoxville Meeting

This year we can look forward to the next annual meeting in Knoxville, Tennessee. Jeremy Crampton will be serving as the program chair (in addition to his many other NACIS duties). He will be assisted by Will Fontanez and Jim Minton, from The University of Tennessee, Knoxville, who are on the local arrangements committee and very keen to present their hometown to the entirety of NACIS. Adding to the excitement, since this year will be the twentieth anniversary of NACIS (or N2X, get it?), we are planning to commemorate the occasion with some kind of gala event. Board member, Donna Genzmer Schenstrom, is open to your suggestions and will be proposing ideas at the Spring Board meeting in Chicago this April. Whatever we decide to do, all indications point toward another memorable NACIS gathering, so please mark your calendars for October 11-14 in Knoxville!

I will conclude this message, which has grown lengthier than I intended, by simply observing that Greg Chu's description of NACIS fourteen years ago as "a new mapping society with friendly members who hail from a wide variety of backgrounds," still applies.

Tom Patterson
President, NACIS

Maps on Stone: The Web and Ethics in Cartography

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Cartographers have struggled with a variety of ethical questions that relate both to how maps should properly convey information and the role of maps in society at large. Monmonier questions the ethics of authoring single, highly authored interpretations of reality. Wood points to the close relationship between cartography and government. A number of ethical questions also surround maps and the Internet. The World Wide Web has emerged as an important new medium for cartography. It is estimated that over 50 million maps are distributed via the web on a daily basis. In the transition to a new medium, ethical questions emerge about the role of cartographers as purveyors of information about the world, and the ethicacy of choosing a medium that limits access to maps.

INTRODUCTION

Ethics are the moral principles, based on social values, that define a code of right and wrong or good and bad. Some ethical codes are set in law but most are simply unwritten rules. Acceptance of a common ethic forms the basis of society. The ethical codes may be set in place by society at large or by any particular sub-group of society. The medical profession, for example, is guided by implicit and explicit ethical codes that have a large influence on how doctors provide medical care to patients.

Cartography is also guided by a set of ethical considerations. For example, cartographers value accuracy and communication. It would be unethical, for example, for a cartographer to intentionally falsify a map, as was the case in some of the former communist countries of Eastern Europe. It would be equally unethical to deliberately create a map that purposely did not communicate information to a potential map user. A host of ethical considerations underlie the entire decision-making process in cartography.

The role of cartographers as neutral "presenters of information" has been brought into question in recent years. In The Power of Maps, Wood (1992, 43) argues that maps are an instrument of the nation-state to wage war, to assess taxes, and to exploit strategic resources. The nation-state is mostly interested in stability and longevity. To this end, cartography is "primarily a form of political discourse concerned with the acquisition and maintenance of power" (Wood 1992, 43).

McHaffie, Andrews and Dobson and two anonymous employees of the US federal government (1990) identify personal and institutional vigilance in product quality assurance, map plagiarism through violation of copyright law, and conflicts of interests as important ethical issues. They question the nature and validity of cartography's claim to truth ("accuracy"), and assert that cartographic ethics cannot be extricated from the values of the larger society that commissions the production of cartographic information.

Monmonier (1991) questions the ethics of the "Single Map Solution." He argues that any single map is a highly selective, authored view reflecting map scale, geographic scope, feature content and data classification. He suggests that the skeptical map viewer should question whether a) an ulterior motive led to a biased view of reality favoring the author's biases, and / or b) whether a lazy map author failed to explore designs offering a more coherent or complete picture of reality. Technology, on the one hand, has aggravated the problem of the one map solution by placing powerful mapping software at the disposal of amateurs. But, he argues, technology can foster greater openness and a more complete understanding of maps and their meaning, and thereby provide a more ethical approach to cartographic analysis and communication. He goes on to present six strategies for a more open and overtly critical cartography in which one-map solutions are both rare and suspect.

Certainly, the major development in cartography in the 1990s has been the dramatic increase in the use of the Internet for distributing maps. Having its beginnings as ARPANET in 1969, the Internet now consists of several data communications protocols including e-mail and the file-transfer protocol (FTP). The dramatic increase in the use of the Internet during this decade can be attributed to the World Wide Web (Crampton 1995). The Web is now a major communications medium. In the process, it has also become the primary means of map distribution (Peterson 1999). The use of the web for map distribution and map use raises a number of ethical questions. First, we examine the growth and usage of this new medium.

THE WEB

Conceived at the European Particle Physics Laboratory (CERN) in Switzerland, the WWW introduced the principle of "universal readership," a concept that networked information should be accessible from any type of computer in any country with a single program. A prototype of the new protocol was finished in 1991. The first widely available browser, Mosaic, was introduced by the National Center for Supercomputer Applications (NCSA) in 1993. Netscape, a commercial successor to Mosaic, was introduced at the end of 1994.

The web has grown rapidly. In June of 1993 there were only 130 web servers. By mid-1995 there were 23,500 web servers and this had grown to 230,000 by 1996 and 2.4 million by 1998. The web now dominates the Internet. By 1999, the web generated 68% of all Internet traffic while e-mail and FTP each had about 11% (www.cyberatlas.com). Estimates of Internet use in the United States are fairly consistent at about 30% of the population (the US ranks fifth in the world behind Iceland, Finland, Sweden and Norway).

Once primarily used by the upper-middle class and the well educated, the Internet has become more mainstream. A MediaMatrix.com report found that 51 percent of those planning to get Internet access are over the age of 35. Almost half (49 percent) of the group have only a high school education or less. More than half of those planning to go online (58 %) make less than $50,000 a year.

Web users in the United States are also divided relatively equally by sex. 52% of web users are male and 48% are female (the actual percentage of male and female is 52% female and 48% male). In terms of age, web usage remains high until about the age of 55. Only 6% of 55-64 year old people had accessed the web in the past 30 days. This is compared with 26% in the 25-34 year old category and 28% in the 35-44 age group (Thompson 1999b).

The number of Internet users around the world is growing quickly. The Computer Industry Almanac has reported that by the year 2000, 327 million people around the world will have Internet access. This is up from 61 million in 1996 and 148 million in 1998. Estimates for 2005 are 720 million. The top 15 countries will account for nearly 82% of worldwide Internet users (including business, educational, and home Internet users). By the year 2000 there will be 25 countries where over 10% of the population will be regular users of the Internet (Cyberatlas 1999).

Maps represent a major component of Internet. In 1997, computers at the commercial MapQuest.com site were able to generate 1000 maps a minute. By 1999, MapQuest responded to an average of about 2,500 user-defined maps a minute. An average of over five million, user-specified maps were distributed by MapQuest on daily basis during 1999.

The World Wide Web (WWW) has become a major communications medium. In the process, it has also become the primary means of map distribution. On a daily basis, more maps are distributed through the web than are printed on paper. More importantly the web has changed map user expectations. Users expect interactive maps. It is clear that we need to better understand how this new medium can be used for cartography.

ETHICS AND THE WEB

The introduction of the web has fostered a new set of ethical questions. McGranaghan (1999, p. 3) argues that “anyone with a modicum of technical savvy can ‘publish’ any content they wish on the internet, without the editorial and market constraints which ostensibly encourage accurate, well-crafted content in traditional media.” He goes on to question whether we can place any trust in the maps that are available through the web. However, he admits that the initial trust in maps based on necessity and the leap of faith guided by critical assessment is many times all we have to establish trust in any map.

Other ethical problems are associated with the distribution of maps through the Internet. Computer monitors can be set to have different display characteristics, which means that maps will not be displayed at the same size. It is somewhat like printing a series of maps on paper and then having each map change in size after it has been printed. The representative fraction (e.g. 1:24,000) and verbal scales (e.g., 1 in:10 miles; 1 cm: 10 KM) are rendered meaningless. Only the bar scale remains a valid way of expressing map scale. Is it ethical to print maps when the size of that map cannot be controlled? Colors also appear differently on different monitors, raising similar ethical questions.

These problems are not unique to cartography. Online stores, for example, will certainly want a system that shows the colors of its products correctly, such as clothes, so that customers know what they are ordering. Some monitors already incorporate color correction software. Depicting the size of objects correctly will be another concern in some parts of the commercial sector. Market forces will demand better standards for the display of their products, which, in turn, will benefit the display of maps.

While there are many problems with the distribution of maps through the web, the most troubling ethical question that it raises concerns its status as a medium. For, if the web is regarded as a significant medium that conveys information to large groups of people, where does this place other mediums, like paper? For example, most would agree that it is unethical to put maps on stone because these maps cannot be easily duplicated or transported and only a few people would have the opportunity to view them. It would be unethical for cartographers to use stone as a medium because this would limit access to the information presented in the maps.

The same, of course, can be said for maps on paper. They also can not be as easily duplicated or transported as maps through the Internet. Is it, therefore, unethical to print maps on paper? Why would cartographers want to intentionally limit access to their products by using a medium that has such a relatively small potential for readership compared with distributing maps through the web? Is it that cartographers only want a few, select people to be able to view their products or are economic considerations the overriding concern? It would seem that printing maps on paper can only be justified if we have the intention of limiting their distribution. If limiting access to information is unethical, then so is the printing of maps on paper.

Economic considerations are, of course, important. Cartographers must earn a living and paper is a tangible medium that can be exchanged for money. Maps are printed at a larger size and a finer resolution partly because they cannot be easily duplicated. The paper medium forces the map user to pay. But, maps and the information they convey should be something more than an economic commodity. They are like a window to the world. They present information that we all need to navigate and understand world distributions. Maps can not be left in the hands of the few.

CONCLUSION

Maps are an important source of information and the cartographic process by necessity guided by a variety of ethical considerations. An important consideration is which medium should be used to distribute maps. In a few short years, the World Wide Web has become a major medium for the distribution of all sorts of information, including maps. Hundreds of millions of people now access the web to access information. More maps are now distributed via the Internet than are printed on paper.

Cartography is now faced with a major ethical question: Continue to distribute limited quantities of maps on paper or provide maps through the Internet to a much wider audience. The information that is presented on maps is seen here to be crucial to gain an understanding of the world. It would, therefore, be unethical to limit access to this information, and equally unethical to continue to print maps on paper.

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Maps and Political Power: A Cultural Interpretation of the Maps in *The Gazetteer of Jiankang Prefecture*

Historians of cartography have recently expressed a greater interest in the relationship between maps and culture and society. This paper examines how political power is reflected in the maps in a Chinese gazetteer from 1261, *The Gazetteer of Jiankang Prefecture (Jiankang zhi)*. It shows how political power influenced the production process of the gazetteer and how this power is reflected in the selection of maps and images. Political power controlled the entire production process of the gazetteer and its maps. According to the local governor's instructions, Zhou Yinghe, the major author of the gazetteer, proposed four principles on how to compile the gazetteer. These principles clearly reveal control by the government in the compiling process. The emperor's power was evidently emphasized in these maps through map selection, cartographic design, and symbolization. This paper supports the general notion that maps are not only geographical representations of the spatial world but can also be viewed as cultural images that reflect the societies in which they are produced.

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INTRODUCTION

Historians of cartography have recently been interested in the relationship between maps and culture and society. As Rundstrom comments: "The study of maps in their cultural milieu has interested researchers in several disciplines, including geography, but this approach was not widely accepted by cultural geographers until the 1970s, and historians of cartography began to see maps explicitly as cultural artifacts only recently" (Rundstrom 1990, 155). Lewis has also pointed out that the examination of the roles of maps within societies and the values placed on them by societies is a recent growth of research interest (Lewis 1993, 52). A number of studies have been done to interpret maps under different cultural traditions. Among them the most comprehensive work is a multiple volume project, *The History of Cartography* edited by Harley and Woodward (Aziz 1975; Lewis 1980, 1986, and 1998; Lanman 1981; Harley 1983, 1989, 1990, and 1991; Harley and Woodward 1987, 1992, and 1994; Gilmartin 1984; Wood 1984; Woodward 1985; Woodward and Lewis 1998; Wood and Fels 1986; Cao et al 1990; Rundstrom 1990, 1991, and 1993; Belyea 1992; Yee 1994 a, b, c; Akerman 1995; and Thrower, 1996).

This paper explores the influence of political power on the maps in a Chinese gazetteer from 1261, *The Gazetteer of Jiankang Prefecture (Jiankang zhi)*. The paper will examine how political power influenced the production process of the gazetteer and its maps and how this power was reflected in the map selection and images. Specific questions discussed here include: Who initiated and organized the production of the gazetteer and its maps? What were the purposes of this production? How was the political power emphasized on these maps through selection of map subjects, titles, features, and cartographic symbols?

A theoretical basis for this paper is adapted from an important concept of cultural geography. As Jackson points out, "culture is not only socially constructed and geographically expressed. . . it must also be admitted that culture is spatially constituted" (Jackson 1989, 3). The maps, as an expression of culture, not only show the location of phenomena on the earth's surface, such as cities, rivers, and landforms, but also give specific insight into the cultural beliefs and concepts of the time in which they were made. As Rundstrom points out, "Maps both reflect and reinforce cultural values and beliefs of the people who make them" (Rundstrom 1990, 156). Maps can thus be also looked upon as cultural images which reflect the societies in which they are produced. Cartography is both a science of making maps and the study of the culture that creates them.

"The maps, as an expresssion of culture, not only show the location of phenomena on the earth's surface, such as cities, rivers, and landforms, but also give specific insight into the cultural beliefs and concepts of the time in which they were made."

Because this paper focuses on the cultural meanings of the maps, it would be insufficient to examine maps solely by using the techniques of cartographic analysis which are based on scientific rules of cartography. It will be important to search for the rules that govern the cultural production of maps. As Harley explains, "To discover these rules, we have to read between the lines of technical procedures or of the map's topographic content. . . In the map itself, social structures are often disguised beneath an abstract, instrumental space, or incarcerated in the coordinates of computer mapping" (Harley 1989, 5-6).

Therefore, the method of iconographical analysis formulated by Erwin Panofsky and adapted by historians of cartography is used to explore the symbolic meanings of maps, such as the values about power as well as the political beliefs attached to territory which are often reproduced, communicated, and experienced through maps. This method is well established in art history and has been effectively used in several studies on early maps (Blakemore and Harley 1980, Harley 1983, 1985; and Gilmartin 1984). As Panofsky defines, "Iconography is that branch of the history of art which concerns itself with the subject matter or meaning of works of art, as opposed to their form" (Panofsky 1939, 3). For iconographical analysis, "Looking at maps in isolation is insufficient. A proper study of the meaning in maps requires precise cultural co-ordinates to be reconstructed for the maps under consideration" (Harley 1985, 36). Therefore, a careful study of the cultural background of map production is necessary for the application of this technique. This study has to be based on non-cartographic sources, such as historical sources and literature. On the basis of this knowledge, according to Harley's interpretation, the first level of analysis is to identify individual conventional signs (points, lines, areas, and lettering) on the maps as representative of geographical objects, such as settlements, rivers, mountains, and lakes. The second level of the analysis is the identification of the specific locations of these geographical objects. The third level, which is the most important goal of iconographical analysis, is to search for the cultural meaning, i.e., the symbolic meaning, within the maps (Harley 1983, 1985, and 1988). The analysis performed in this paper will focus on how the political power of the society, from which the maps were produced, was reflected in the maps.

". . . the method of iconographical analysis formulated by Erwin Panofsky and adapted by historians of cartography is used to explore the symbolic meanings of maps, such as the values about power as well as the political beliefs attached to territory which are often reproduced, communicated, and experienced through maps."

THE MAPS IN THE GAZETTEER OF JIANKANG PREFECTURE

Since the maps discussed in this paper appear in *The Gazetteer of Jiankang Prefecture*, it is necessary to introduce some background on the gazetteer itself. The Chinese term *Fangzhi* is translated in English as gazetteer. From a linguistic point of view, one of the definitions of *fang* is region or local place and one of the meanings of *zhi* is record or account. Together, *Fangzhi,* in Chinese culture refers to a comprehensive record of a certain geographical area, object, or institution, such as an administrative division, mountain, river, lake, city, temple or academy. Although different types of *fangzhi* may have different focuses, in general, the contents of *fangzhi* include administrative divisions, official ranks, governmental buildings, military defense, water conservancy, schools, feudal land tax and corvée (an obligation imposed on inhabitants of a district to perform unpaid labor services), products, cities, townships, population, custom (a group pattern of local habitual activity transmitted from one generation to another), notable people, scenic and historical sites, bridges, temples, mountains, mountain passes, rivers, lakes, literature, and natural disasters. Some of these may cover both the time when the gazetteers were compiled and the history.

In the field of Chinese studies, *Fangzhi* is translated in English as either "gazetteers" or "local histories." (Dow 1969; Leslie and Davidson 1967; Library of Congress 1942; Needham 1959; Shiba 1989; and Yee 1994, a). It should be explained that neither of these translations precisely reflects the characteristics of *fangzhi* and both are somewhat misleading about their contents. As described above, the contents of *fangzhi* are far beyond that of either gazetteers or local histories. In addition, the contents are arranged according to their importance instead of their linguistic or chronological order. Nevertheless, because these two English renderings have already been accepted in the field of Chinese studies and this paper focuses on the geographical aspects instead of the historical aspects of *fangzhi*, the translation "gazetteer" is used in this paper.

Gazetteers are a very important part of Chinese literature. Based on several bibliographic works, more than 8,000 ancient gazetteers are still in existence, perhaps a fraction of their original number. As Joseph Needham, a world-renowned scholar in the history of Chinese science, comments, "Anyone at all acquainted with Chinese literature is familiar with the host of 'gazetteers', . . . In other literatures there is little comparable to this forest of monuments which the industry of provincial scholars erected over the centuries" (Needham 1959, vol. 3, 517).

The Gazetteer of Jiankang Prefecture is a well-known gazetteer of the Song dynasty (960-1279). This gazetteer was compiled by Ma Guangzu and Zhou Yinghe and was originally printed in 1261. It is one of the most influential gazetteers in Chinese history. Many ancient and modern Chinese scholars have claimed to have used the style of this gazetteer as a model. It is also the earliest extant gazetteer of the present region of Nanjing, a city in Jiangsu province in southeastern China. At the time when this gazetteer was compiled, Nanjing was called Jiankang. It was a commercial center and an important place for the military defense of the Southern Song dynasty with about 250,000 residents (Fan 1978, 380).

"The Gazetteer of Jiankang Prefecture *is a well-known gazetteer of the Song dynasty (960-1279). This gazetteer was compiled by Ma Guangzu and Zhou Yinghe and was originally printed in 1261. It is one of the most influential gazetteers in Chinese history."*

Unfortunately, a few years after the original gazetteer was printed, the original wood block printing plate was destroyed by fire and only a few later reprints still exist. Therefore, like many studies concerned with ancient Chinese sources, choosing the best edition of the gazetteer becomes very important because the text, and particularly the style of the maps, might be different between the editions. After a careful comparison of several later reprints, the 1801 edition was chosen as a primary source for this paper because it based on an original copy from the Song dynasty (960-1279). Detailed studies have already been made on the editions of the gazetteer and the technical aspects of the maps (Hu 1988 a and b, 1990 a and b). Nineteen maps appear in this gazetteer as an independent chapter (*juan*), chapter 5. Their titles are listed in Table 1.

THE INFLUENCE OF POLITICAL POWER ON THE PRODUCTION PROCESS

The study of maps cannot be divorced from the cultural context in which they were produced. According to Harley's theory, ". . . the scientific rules of mapping are, in any case, influenced by a quite different set of rules, those governing the cultural production of the map . . . They are related to values, such as those of ethnicity, politics, religion, or social class, and they are also embedded in the map-producing society at large . . . Such an interplay of social and technical rules is a universal feature of cartographic knowledge" (Harley 1989, 5-6).

No.	Original map title	Translation
1	Long pan hu ju tu	The map of the place coiled by a dragon and crouched by a tiger
2	Lidai chengguo hujian zhi tu	The map of Jiankang cities of previous dynasties
3	Huangchao Jiankang fujing zhi tu	The map of Jiankang prefecture of the empire
4	Yanjiang dakun suobu tu (Shang)	The first part, the map of naval bases along the Yangtze River
5	Yanjiang dakun suobu tu (Xia)	The second part, the map of naval bases along the Yangtze River
6	Fucheng zhi tu	The map of the prefectural capital
7	Song Jiankang xinggong tu	The map of the emperor's temporary dwelling palace in Jiankang city of the Song dynasty
8	Fuxie zhi tu	The map of the compound of the prefectural government
9	Zhisi simo guanting tu	The map of Simo palace
10	Shangyuan xian tu	The map of Shangyuan county
11	Jiangning xian tu	The map of Jiangning county
12	Jurong xian tu	The map of Jurong county
13	Lishui xian tu	The map of Lishui county
14	Liyang xian tu	The map of Liyang county
15	Fu xue zhi tu	The map of prefectural school
16	Chongjian gongyuan zhi tu	The map of reconstructed buildings of bureaucratic examination
17	Mingdao Shuyuan zhi tu	The map of Mingdao Academy
18	Qingxi tu	The map of Qingxi garden
19	Chongjian shetan zhi tu	The map of a renovated altar to the God of the earth

Table 1. Maps in The Gazetteer of Jiankang Prefecture

"Similar to other gazetteers of the same period, the main purpose of The Gazetteer of Jiankang Prefecture *was to provide a comprehensive reference on the local region in order to assist in administration (*zi zheng*)."*

Because the maps in *The Gazetteer of Jiankang Prefecture* are illustrations, a discussion of the production of these maps cannot be separated from the compilation of the gazetteer itself. Similar to other gazetteers of the same period, the main purpose of *The Gazetteer of Jiankang Prefecture* was to provide a comprehensive reference on the local region in order to assist in administration (*zi zheng*). Ma Guangzu, the governor of Jiankang prefecture, explained that the compilation of *The Gazetteer of Jiankang Prefecture* was "helpful to society" (Ma and Zhou 1261, "*Xu*" written by Ma Guangzu, 1 b). He personally initiated, organized, supervised its compilation and wrote the preface. He invited Zhou Yinghe to compile this gazetteer and its maps and often gave detailed instructions. These instructions told how to consult the previous gazetteers of the Jiankang region and what the style and contents of the gazetteer should be. In particular, Ma Guangzu emphasized that the gazetteer must include maps so that the readers could know the territory and geographical environment of Jiankang region. Some of these instructions were recorded in Zhou Yinghe's "Process of Compiling the Gazetteer during the Jingding Reign" (*Jingding xiu zhi benmo*). According to these records, "Ma Guangzu instructed, '. . . Now we should combine these books together to compile a new gazetteer . . . You (Zhou Yinghe) should follow the style of *The Gazetteer of Jiangling Region* (*Jiangling zhi*, compiled by Zhou Yinghe) to compile this new gazetteer and include materials which have not been recorded in the old ones'" (Ma and Zhou 1261, *Jiankang zhi mu*, 14,b-15,a).

According to Ma Guangzu's instructions, Zhou Yinghe proposed four principles on how to compile the gazetteer. Some of these principles were influential and followed by many later scholars as guidelines to compile gazetteers. These four principles are: To decide the style, to share responsibilities, to search data completely, and to circulate and revise the draft thoroughly.

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Of these four principles, the most important and influential one is the first: To decide the style of a gazetteer. According to Zhou Yinghe's proposal, a gazetteer should include four sections: maps (*tu*), chronological tables (*biao*), accounts (*zhi*), and biographies (*zhuan*). Because Jiankang was an ancient capital in history, Zhou Yinghe also proposed that "an additional section, 'Record on the Ancient Capital' (*Liu du lu*), should be added and placed in the beginning of *The Gazetteer of Jiankang Prefecture*" (Ma and Zhou 1261, "*Jiankang zhi mu*," 15, b). From Zhou Yinghe's description, it is clear that maps are an important portion of the gazetteer.

Zhou Yinghe's description of the fourth principle, to circulate and revise the draft thoroughly, reveals control by the government in the compiling process. As Zhou Yinghe proposed, ". . . after finishing each chapter of the first draft of the gazetteer, the draft should be enclosed in a purple bag and circulated among each official in the government . . . Then the first draft will be revised based on their annotations and comments. After that, the second draft should be enclosed in a purple bag and circulated among these officials again. The second revision then will be handed to the local governor for approval. The manuscript will not be printed until the local governor approves it" (Ma and Zhou 1261, *Jiankang zhi mu*, 18, a).

"Zhou Yinghe's description of the fourth principle, to circulate and revise the draft thoroughly, reveals control by the government in the compiling process."

Ma Guangzu, the governor of Jiankang prefecture, approved the first, third, and forth principles, but not the second ("to share the responsibilities") because he wanted Zhou Yinghe to be fully in charge of compilation. In practice, the entire compilation process was under the close supervision of the governor. As Zhou Yinghe recalled, he was required during the compilation to consult the governor on a regular basis and each chapter had to be reviewed by the governor (Ma and Zhou 1261, *Jiankang zhi mu*, 18, b). After the gazetteer was finished and printed, the 994 printing blocks used to print the gazetteer were locked in five bookcases in a study of the local government. The keys were controlled by a scholarly official in the government (Ma and Zhou 1261, *Jiankang zhi mu*, 19, a, b).

As explained above, *The Gazetteer of Jiankang Prefecture* was influential in Chinese history. After its original printing in the second year of the Jingding reign (1261), it was reproduced and hand-copied several times. The facts surrounding the reproductions also reflect the influence of political power because most of these reproductions were also organized by local governments.

A reproduction of the gazetteer appeared in 1343 in the Yuan dynasty (1279-1368). The evidence was found in "The Document on Compiling the Gazetteer" in *The Gazetteer of Jinling Region* of Zhizheng Reign (Zhizheng

Jinling xin zhi). At the beginning of the Zhizheng reign of the Yuan dynasty (ca. 1342), the government of Jiqing prefecture (*lu*, the administrative division of the Yuan dynasty which governed the same region of Jiankang prefecture during the Song dynasty) was ordered by Suo Yuandai, the commissioner of several provinces in the southern part of the empire, to reproduce the Song version. Suo Yuandai believed that this gazetteer was of such great importance that it must be passed on to later generations. At that time, the original wood-blocks of this gazetteer had been destroyed by fire. Fortunately, an original print still survived. Suo explained that it was important to reproduce this gazetteer from the original print so that it could be continually used not only by the local governments and residents but also by the state. At the command of Suo Yuandai, the government of Jiqing prefecture instructed the prefectural school to engrave a wood-block to reprint this gazetteer based on the original print of the Song dynasty. The expenses for the reproduction of the gazetteer were also covered under the budget of the prefectural school (Zhang 1343, *Xiu zhi wenyi*, 3-5).

The Gazetteer of Jiankang Prefecture continued to be used and reproduced after the Yuan dynasty. Based on the record in the "Preface to Reproduction of *The Gazetteer of Jiankang Prefecture*" written by Fei Chun in *The Gazetteer of Jiankang Prefecture* 1801 edition, Emperor Kangxi (1662-1722) inscribed on a copy of the Song dynasty of *The Gazetteer of Jiankang Prefecture* and sent it to the local government. The local governor kept this gazetteer on his desk and often read it (Ma and Zhou 1261, *Chongke Jiankang zhi xu* written by Fei Chun, 1, b). This copy from the Song dynasty had a seal from the Ministry of Rites of the Ming dynasty (1368-1644) suggesting that this gazetteer was also used by the central government of the Ming dynasty (Ma and Zhou 1261, *Chongke Jiankang zhi hou xu* written by Sun Xingyan, 1, a). During the 37th to 47th year of the Qianlong reign (1772-1782) of the Qing dynasty, the central government compiled "*A Complete Collection on Confucian Classics, History, Philosophy, and Belles-lettres*" *(Siku quan shu*). *The Gazetteer of Jiankang Prefecture* was also included in this series based on the edition owned by Ma Yu (Ma and Zhou 1261, "*Chongke Jiankang zhi xu*" written by Fei Chun, 1, b). In the sixth year of the Jiaqing reign of the Qing dynasty (1801), this gazetteer was reproduced again based on the copy from the Song dynasty given by Emperor Kangxi.

". . . the production of The Gazetteer of Jiankang Prefecture *and its maps was initiated and organized by these governments. The compilation was totally controlled by their political power."*

It is clear that the production of *The Gazetteer of Jiankang Prefecture* and its maps was initiated and organized by these governments. The compilation was totally controlled by their political power. The main purpose was to serve the administration by providing comprehensive information on this part of China.

SELECTION OF THE MAPS IN THE GAZETTEER

Among the nineteen maps in the gazetteer, two were directly related to the emperor. The emperor's power was supreme in ancient Chinese society and influenced every aspect of Chinese culture. The first one is *The Map of the Place Coiled by a Dragon and Crouched by a Tiger* (*Long pan hu ju tu*, Figure 1). It is placed first in the gazetteer, reflecting its importance. "A dragon," which appears in the title of the map, was often used as a symbol for the emperor in Chinese culture. As Zhou Yinghe, the author of the maps in *The Gazetteer of Jiankang Prefecture*, explained, the place coiled by a dragon and crouched by a tiger suggested that this was an emperor's residence (Ma and Zhou 1261, chapter 5, 1, b). *The Map of the Place Coiled by a Dragon and Crouched by a Tiger* simply shows the city wall and a canal of Jiankang, mountains, and the Yangzi River around the city. It does not contain any detailed features in the city except for a canal. The pictorially represented city wall was enlarged and placed in the center of the map. Based on a lack of geographic details about the city, and as suggested by the title, it becomes

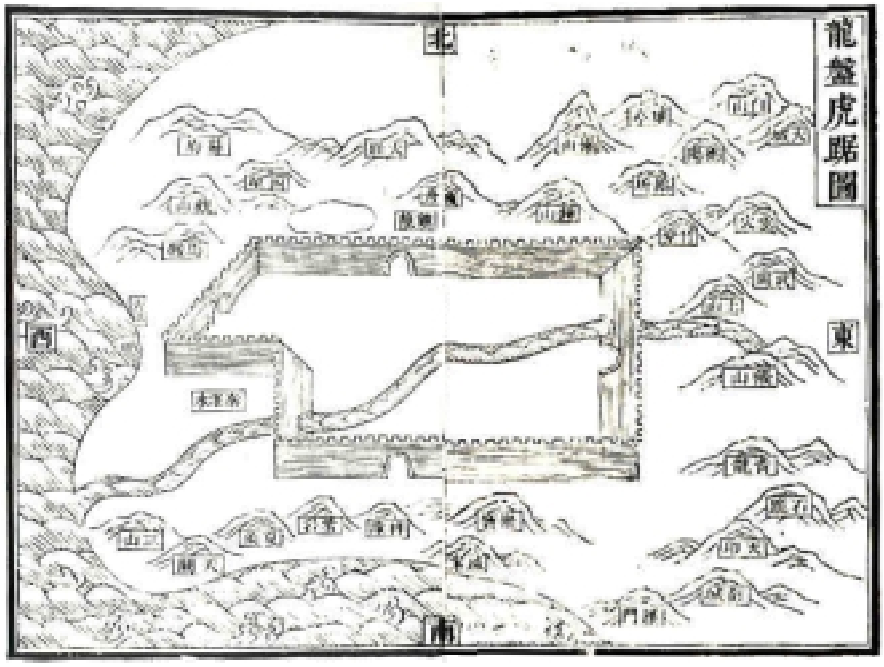

Figure 1. The Map of the Place Coiled by a Dragon and Crouched by a Tiger. The original map area: 26.6 x 19.4 cm (10 1/2 x 7 5/8 inches).

obvious that the political meaning of this map was more important than its geographical significance. It implies that this was the place where the emperor lived.

The second map relating to the emperor is *The Map of the Emperor's Temporary Dwelling Palace in Jiankang City of the Song Dynasty* (*Song Jiankang xinggong tu*, Figure 2). As its title indicates, the only purpose of this map was to depict the compound of the emperor's temporary dwelling palace

". . . the political meaning of this map was more important than its geographical significance."

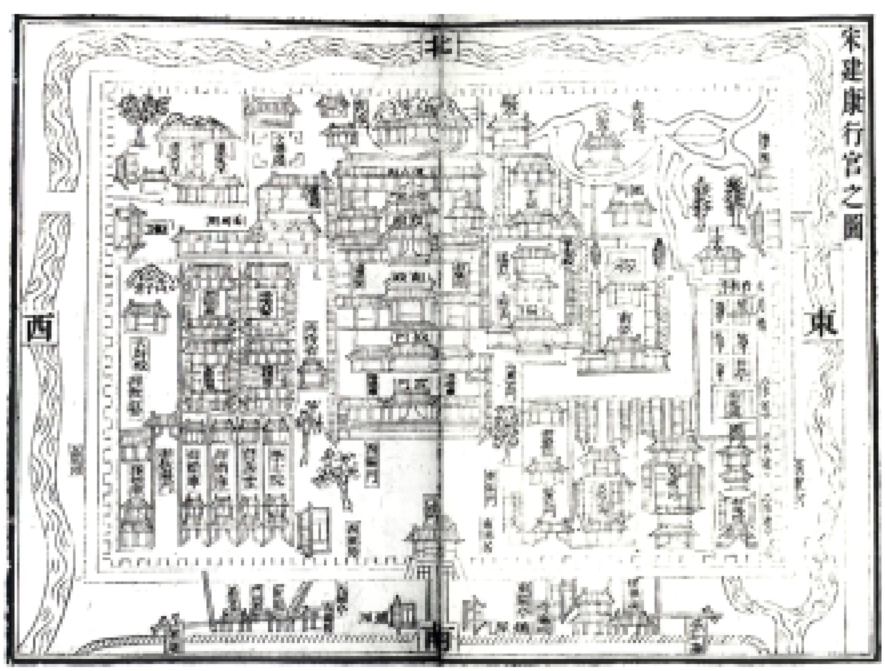

Figure 2. The Map of the Emperor's Temporary Dwelling Palace in Jiankang City of the Song Dynasty. The original map area: 26.6 x 19.4 cm (10 1/2 x 7 5/8 inches).

which was located in the center of the city. This map shows the compound in detail, including the palace, palace wall, moat, imperial offices, warehouses, study, stable, pond, vegetation, streams, gardens, and bridges. The emperor's palace is in the center of the compound. On its left are imperial offices and warehouses, such as The Department of Internal Affairs of the Emperor's Palace (*Nei si sheng*), Imperial Wine Warehouse (*Yü jiu ku*), and Imperial Vinegar Warehouse (*Yü cu ku*). On the right of the palace are the imperial study, garden, and stable. The walled compound is surrounded by the moat on its eastern, northern, and western sides. Its southern side is facing a street. The main gate of the compound is located in the middle of the southern side and is labeled as "The Gate of the Emperor's Temporary Dwelling Palace" (*Xinggong men).* The other two gates are located in the middle of the eastern and western walls.

The practice of emphasizing the emperor's power through the map selections agrees with the contents of the text. There are fifty chapters. Chapters one to four are "Records on the Ancient Capital" (*Liu du lu*), that includes all the important details relating to the Emperor's Temporary Dwelling Palace. Specifically, the records include those on historical events related to the construction of the Emperor's Temporary Dwelling Palace, the architectural structure of the palace, the officials and the governmental department in charge of the maintenance of the palace, and the emperor's garden, edicts, and writings.

"... it is obvious that demonstrating political power and state territory was one of the purposes of The Gazetteer of Jiankang Prefecture."

In addition to the above two maps which are directly related to the emperor, six maps in the gazetteer specifically show the state territory. One is *The Map of Jiankang Prefecture of the Empire* (*Huangchao Jiankang fu jing zhi tu,* Figure 3). The others are the five county maps, which were under the administration of Jiankang prefecture. Moreover, two maps, *The Map of the Compound of the Prefectural Government* (*Fuxie zhi tu*) and *The Map of the Simo Palace* (*Zhisi simo guanting tu*) directly depict the compounds of the prefectural government.

From these maps, it is obvious that demonstrating political power and state territory was one of the purposes of *The Gazetteer of Jiankang Prefecture*.

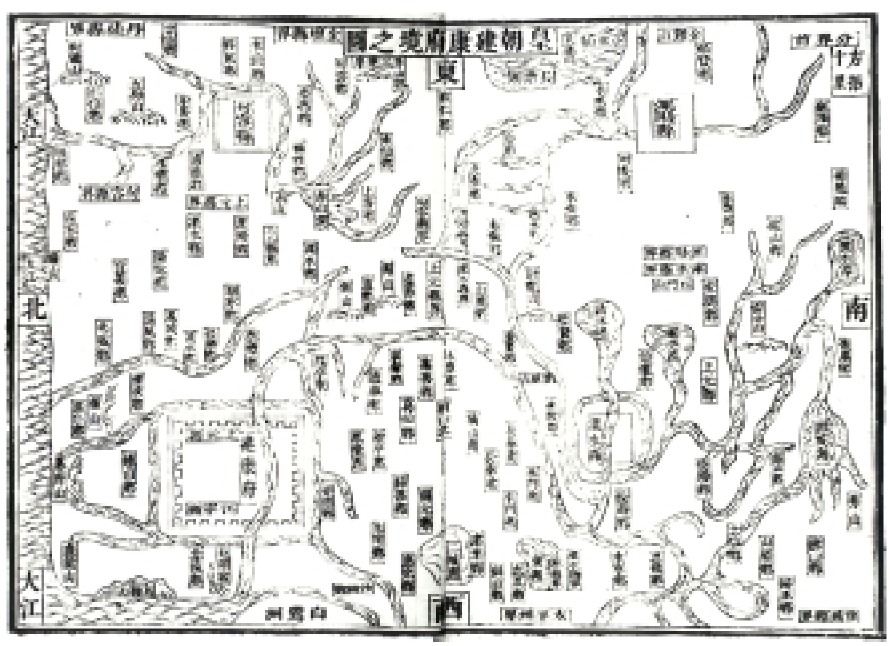

Figure 3. The Map of Jiankang Prefecture of the Empire. The original map area: 26.6 x 19.4 cm (10 1/2 x 7 5/8 inches).

REFLECTION OF POLITICAL POWER ON MAP IMAGES

Cartographic design and symbolization were used to emphasize the influence of political power. An example is *The Map of the Prefectural Capital* (*Fu cheng zhi tu*, Figure 4). This map shows the capital of Jiankang prefecture (*fu*) in detail, including the city wall, moat, canal, streets, bridges, lake, hill, and approximately 160 place names. These names are those of the emperor's temporary dwelling palace, official mansions, military camps, warehouses, the prefectural academy and school, market places, temples, residential districts, gates, streets, gardens, bridges, a river, and a cave. Table 2 reviews the contents of the map.

"Cartographic design and symbolization were used to emphasize the influence of political power."

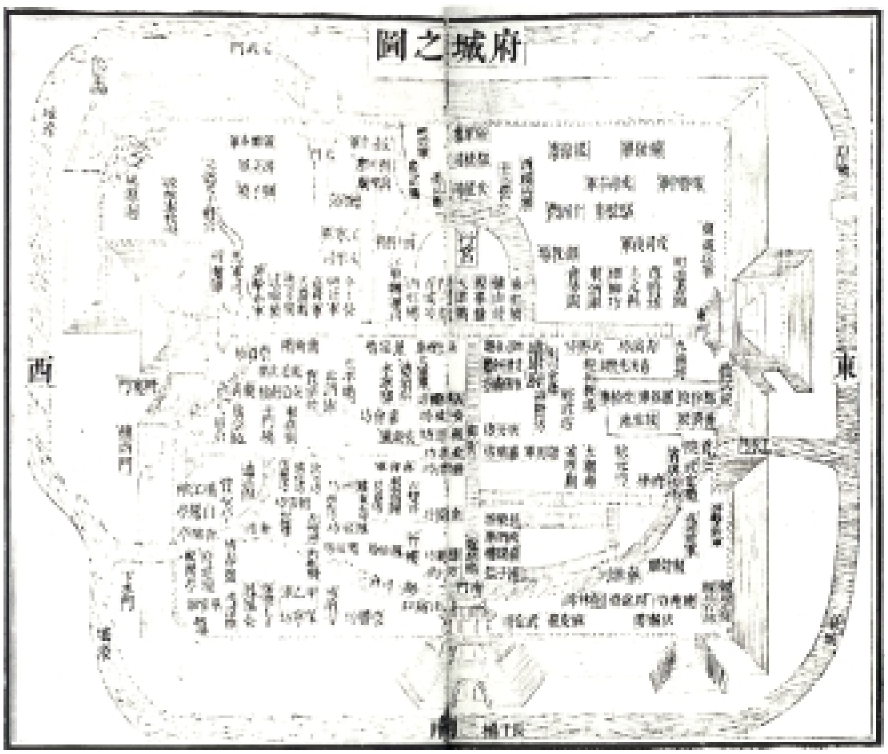

Figure 4. The Map of the Prefectural Capital. The original map area: 26.6 x 19.4 cm (10 1/2 x 7 5/8 inches).

Features	Quantity	Rate (per square decimeter on the map)
Place names	167	32.4
Moat and canal	127 centimeters long	24.6 centimeters long
Lake	1	0.2
Bridges	17	3.3
Hill	1	0.2
Streets	56 centimeters long	10.9 centimeters long
City wall & palace wall	85 centimeters long	16.5 centimeters long

*The original map area is 2.66 x 1.94 = 5.16 square decimeters. The rate in this table is calculated based on this size. See Hu 1988, a, 36 for the source of this table.

*Table 2. Contents of the Map of the Prefectural Capital**

This map is oriented with north at the top because the south, east, and west are indicated in the middle of the bottom, right, and left sides of the map. The city on the map was surrounded by a wall and moat. The five main gates of the city wall are labeled and pictorially represented. In the center of the map is the Emperor's Temporary Dwelling Palace (*Xinggong*). It is facing the main gate of the city, the Southern Gate (*Nan men*). The main street of the city, Imperial Street (*Yu jie),* connects the Emperor's Temporary Dwelling Palace and the Southern Gate. Along Imperial Street, starting from its northern end, are some official mansions, such as the compound of the prefectural government. Military camps are distributed throughout the northern half of the city. The Emperor's Temporary Dwelling Palace (*Xinggong*) is indicated using the largest Chinese characters enclosed by a double rectangle. As a result, it is the most obvious place name on the map. The symbolic meaning of this design clearly shows that, in the map maker's mind, the emperor's temporary dwelling palace is the most important place in the whole city. Here "the distinction of class and power are engineered, reified and legitimated in the map by means of cartographic signs. The rule seems to be 'the more powerful, the more prominent.' To those who have strength in the world shall be added strength in the map" (Harley 1989, 7). This representation provides another example of "how the 'rules of the social order' appear to insert themselves into the smaller codes and spaces of cartographic transcription" (Harley 1989, 6).

"This representation provides another example of "how the 'rules of the social order' appear to insert themselves into the smaller codes and spaces of cartographic transcription"."

By using techniques of generation and symbolization, the administrative seats are also emphasized on the maps which show state territories. For example, on *The Map of Jiankang Prefecture of the Empire*, all place names, including a prefecture (*fu*), counties (*xian*), and townships (*xiang*), are administrative divisions except mountains and lakes. The pattern and size of the symbols and labels for the administrative seats were arranged according to their administrative levels. The representation of the prefectural seat was much larger than its actual size and was greatly enlarged according to its administrative importance. This indicates that the symbols on the map were designed according to their political importance rather than the map scale. As a result, the prefecture became the most visible feature on the map. The symbols of the county seats were also enlarged although to a smaller scale.

The political significance of emphasizing the state administrative structures is reflected in the title of the map, "*The Map of Jiankang Prefecture of the Empire*." The title indicates that the territory was controlled by the political power-empire. This political significance is also attested to by a statement of the author, Zhou Yinghe. In the preface on the maps in this gazetteer, he states, "Dasitu (a title of an official) was in charge of the territory maps and census. By using these maps and data, he assisted the emperor in ruling the country... Jiankang was an ancient capital . . . It is such an important place that it must have maps to show it. Therefore, I made these maps in the gazetteer" (Ma and Zhou 1261, chapter 5, 1, a-b). This statement, on the one hand, suggests that the territory shown on the maps was controlled by the empire - a political power. On the other hand, it reveals that the maps, which showed the territory, served as administrative tools for the empire.

CONCLUSION

It can be seen that political power had a large influence on *The Gazetteer of Jiankang Prefecture* and its maps. By using the techniques of map selection, cartographic design, and symbolization, the emperor's power and state territory were clearly emphasized on these maps. This important political feature indicates that showing political power was one of the purposes in making these maps, and the nature of these maps also served as a political tool of the governments.

This paper supports the general notion that maps are not only geographical representations of the spatial world but can also be viewed as cultural images that reflect the societies in which they are produced. On the one hand, naming and locating a feature on a map does have geographical significance. On the other hand, representations of these geographical features often have social and cultural meanings. Thus, besides their geographical functions, maps themselves may also have multiple cultural functions and have their own impact on the society. From this point of view, the interpretation of maps can go beyond their cartographic technology to explore their social and cultural significance in their specific historical contexts. Maps thus can be studied in a much broader sense than merely as geographical representations of the spatial world.

". . . besides their geographical functions, maps themselves may also have multiple cultural functions and have their own impact on the society."

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Spatial Concept Lattices: An Integration Method in Model Generalization

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The ability to view and analyze data of different detail and from different perspectives, and to move dynamically from one scale to another requires modeling geographic information at different generalization levels. On this account, in the framework of model generalization, the concept of multi-scale database is adopted to provide a consistent multiple representation of existent mono-scale representations. Spatial Concept Lattices are propounded as a new approach to thematic generalization through the semantic integration of multiple classification schemata and the creation of a multi-scale, multi-context database. The methodology presents in an explicit and systematic manner the integration of classification schemata, which exhibit differences in spatial and thematic resolution. In order to comprehend the stepwise SCL methodology, an actual example is used to demonstrate the integration of three independent land cover/land use classification schemata. The integration process is part of model generalization, since the resulting hierarchical integrated schema supports various levels of thematic resolution and represents geographic space from different application perspectives.
Keywords: concept lattices, semantic integration, thematic classification, model generalization.

INTRODUCTION

In contrast to cartographic generalization which focuses on graphic representation issues, model generalization involves modeling geographic information at different levels of spatial and semantic resolution (Müller et al., 1995). From this perspective, model generalization reflects changes in the perception level of geographic information (Ruas & Lagrange, 1995), and hence precedes cartographic generalization (Ruas & Lagrange, 1995; Weibel, 1995, Weibel & Dutton, 1999). The important objective of model generalization is the production of databases at multiple levels of detail, for multiple purposes and applications (Molenaar, 1996; Müller et al., 1995; Uitermark et al., 1998; Voisard & Schweppe, 1998). Multiple representations outstrip static views, expanding users' ability of viewing and analyzing geographic data. The concept of multi-scale (or multi-resolution) databases aims at the representation of the same real-world phenomenon at different resolutions (Weibel, 1995; Devogele et al., 1997; Weibel & Dutton, 1999). This is normally accomplished, either by generalizing a single large-scale database, or by collecting different independent representations and each time utilizing the appropriate representation for the specified level of detail (Buttenfield, 1995; Devogele et al., 1997; Govorov, 1995).

"The important objective of model generalization is the production of databases at multiple levels of detail, for multiple purposes and applications."

Another approach to building a multi-scale database concentrates on the development of multiple representations by integrating existing databases at different levels of detail, and linking representations that correspond to the same real world phenomenon. This approach allows reuse of data, and interoperability between representations (Devogele et al., 1997). Thereby, users can navigate dynamically and continuously from one level of detail to another, specified by the scale needed for the application. However, if the input databases do not use the same conceptual schema, the process of building a multi-scale database demands a schema integration methodology. The intention of the present work is to tackle thematic generalization by putting emphasis on attributes and semantic integration, as a form of model generalization.

"The intention of the present work is to tackle thematic generalization by putting emphasis on attributes and semantic integration, as a form of model generalization."

Spatial Concept Lattices (SCL) provide a specific and systematic methodology for the semantic integration of multiple classification schemata. The methodology can be used to build a multi-scale, multi-context database, providing multiple representations of geographic data, not only at various scales and levels of thematic resolution, but also from different application perspectives and thus different semantics. The integration of different classification schemata, apart from providing the means to move along different levels of detail and intelligently change scale, it also allows to move across different contexts and perform a change in the perception of geographic information (Fig. 1).

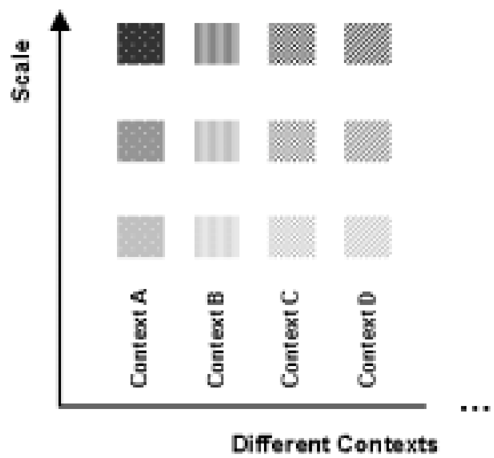

Figure 1. Integration along different scales and across different contexts

Previous work (Kokla & Kavouras, forthcoming) has developed the SCL methodology for the semantic integration of two different classification schemata. This paper exploits the ability of SCL to produce an integrated classification schema as the basis for dynamic model generalization.

THE SPATIAL CONCEPT LATTICES METHOD

Formal Concept Analysis

SCL are founded on *Formal Concept Analysis* (Wille, 1992), a theory of concept formation and conceptual classification. Formal Concept Analysis (FCA) provides a basic analysis of a context and at the same time indicates the implications between attributes. Generally, FCA works in a specific context named *Formal Context*, consisting of a set of objects, a set of attributes and a binary incidence relation connecting objects and attributes. The central notion in FCA is the *formal concept*, or *conceptual class* or *category*, which is defined as a collection of entities or objects exhibiting one or more common characteristics or attributes. Their *extent* and *intent* logically characterize formal concepts. The *extent* is the aggregate of objects or entities belonging to the concept, whereas the *intent* is the sum of attributes (or properties) implying the formal concept.

"SCL are founded on Formal Concept Analysis *(Wille, 1992), a theory of concept formation and conceptual classification."*

An important relationship in FCA is the *superconcept/subconcept relation*, which is defined as the order proceeding top-down from more generalized concepts with larger extent and smaller intent to more specialized concepts with smaller extent and larger intent. Formal Concepts associated to each other with the superconcept / subconcept relation form a class hierarchy, called *Concept Lattice*. In other words, a Concept Lattice is the ordered set of all formal concepts of a formal context.

". . . a Concept Lattice is the ordered set of all formal concepts of a formal context."

Concept Lattices have been applied to a number of different fields, such as medicine (Spangenberg & Wolff, 1999), biology (Ganter & Wille, 1989), sociology (Ganter & Wille, 1989), and information and computer science (Kent & Neuss, 1995; Faid et al., 1997; Schmitt & Saake, 1997; Deogun et al., 1998; Priss, 1999). Schmitt and Saake (1997) have applied the algorithm provided by FCA for deriving concept lattices from context information for schema integration. In order to satisfy the demands of database design and maintenance, they transform the integrated schema with respect to different quality criteria.

In order to deal with the geospatial characteristics of entities and the classification schemata involved in geographic applications, FCA has been employed to derive Lattices of Spatial Concepts, thereafter called Spatial Concept Lattices (SCL). In this research, SCL are applied to manage hierarchical geographic data with overlapping classes. The process of creating the Spatial Concept Lattice, and hence the integrated hierarchical schema, necessitates knowledge of scale transitions and inheritance relationships for the entities involved and their attributes. Entities and attributes are in most cases scale dependent. Moreover, very often, the meaning of spatial entities, as well as their level of detail is inherently based on their attributes. This intrinsic spatial knowledge is necessary for identifying correspondences and resolving conflicts between the input classification schemata. However, this does not influence the mechanics of the method at all, which may be claimed to be independent of the application.

"In this research, SCL are applied to manage hierarchical geographic data with overlapping classes."

The integration process described in this research is based on the theory of FCA. The conversion of schemata into one merged context, as well as the transformation of the integrated schema relies on an improved approach as described in Schmitt & Saake (1997).

In order to demonstrate in a comprehensive fashion the application of FCA, a running example is used involving the integration of three independent classification schemata:

- The hierarchical CORINE Land Cover nomenclature (CORINE Land Cover-Technical Guide, 1994) for scales 1:100,000–1:1,000,000.
- The DIGEST nomenclature for geographic objects (DIGEST Standards Specification, DGIWG, 1997), addressing a variety of scales.
- The classification used by the Hellenic Mapping and Cadastral Organization (Technical Specifications of the Greek Cadastre, HEMCO, 1996) to record land use characteristics referring to scales 1:1,000–1:5,000.

For reasons of presentation and space limitation, only a small, but complete excerpt of the above case is presented.

The SCL methodology used in this research is formalized by an algorithm, which proceeds in two main steps. At the first step, the different contexts are merged into a single, integrated context. The second step is devoted to the generation of the concept lattice of the integrated context. More specifically, in order to integrate the different contexts into a single one, it is necessary to find and resolve conflicts and identify correspondences between the input classification schemata. Therefore, the classes of the input classification schemata are analyzed (Fig. 2), to specify equivalencies and overlappings between them (extensional decomposition).

"The SCL methodology used in this research is formalized by an algorithm, which proceeds in two main steps. At the first step, the different contexts are merged into a single, integrated context. The second step is devoted to the generation of the concept lattice of the integrated context."

Thus, the first column of Matrix 1 lists the original classes of the input classification schemata and the remaining columns represent the classes derived by the extensional decomposition. In case of overlapping between two or more original classes, these are split to subclasses. A cross (x) for the intersection of a column (subclass) and a row (original class) means that the specific subclass belongs to the corresponding original class. For example, the CORINE Land Cover category "*Fruit trees and berry plantations*" is decomposed to subclass $\mathbf{s}_7$ and $\mathbf{s}_8$, corresponding respectively to cadastral categories "*Citrus fruits*" and "*Other trees*". Categories "*Arable land*" (CORINE Land Cover and HEMCO) and "*Cropland*" (DIGEST) denote the same thing and thus include the same subclasses $\mathbf{s}_1$ ("*Non-irrigated arable land*"), $\mathbf{s}_2$ ("*Permanently irrigated arable land*") and $\mathbf{s}_3$ ("*Rice fields*").

Similarly, specific attributes are assigned to each original class (Fig. 3), in order to determine equivalencies and overlappings between attributes (intensional decomposition). A cross (x) for the intersection of a column (attribute) and a row (original class) means that the specific attribute is ascribed to the corresponding original class. For example, category "*Crop-*

	Subclasses / Original Classes	Non-irrigated arable land s_1	Irrigated arable land s_2	Rice fields s_3	Hedgerow s_4	Nursery s_5	Botantical Garden s_6	Citrus fruits s_7	Other trees s_8	Vineyards s_9	Olive groves s_{10}
CORINE Land Cover	**2. Agricultural Areas**	x	x	x				x	x	x	x
	2.1. Arable land	x	x	x							
	2.1.1. Non-irrigated arable land	x									
	2.1.2. Permanently irrigated land		x								
	2.1.3. Rice fields			x							
	2.2. Permanent Crops							x	x	x	x
	2.2.1. Vineyards									x	
	2.2.2. Fruit trees and berry plantations							x	x		
	2.2.3. Olive groves										x
CADASTRE	**1.1. Cultivated areas**	x	x					x	x	x	x
	1.1.1. Trees							x	x	x	x
	1.1.1.1. Vineyards									x	
	1.1.1.2. Olive groves										x
	1.1.1.3. Citrus fruits							x			
	1.1.1.4. Other								x		
	1.1.2. Arable land	x	x	x							
	1.1.2.1. Irrigated		x								
	1.1.2.2. Non-irrigated	x									
DIGEST	**4. Vegetation**										
	4.1 Cropland	x	x	x	x	x	x	x	x	x	
	4.1.1. Cropland	x	x	x							
	4.1.2. Hedgerow				x						
	4.1.3. Nursery					x					
	4.1.4. Botantical Garden						x				
	4.1.5. Orchard/Plantation							x	x		
	4.1.6. Vineyards									x	

Figure 2. Extensional decomposition-Matrix 1

land" (DIGEST) has the attribute "*Crop type*" ($\mathbf{a}_{18}$). It is important to mention that subclasses inherit the attributes of their superclasses, as for example CORINE Land Cover class "*Arable land*" inherits attributes $\mathbf{a}_1$ to $\mathbf{a}_3$ from its superclass "*Agricultural Areas*".

Then, attributes specified during the intensional decomposition are associated with subclasses resulting from the extensional decomposition. In other words, Matrix 3 (Fig. 4) is created by combining Matrices 1 and 2. Essentially, Matrix 3 constitutes the cross-table of the integrated context, and it is used to build the multi-context Concept Lattice.

At the second step, Formal Concept Analysis is applied, in order to generate the Concept Lattice of the integrated context.

If G is the set of subclasses and M the set of attributes, then two sets are defined as follows:

$$\text{Int} = \{\{g\}' \mid g \in G\}$$

$$\text{Ext} = \{\{m\}' \mid m \in M\}$$

	Original Classes \ Attributes	Climate a_1	Altitude a_2	Productivity a_3	Soil type a_4	Annual crop a_5	Irrigation system a_6	Soil humidity a_7	Cultivation methods a_8	Fruit type a_9	Olive type a_{10}	Average yield produce a_{11}	Percentage of vegetation a_{12}	Area a_{13}	Number of trees a_{14}	Vineyard type a_{15}	Citrus type a_{16}	Tree type a_{17}	Crop type a_{18}	Hedgerow width a_{19}	Tree canopy levels a_{20}
CORINE Land Cover	**2. Agricultural Areas**	x	x	x																	
	2.1. Arable land	x	x	x	x																
	2.1.1. Non-irrigated	x	x	x	x	x															
	2.1.2. Permanently irrigated	x	x	x	x		x														
	2.1.3. Rice fields	x	x	x	x			x													
	2.2. Permanent Crops	x	x	x					x												
	2.2.1. Vineyards	x	x	x					x												
	2.2.2. Fruit trees	x	x	x					x	x											
	2.2.3. Olive groves	x	x	x					x		x										
CADASTRE	**1.1. Cultivated areas**			x								x	x	x							
	1.1.1. Trees			x								x	x	x	x						
	1.1.1.1. Vineyards			x								x	x	x	x	x					
	1.1.1.2. Olive groves			x							x	x	x	x	x						
	1.1.1.3. Citrus fruits			x								x	x	x	x		x				
	1.1.1.4. Other			x								x	x	x	x			x			
	1.1.2. Arable land			x					x			x	x	x							
	1.1.2.1. Irrigated			x			x		x			x	x	x							
	1.1.2.2. Non-irrigated			x					x			x	x	x					x		
DIGEST	**4. Vegetation**																				
	4.1 Cropland																				
	4.1.1. Cropland																		x		
	4.1.2. Hedgerow																			x	
	4.1.3. Nursery																				
	4.1.4. Botantical Garden																				
	4.1.5. Orchard/Plantation																				x
	4.1.6. Vineyards																				

Figure 3. Intensional decomposition-Matrix 2

Attributes \ Subclasses		Non-irrigated arable land s_1	Irrigated arable land s_2	Rice fields s_3	Hedgerow s_4	Nursery s_5	Botanical Garden s_6	Citrus fruits s_7	Other trees s_8	Vineyards s_9	Olive groves s_{10}
Climate	**a1**	x	x	x				x	x	x	x
Altitude	**a2**	x	x	x				x	x	x	x
Productivity	**a3**	x	x	x				x	x	x	x
Soil Type	**a4**	x	x	x							
Annual Crop	**a5**	x									
Irrigation system	**a6**		x								
Soil humidity	**a7**			x							
Cultivation methods	**a8**	x	x					x	x	x	x
Fruit type	**a9**							x	x		
Olive type	**a10**										x
Aver. yield produce	**a11**	x	x					x	x	x	x
Percentage of vegetation	**a12**	x	x					x	x	x	x
Area	**a13**	x	x					x	x	x	x
Number of trees	**a14**							x	x	x	x
Vineyard type	**a15**									x	
Citrus type	**a16**							x			
Tree type	**a17**								x		
Crop type	**a18**	x									
Hedgerow width	**a19**				x						
Tree canopy levels	**a20**							x	x		

Figure 4. Cross-table of the integrated context-Matrix 3

Set Int includes the attributes that distinguish each subclass, while set Ext represents the subclasses described by each attribute. Specifically for the excerpt of the running example:

$$
\begin{aligned}
\text{Int} &= \{\{s_1\}', \{s_2\}', \{s_3\}', \ldots, \{s_{10}\}'\} \\
&= \{\{a_1, a_2, a_3, a_4, a_5, a_8, a_{11}, a_{12}, a_{13}, a_{18}\} \\
&\quad \{a_1, a_2, a_3, a_4, a_6, a_8, a_{11}, a_{12}, a_{13}\} \\
&\quad \{a_1, a_2, a_3, a_4, a_7\} \\
&\quad \{a_{19}\} \\
&\quad \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{16}, a_{20}\} \\
&\quad \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{17}, a_{20}\} \\
&\quad \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}, a_{14}, a_{15}\} \\
&\quad \{a_1, a_2, a_3, a_8, a_{10}, a_{11}, a_{12}, a_{13}, a_{14}\}\} \\
\text{Ext} &= \{\{a_1\}', \{a_2\}', \{a_3\}', \ldots, \{a_{20}\}'\} \\
&= \{\{s_1, s_2, s_3, s_7, s_8, s_9, s_{10}\} \\
&\quad \{s_1, s_2, s_3\} \\
&\quad \{s_1\} \\
&\quad \{s_2\} \\
&\quad \{s_3\} \\
&\quad \{s_1, s_2, s_7, s_8, s_9, s_{10}\} \\
&\quad \{s_7, s_8\} \\
&\quad \{s_{10}\}
\end{aligned}
$$

$\{s_7, s_8, s_9, s_{10}\}$
$\{s_9\}$
$\{s_7\}$
$\{s_8\}$
$\{s_4\}\}$.

Specifying sets of classes with common subclasses and attributes, derives the formal concepts of the integrated context. Therefore, from Int and Ext two sets of concepts are generated:

$$Con_I = \{(I', I) \mid I \in Int\}$$

$$Con_E = \{(E, E') \mid E \in Ext\}$$

For the specific application, Con_I and Con_E are formed as follows:

$Con_I = \{(\{s_1\}, \{a_1, a_2, a_3, a_4, a_5, a_8, a_{11}, a_{12}, a_{13}, a_{18}\})$
$(\{s_2\}, \{a_1, a_2, a_3, a_4, a_6, a_8, a_{11}, a_{12}, a_{13}\})$
$(\{s_3\}, \{a_1, a_2, a_3, a_4, a_7\})$
$(\{s_4\}, \{a_{19}\})$
$(\{s_7\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{16}, a_{20}\})$
$(\{s_8\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{17}, a_{20}\})$
$(\{s_9\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}, a_{14}, a_{15}\})$
$(\{s_{10}\}, \{a_1, a_2, a_3, a_8, a_{10}, a_{11}, a_{12}, a_{13}, a_{14}\})\}$.
$Con_E = \{(\{s_1, s_2, s_3, s_7, s_8, s_9, s_{10}\}, \{a_1, a_2, a_3\})$
$(\{s_1, s_2, s_3\}, \{a_1, a_2, a_3, a_4\})$
$(\{s_1\}, \{a_1, a_2, a_3, a_4, a_5, a_8, a_{11}, a_{12}, a_{13}, a_{18}\})$
$(\{s_2\}, \{a_1, a_2, a_3, a_4, a_6, a_8, a_{11}, a_{12}, a_{13}\})$
$(\{s_3\}, \{a_1, a_2, a_3, a_4, a_7\})$
$(\{s_1, s_2, s_7, s_8, s_9, s_{10}\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}\})$
$(\{s_7, s_8\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{20}\})$
$(\{s_{10}\}, \{a_1, a_2, a_3, a_8, a_{10}, a_{11}, a_{12}, a_{13}, a_{14}\})$
$(\{s_7, s_8, s_9, s_{10}\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}, a_{14}\})$
$(\{s_9\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}, a_{14}, a_{15}\})$
$(\{s_7\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{16}, a_{20}\})$
$(\{s_8\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{17}, a_{20}\})$
$(\{s_4\}, \{a_{19}\})\}$.

From the union of sets of concepts, the set of final classes is derived:

$$Con = Con_I \cup Con_E$$

$C_1 = (\{s_1, s_2, s_3, s_7, s_8, s_9, s_{10}\}, \{a_1, a_2, a_3\})$
$C_2 = (\{s_1, s_2, s_3\}, \{a_1, a_2, a_3, a_4\})$
$C_3 = (\{s_1, s_2, s_7, s_8, s_9, s_{10}\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}\})$
$C_4 = (\{s_7, s_8, s_9, s_{10}\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}, a_{14}\})$
$C_5 = (\{s_7, s_8\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{20}\})$
$C_6 = (\{s_1\}, \{a_1, a_2, a_3, a_4, a_5, a_8, a_{11}, a_{12}, a_{13}, a_{18}\})$
$C_7 = (\{s_2\}, \{a_1, a_2, a_3, a_4, a_6, a_8, a_{11}, a_{12}, a_{13}\})$
$C_8 = (\{s_3\}, \{a_1, a_2, a_3, a_4, a_7\})$
$C_9 = (\{s_4\}, \{a_{19}\})\}$.
$C_{10} = (\{s_7\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{16}, a_{20}\})$
$C_{11} = (\{s_8\}, \{a_1, a_2, a_3, a_8, a_9, a_{11}, a_{12}, a_{13}, a_{14}, a_{17}, a_{20}\})$
$C_{12} = (\{s_9\}, \{a_1, a_2, a_3, a_8, a_{11}, a_{12}, a_{13}, a_{14}, a_{15}\})$
$C_{13} = (\{s_{10}\}, \{a_1, a_2, a_3, a_8, a_{10}, a_{11}, a_{12}, a_{13}, a_{14}\})$

Matrix M (Fig. 5) is created, in order to represent the superconcept / subconcept relation defined for the generated classes by comparing each class to all other classes. A value "1" in the binary matrix M at the intersection of row i and column j means that class C_i is a subclass of class C_j.

Then, Matrix M_1=M-M*M (Fig. 6) is computed, in order to remove transitive specializations and thus, preserve only the direct subclasses of each class. Consequently, Matrix M_1 reveals the hierarchical structure of the integrated context.

Subconcept-superconcept relation

Final Classes	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1													
C_2	x												
C_3	x												
C_4	x		x										
C_5	x		x	x									
C_6	x	x											
C_7	x	x											
C_8	x	x											
C_9													
C_{10}	x		x	x	x								
C_{11}	x		x	x	x								
C_{12}	x		x	x									
C_{13}	x		x	x									

Figure 5. Subconcept-superconcept relation Matrix M

Subconcept-superconcept relation

Final Classes	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1													
C_2	x												
C_3	x												
C_4			x										
C_5				x									
C_6		x	x										
C_7		x	x										
C_8		x											
C_9													
C_{10}					x								
C_{11}					x								
C_{12}				x									
C_{13}				x									

Figure 6. Subconcept-superconcept relation Matrix M_1 without transitive specializations

At last, the hierarchical, integrated schema (Fig. 7) can be optimized with respect to different criteria (Schmitt & Saake, 1997). The optimization process includes operations (e.g., removing classes, vertically or horizontally merging classes, splitting classes and removing multiple specializations), which aim at the improvement of the hierarchical schema. Figure 7 shows the corresponding excerpt of the final hierarchical schema generated from the original schemata. In the same figure, the shadowed block represents the class "Cultivated Areas" which can be removed by the transformation procedure.

"An optimization process can be applied, in order to improve the final integrated schema."

Discussion of SCL

The SCL methodology and the algorithm presented above for the integration of classification schemata are based on the mathematical theory of Formal Concept Analysis. SCL can be used to formally describe the objects and their attributes at all levels of detail, as well as the relationships between object classes.

The methodology can be successfully applied independently of the spatial and thematic resolution represented by the input classification schemata. Therefore, it is possible to associate classifications created for similar purposes dealing with many overlappings between the input classes or, to integrate classification schemata of different thematic resolutions.

"The methodology can be successfully applied independently of the spatial and thematic resolution represented by the input classification schemata."

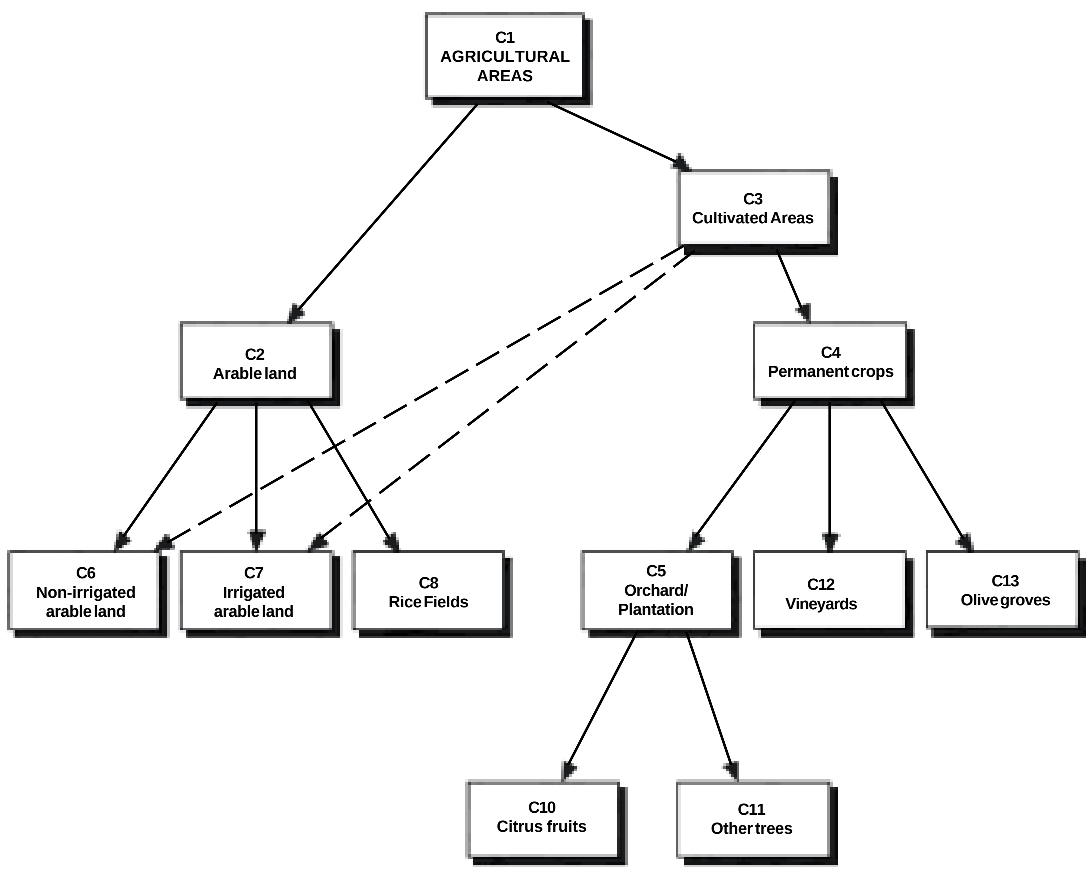

Figure 7. Excerpt of the final hierarchical schema.

". . . in SCL, hierarchies are used as a conceptual tool and not as a restriction of the method."

The integrated schema is hierarchical, but not strictly tree-structured, thought it can be transformed to a tree. This means that in the final schema, certain classes may have more than one superclass, and it depends on the user to select the appropriate link for the application at hand. For example, class "Cemetery" (DIGEST) may as well belong to "Green urban areas" (CORINE Land Cover), or to "Religious sites" (Cadastre). Therefore, in SCL, hierarchies are used as a conceptual tool and not as a restriction of the method.

Moreover, during the integration process, possible conflicts (Batini et al., 1986; Bishr et al., 1997; Pitoura et al., 1995; Reddy et al., 1994; Spaccapietra et al., 1992) between different schemata are resolved. These relate mainly to (Bishr et al., 1997): (a) naming conflicts, (b) semantic conflicts, and (c) schematic conflicts. Naming conflicts contain homonyms, where the same name is ascribed to different concepts and synonyms, where different names describe the same concept. Semantic conflicts occur due to different interpretations of the same concept. Schematic conflicts rise due to differences in schema elements (i.e., objects, attributes and relationships) of different schemata.

Finally, the integration process converts the input classification schemata to a single schema corresponding to an integrated but also uncompromising conception of space. Namely, the original classes and attributes are not altered, but semantically related to each other to form the final hierarchical schema. Therefore, the integration process identifies similarities and reconciles differences without preventing the independent and autonomous use of the original schemata.

USAGE OF THE INTEGRATED SCHEMA

The integration of different classification schemata provides a flexible and effective means to build a multi-scale, multi-context database. The integration can proceed both to the "vertical" and the "horizontal" direction (Fig. 1). "Vertical" integration refers to the association of classification schemata created for different scales, whereas "horizontal" integration refers to the fusion of classification schemata created by different agencies or for different applications. Thus, users can navigate along different scales, but also across different classification schemata and hence different conceptualizations of geographic data.

"The present research focuses primarily on class-driven generalization . . ."

The present research focuses primarily on class-driven generalization, separating the conceptual problem from the visualization context (Ruas & Lagrange, 1995; Kilpeläinen & Sarjakoski, 1995). From this perspective, generalization is considered as a process induced by variations in the conceptualization of space. Space is represented differently as scale changes. Correspondingly, variations in the perception and semantics of geographic information alter the level of detail. Class-driven generalization deals with changes in the perception and semantics of geographic information at a given level of detail. In this process, and contrary to geometric generalization, changes in the geometric aspects of features succeed changes in the conceptualization of geographic phenomena.

". . . the final hierarchical schema operates as a guide for determining the appropriate classification for a specific map scale."

SCL methodology serves as a basis for the development of a dynamic generalization / specialization process, which can subsequently be automated. Namely, the final hierarchical schema operates as a guide for determining the appropriate classification for a specific map scale. Given a scale and a context, the generalization hierarchy makes it possible to determine the appropriate "band" and derive the classes to be used (Fig. 8). Figure 9 shows an excerpt of the final hierarchical schema.

This particular case study addresses and associates two parameters of model generalization, scale and context. Apart from these parameters, the entity definition and its spatial characteristics also affect the model gener-

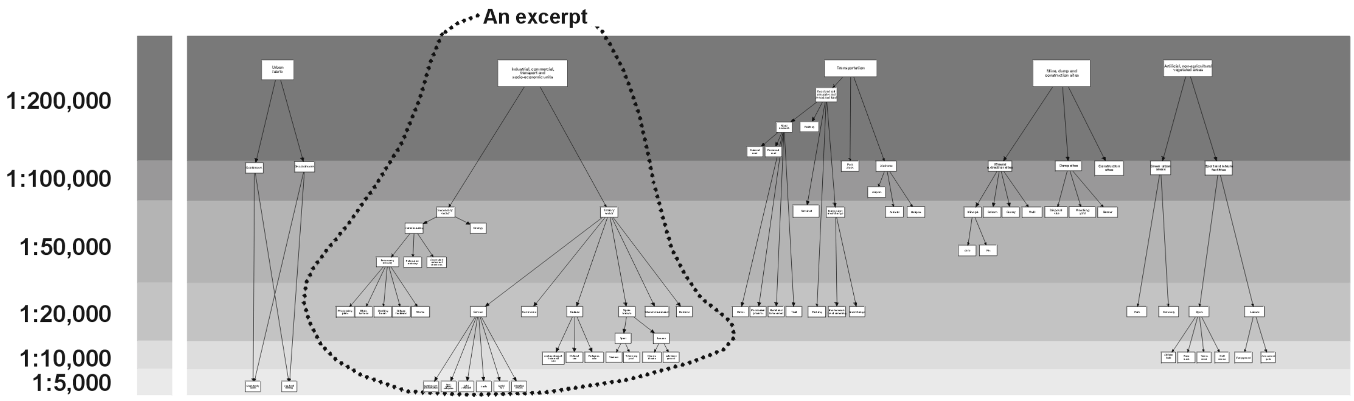

Figure 8. The final generalization hierarchy.

alization process, but they were not dealt with in this paper. Thus, classes are defined according to the scale and context specified by the user. These classes refer to specific geographic entities. For example, classes "Apartment building" and "Single-family house" appear at the lowest level of the hierarchical schema (large scale) referring to the geographical entity "building". If at this large scale, other more general entities must appear (e.g., "building blocks"), their classification shall be determined from the hierarchical level where they are defined.

Moreover, the final integrated schema, due to its hierarchical structure, represents links between similar classes at different levels of detail. This ability can be utilized to transfer from one level of detail to another and thus provide continuous on-the-fly generalization on the screen, depending on the zoom factor. Zooming in or out prompts a change to the classification schema and its corresponding legend. Large scales permit the inclusion of more classes. As scale decreases, thematic classes tend to collapse (Fig. 10). Users who zoom in or out in a dynamic environment perceive only those classes that are appropriate for the specific level of detail. Furthermore, they can navigate dynamically and continuously from any scale to any other and from any classification scheme to any other by alternating the parameters of scale and context.

"The hierarchical, integrated schema serves as a basis for the development of a dynamic thematic generalization process."

CONCLUSION

SCL constitute a methodology for integrating classification schemata corresponding not only to different scales, but also to different contexts. The resulting schema, due to its hierarchical structure, models the transition between similar classes at different levels of detail and different application perspectives. Therefore, the methodology constitutes a form of model generalization, based on attributes and semantic integration of different classifications. It provides the basis for determining the appropriate representation for a user-specified scale range or context, thus supporting dynamic thematic generalization.

A notable advantage of SCL is that the input classification schemata preserve their autonomy, because the developed methodology performs a complete integration and not a conversion between them. Consequently, each classification schema can still be used independently, as it is not altered, but it is semantically related to the others.

Future steps include further refinement of the methodology to address several kinds of attribute equivalencies and resolve conflicts occurring due to different domains or values of semantically similar attributes. In this case, the methodology would identify and distinguish data classes having different values of the same attributes.

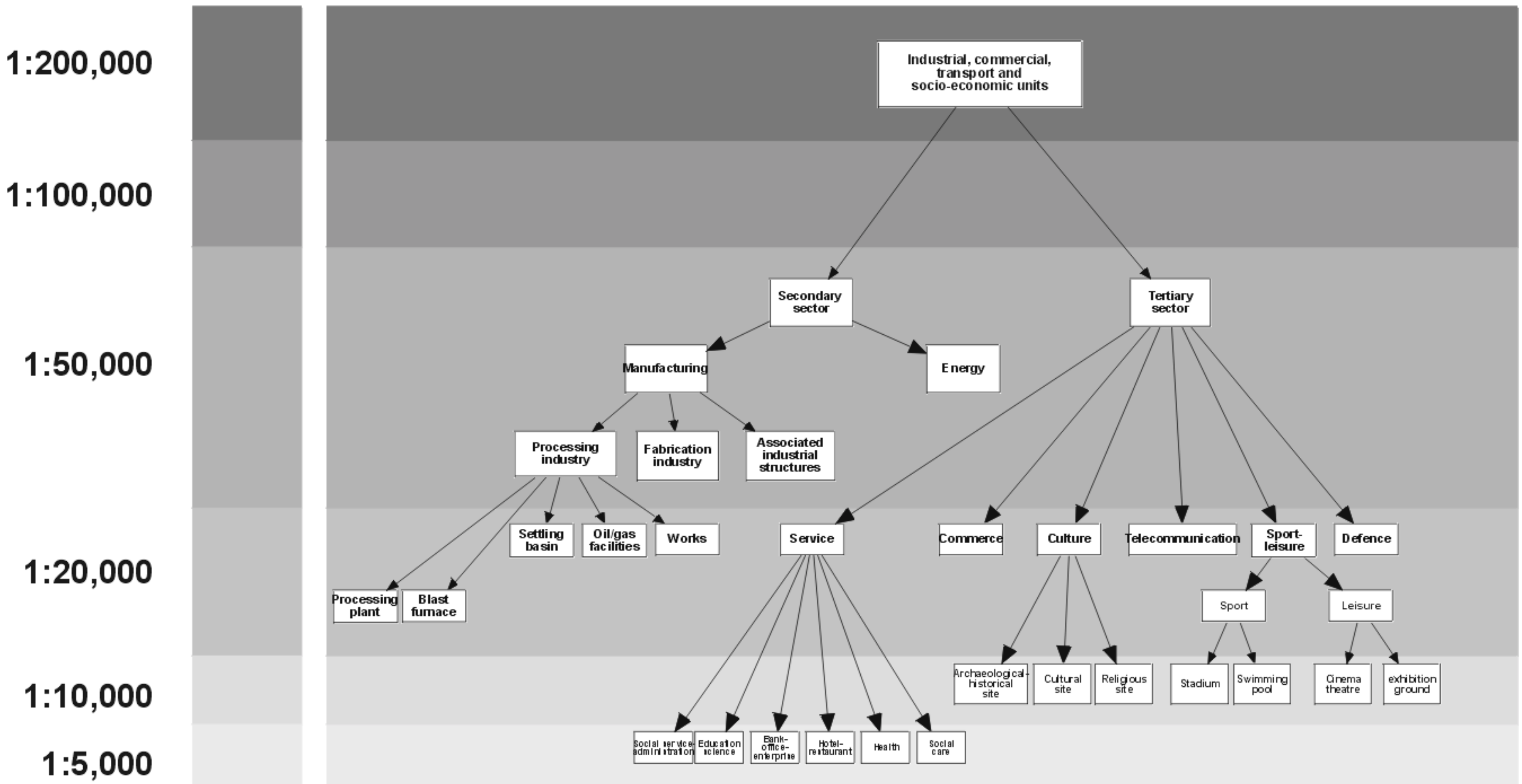

Figure 9. An excerpt of the final generalization hierarchy.

Figure 10. Thematic classes collapsing across scales.

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cartographic techniques

"UO Campus Mapping Program: Integrating CAD, GIS, and Map Publishing"

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Introduction

The University of Oregon Department of Geography's InfoGraphics Lab coordinates the UO's Campus Mapping Program for several offices on campus (Figure 1). The Campus Mapping Program consists of three main components, 1) Computer Aided Design (CAD) drawings of building floorplans, 2) campus Geographic Information Systems (GIS) mapping layers, and 3) graphic illustration map publishing files (Figure 2). Maintaining and integrating these various program components creates many challenges and opportunities. This paper will cover the design and implementation of a comprehensive campus mapping model that addresses multidisciplinary needs, administration issues, cross-campus coordination, and CAD / GIS / Graphic software and database integration.

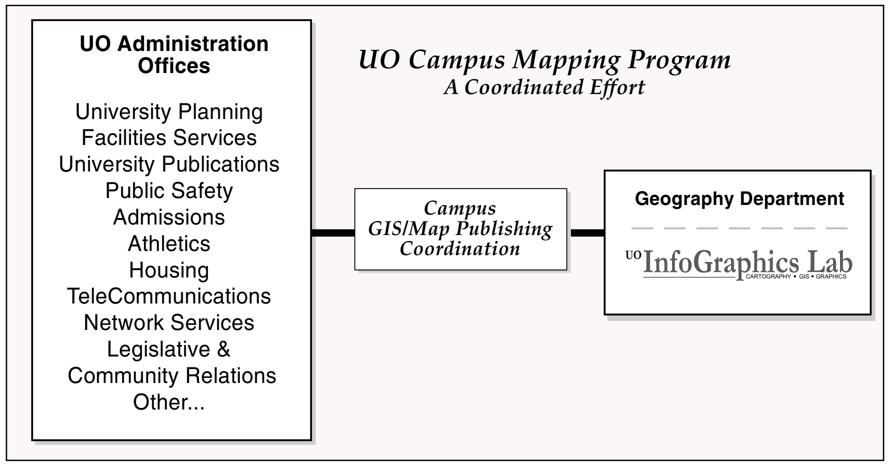

Figure 1. Campus mapping program participants.

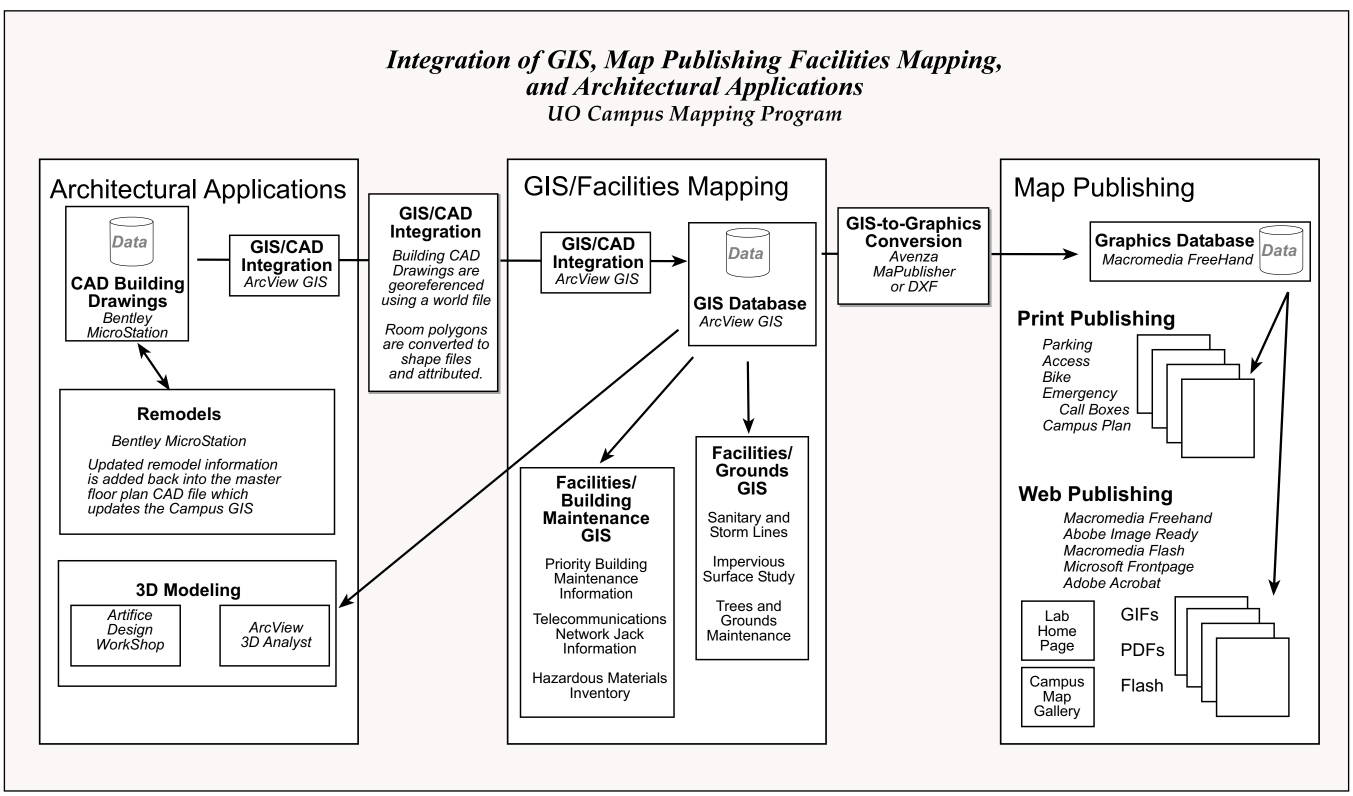

Figure 2. Integration of GIS, CAD, and graphics databases and applications.

Background

The current campus mapping effort was started in 1986. At that time, the University Planner contracted to have aerial photographs taken and a set of planimetric map panels created by a local photogrammetry firm. The resulting products were a set of Mylar 1:600 scale map panels with the original Intergraph IGDS design files. In 1988 the Geography Department acquired a new Intergraph Unix workstation with MicroStation CAD software. This gave the University of Oregon the ability to read and modify the campus CAD files. The panels were mosaicked together to create a new campus base map. Up until that time an ink-on-Mylar map had served the facility mapping needs.

The mapping program has grown in number of users, maps, applications and the size of the mapping databases. There has been an evolution from primarily CAD mapping to include graphic illustration cartography using Macromedia FreeHand and the implementation of Environmental Systems Research Institute (ESRI) ArcView GIS. These changes have been driven by a bottom-up approach of striving to understand and address changing map user needs and then applying new mapping methods and technologies to solve those needs. The program has grown from the single Unix Workstation in the Geography Department to include dozens of PC's and Mac's running CAD, GIS and graphic illustration programs spread across campus. In addition there are great numbers of users accessing the campus maps published on the web. The challenge is to smoothly integrate these systems and maintain the currency of the mapping files.

Multidisciplinary Approach

Creating an accurate and up-to-date spatial framework for campus information that can serve many university community needs is one of the main objectives of the mapping program. The multi-disciplinary needs vary greatly from architects using CAD to design remodels, to facility managers using GIS to inventory utilities and building maintenance information, to the University Publications Office needing high quality cartographic products in graphic illustration software for brochures and web pages. (Figure 1).

Administrative Issues

The UO InfoGraphics Lab housed in the Geography Department serves as the coordinator for this program. This program has created a mutually beneficial bridge between an academic research facility and the administrative offices charged with the management of the campus. The InfoGraphics Lab is a great position to assist campus offices with the implementation of new mapping technologies, helping them fulfill their missions more efficiently. Being able to serve the UO Campus also has many rewards for InfoGraphics Lab's research staff and student assistants in they are able to apply new GIS methodologies and mapping technologies right here on campus.

The funding of this program has been primarily through a "Campus Mapping Consortium." The University Planning Office is the founding member and provides guidance in establishing the concept of a mapping consortium. Each member provides an annual funding amount that reflects their use of and commitment to the campus mapping database and its development and derived map products. Part of the consortium concept is the development of an accurate common mapping database that serves as a vehicle to help bring the diverse working arms of the campus together. This works partly because the members become users and contributors to the system. A common mapping database facilitates more efficient data sharing among the member offices and other campus users. The semi-regular funding helps establish stability for the continued progression and maintenance of the program.

Software and Database **Integration**

Integration of CAD, GIS and graphic illustration software is central to the mapping program, because one software application does not fulfill the diverse mapping needs on campus. The use of CAD software for the architectural design, GIS for facilities management and graphic illustration software for publishing creates a need to for a mapping program that can efficiently move and integrate mapping databases between software applications.

Architectural Applications

The *Architectural Applications* consist of the development of a CAD database of buildings with floor plans and interior features. The CAD building floorplan drawings are created by the Facilities Services using Bentley MicroStation software. The building drawings rely on the source information of architectural construction and existing condition drawings. These drawing files are generated in a local coordinate system in the CAD file with the design unit of inches. The building floor plan drawings are used for remodels and various architectural and space planning needs.

The CAD files are integrated with the ArcView GIS database by georeferencing the building drawings with the campus map coordinate system (Figure 3). The first step in registering the building drawings is to shift the buildings within the CAD file so they are in their correct relative position to other cam-

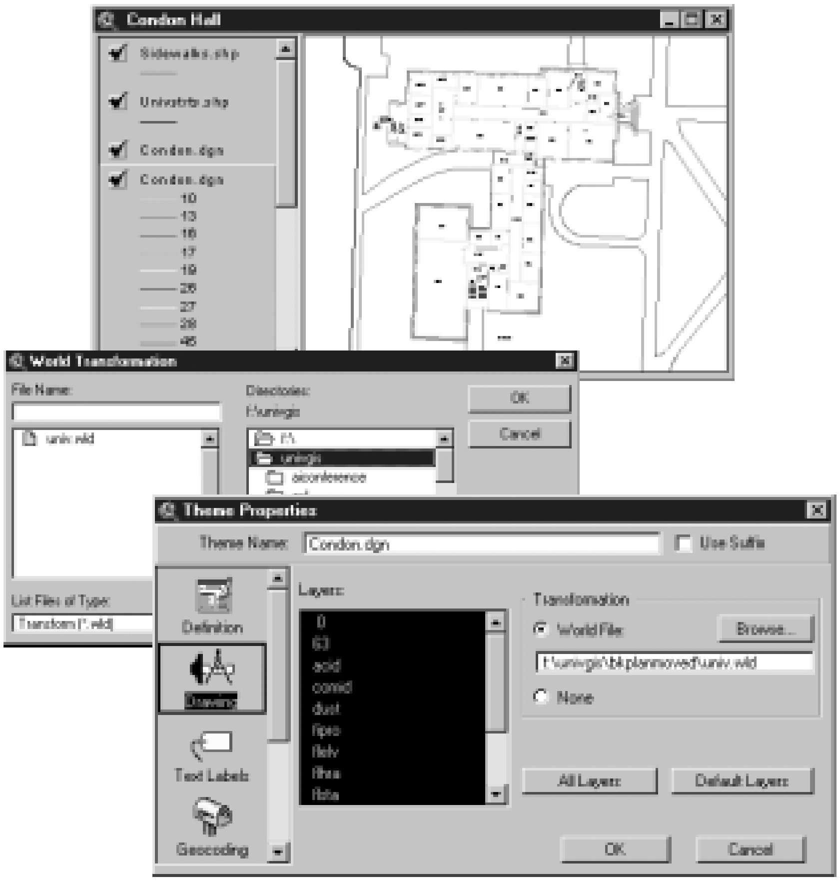

Figure 3. CAD/GIS Integration. Condon Hall first floor plan georeferenced with world file and added into campus GIS ArcView project.

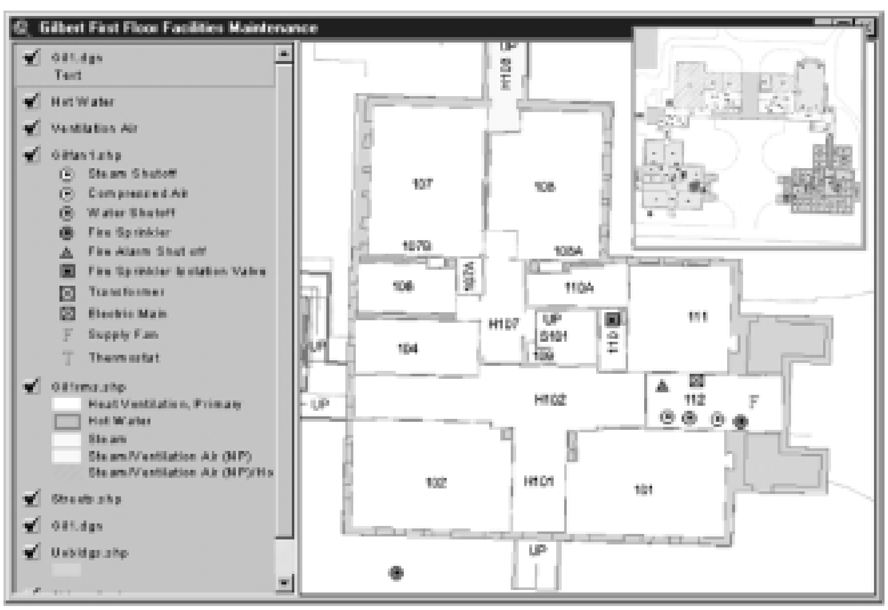

Figure 4. Building maintenance facilities mapping/GIS application: tracking of priority building information.

pus buildings. Having the buildings in their relative location to each other allows for use of a single common university "world file". In ArcView when the CAD drawing is added to a "view" the user can select the university world file from the "theme properties-drawing menu." The world file contains information for the coordinate offset, scale, and rotation to transform the CAD drawing into the campus GIS projection. The world file format is: <X,Y location in CAD drawing> <space> <X,Y location in geographic space>. The ArcView GIS online help has a good explanation of how to create a world file.

A layer within the CAD file is defined for room outline polygons. In ArcView the CAD file is added and the level with the room polygons is selected and converted to a shape file and attributes are added. The other layers in the CAD file are not converted as they are used only as a visual reference with the GIS themes.

GIS/Facilities Mapping

The *GIS/Facilities Mapping* area can be divided into two main categories: building maintenance and grounds maintenance. The building maintenance applications track a variety of maintenance and infrastructure information down to the room level (Figure 4). The grounds maintenance applications track campus-wide information on several themes including trees (Figure 5), storm lines, and sanitary lines. The GIS database contains base layers of building footprints, sidewalks, roads, hydrography, topography, and other base features. The GIS database is stored in an ArcView GIS shapefile format. The map projection is the same as local city and county government GIS mapping systems (Oregon State Plane South Lambert projection). Having a common projection is beneficial in exchanging facility, and planning GIS data layers with the city and county. This has been especially useful in making county zoning and city utility ESRI Arc/Info coverages available to university facility managers and planners.

A web-based GIS application is being planned and investigated potentially using either ESRI ArcIMS, Intergraph GeoMedia Web Map or another similar type application to serve the GIS campus layers on the internet.

Map Publishing

The *Map Publishing* part of the program relies primarily on FreeHand 8 for the development of many products for print and for the web. A series of FreeHand map files have been created for a variety of regular publications. The series includes maps for the university catalog, class schedule, parking (Figure 6), bicycling, campus at night, and campus accessibility, among others.

The FreeHand database of graphics information relies on updates from the ArcView GIS shape files and other sources. The ArcView Shape files are converted into FreeHand using Avenza MaPublisher. MaPublisher is also useful for converting CAD data in a DXF format into FreeHand.

Using FreeHand as the main application for map publications has allowed the InfoGraphics Lab to work successfully with the graphic-oriented University Publications and Printing Services in creating high quality products. The FreeHand files allow for more graphic control when producing a variety of web graphics. The main campus web map is in a GIF format (Figure 7) and the FreeHand maps that are created for print are converted directly into an Adobe PDF (Portable Document Format) and published on the web. Converting the FreeHand map to PDF directly out of FreeHand is an export option. The building drawings are also being converted from the CAD

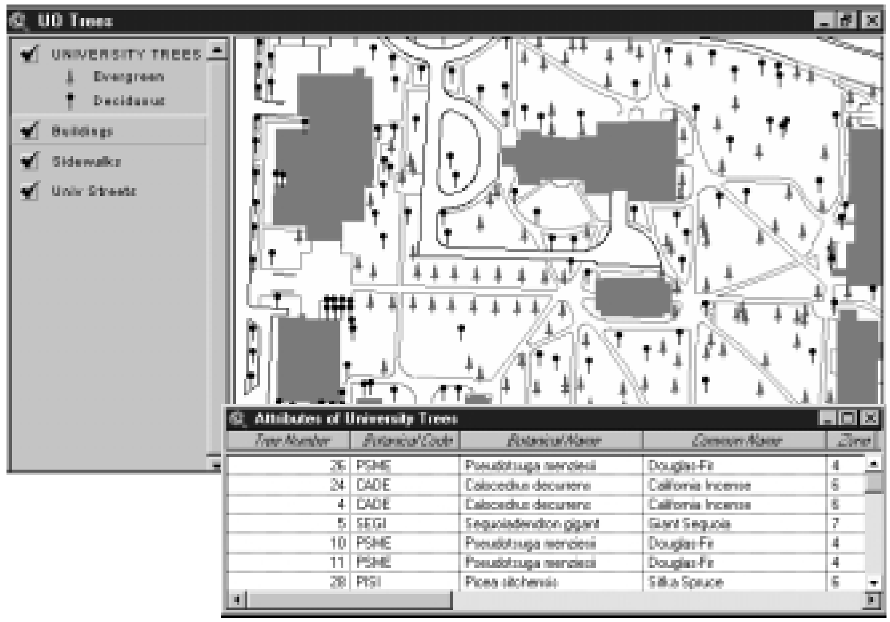

Figure 5. Grounds maintenance facilities mapping/GIS application: inventory of campus trees.

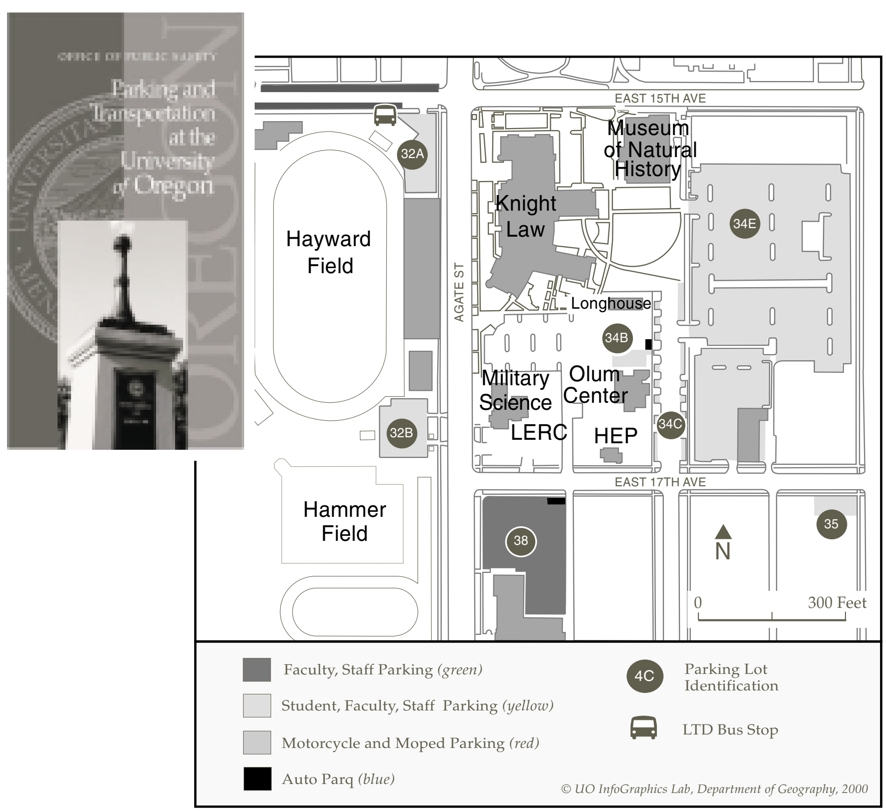

Figure 6. Portion of parking and transportation map with legend and reduced cover.

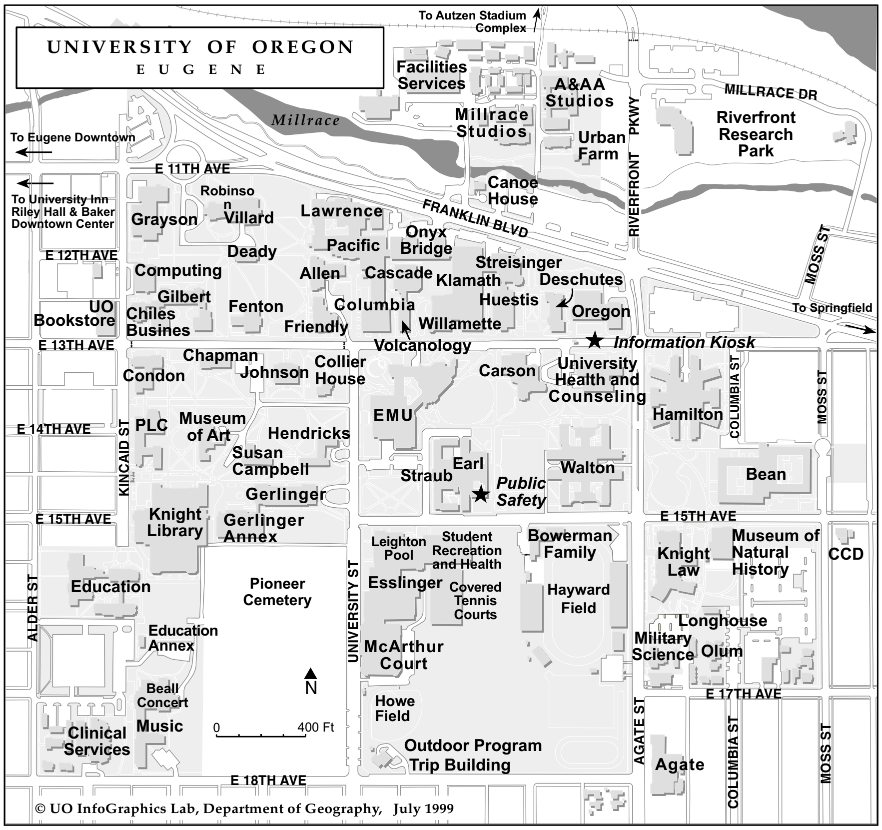

Figure 7. Main campus web map (published in GIF format).

format into a PDF for web publication.

By using a diverse number of tools and data formats we are able to solve a wide range of multi-disciplinary problems and provide better and more extensive service to the university community. We anticipate that the use of the campus map information will continue to increase and become more widespread as the web applications develop.

online mapping

Critical Success Factors when Publishing Internet Mapping Services

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The internet has changed the way cartographer's package and distribute maps. Rather than dwell upon previously well documented technical considerations of internet mapping, this paper concentrates upon the commercial and logistical factors which determine the success of an internet mapping service.

Internet Growth

The current annual rate of internet growth is estimated to be 46%[1]. This rate is driven primarily by an increasing range of access points, improved bandwidth and the growing availability of diverse content[2]. If the internet continues to expand exponentially, and is soon accessed by significant portions of the population, then the challenge for cartographers will be to deliver effective internet mapping services across this new publishing medium.

Internet Mapping Services

In the rapid transition from a paper to online medium the key needs of any map user have not altered greatly. The desire to conveniently navigate and locate places and people still exists today as it did during the previous centuries of paper based mapping.

What has altered is the technology with which we use to publish and distribute maps. Printing technology enabled cartographers to reach critical mass by making multiple copies of any one map edition[3]. Today, internet technology is enabling the re-packaging of maps and spatial information into more service based applications which have interactivity and customisation as their core function.

There are indeed many ways to segment the current range of mapping services available on the internet. The following attempts to do so across 5 broad application areas:

1. Mapping & Routing Services: Often with localisation (geocoding) functionality, used to position addresses, towns, POIs (Points of Interest) or other relevant locations (www.mapquest.com).
2. Dealer Locator Services: Published by organisations wishing to display the location of their dealer networks and thus assist customers in accessing and purchasing their goods and services (www.visa.com).
3. Directory Services: Location based mapping of directory databases such as White Pages, Yellow Pages or even classified advertising (www.whitepages.com.au).
4. City Guide Services: Online information regarding the leisure, entertainment and touristic activities of a particular town or city (www.newyork.sidewalk.com).
5. Telematic Integrated Services: Real time local information (such as traffic congestion) provided using internet protocols and increasingly delivered over wireless networks (www.etaktraffic.com).

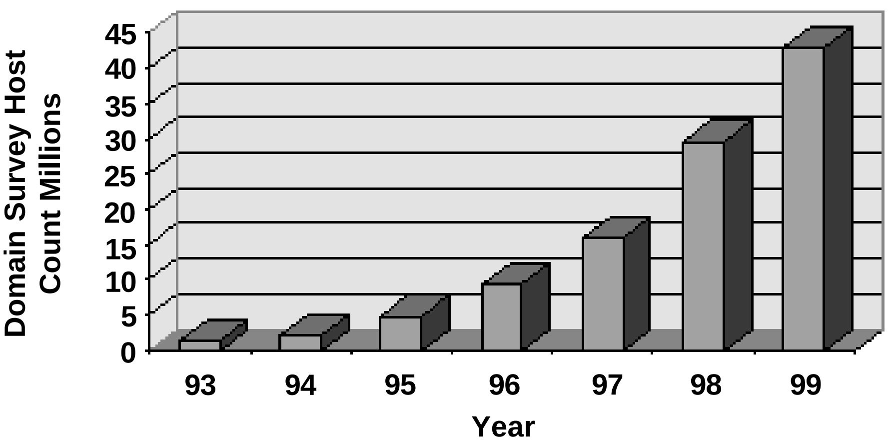

Figure 1. Annual Internet Growth Rate '93 - '99[1].

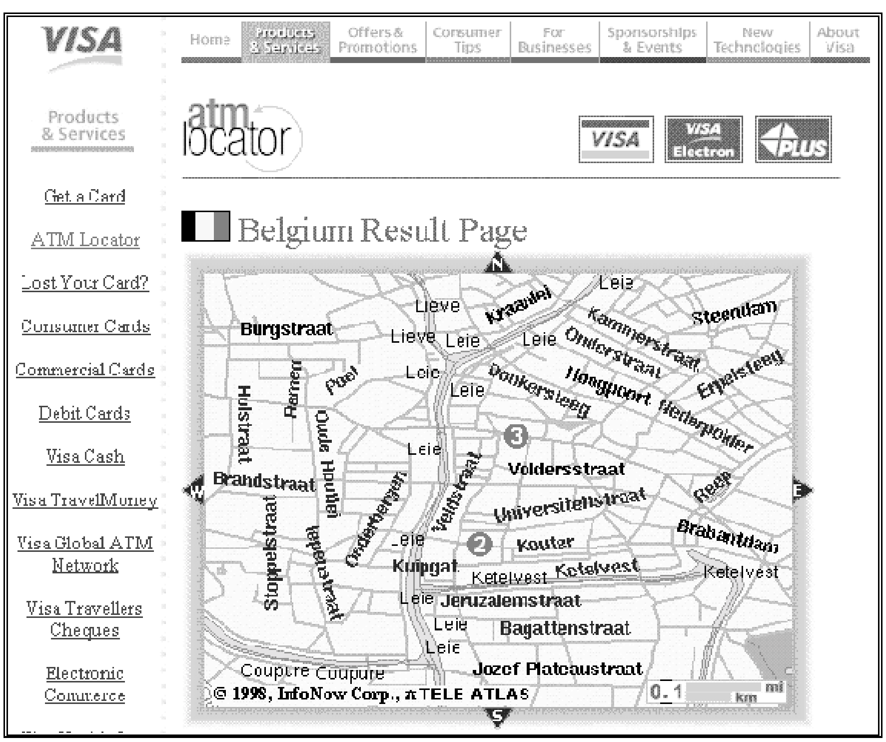

Figure 2. The VISA ATM locator service developed by InfoNow Corp. (www.visa.com).

Critical Success Factors

As with any mapping product, it is in the best interests of the internet map publisher to ensure that the user receives a more than satisfactory service. This will encourage repeat usage and hopefully enable the publisher to reach and maintain profitability. Factors which determine this are typically related to the cost and quality of the actual service.

Valued Eye Balls

The internet community represents a small, but rapidly growing, percentage of the population and as such has considerable power. This power has been used to quickly establish a marginal, if not free, expectation of the cost of any internet offering.

However, many users fail to realise that although they believe they are receiving a genuinely free service that they are in fact paying dearly with their time and attention rather than cash[4]. Online advertising has quickly established itself as the predominant model used to finance most web services with global advertising revenues estimated at $2.7 Billion US in 1999[5]. As such, it is in the map publishers interests to not only increase the number of users accessing their web site, often referred to in the internet world as 'eye balls', but also to lengthen the amount of time users spend accessing the site. This motive conflicts with most users desire to spend less time on the web accessing difficult to find and slow to use sites. If end users collectively desire more control over the quality of any internet based service then they must realise that this can only occur once the services receive greater funding, perhaps through more traditional payment methods. This will in turn provide sound justification for publishers to steer away from advertising as their sole source of internet revenue.

Payment after Delivery

Another unique aspect regarding the cost of any internet mapping service is that maps have to be virtually given away before they can be purchased. This has largely to do with the fact that electronic information cannot be shown without first giving it away (or portions of it). Either way, when a user pays for information (either with funds or through time) they are always paying for the last piece of information they received, not the next piece of information they are going to receive[6]. This is in complete contrast to what occurs when purchasing traditional maps and both the end users and publishers must also quickly adapt, and respect, this new online payment paradigm.

Value of Content

The cost of any internet mapping service is partly determined by the cost associated in securing content (ie digital map data, directory information, traffic information etc.). Unlike traditional cartographic publishers, who over many years were able to build and develop their own proprietary content, it is highly unlikely that publishers of electronic media will also be able to support the cost of sourcing, digitising and monitoring their own digital content. More often than not, publishers of internet mapping services will need to license the actual maps from dedicated content providers whose sole task is to develop and maintain digital mapping databases and other related information.

Regardless of whether it is the actual publisher who owns the intellectual rights, or whether the rights are held by a 3rd party, digital content providers themselves have several important issues to consider when licensing or publishing data over the internet which in turn directly effect the cost of any given service.

Unlike traditional forms of content, electronic content is not a scarce resource. For example, 10,000 un-sold maps are considered an asset because they are the last remaining titles of an expensive print edition. As such, these remaining maps are a scarce finite resource and, as basic economic principals state, will hold their value given no change in demand[7]. This is not the case for electronic information which, as a potentially infinite resource, can run the risk of not remaining scarce and therefore experience a dramatic decrease in value when distributed widely. This is a major dilemma electronic map providers face today when confronted with the massive distribution power of the internet.

Content or Context

If map content providers continue to focus upon the actual information they supply in licensing data online then they risk of running into a limited revenue stream as information approaches marginal commodity rates. Rather, content providers must study the context under which their data is distributed and used online. For example, an anxious tourist arriving in Paris without any idea of how to find a hotel will most probably pay more for this information then than prior to their arrival. It is in understanding this context, not the actual content, that providers of information will find successful models under which to license their data. More often than not, this means locking into the actual transaction which occurs when users access internet based services. Only through the establishment of transaction based licensing, or other related price models, will map content providers ensure that they also benefit from future internet growth.

Creating Friction

The main goal of any internet map publisher is to create friction[8]. The internet is a frictionless medium, owing to the fact that it takes no effort for a user to switch between sites. In fact, movement and navigating amongst different page views and hyperlinks is something that is encouraged and is one of the fundamental aspects of the world wide web.

The quality of any online service varies significantly and end users tend to remain loyal to those services from which they receive consistent results. Many believe that services will not improve until a viable commerce system, together with a range of suitable payment options, is put in place. Until such a time, maps of any real value will tend to stay with other media, such as printed publications, which have well established distribution models that support map publishers and their respective suppliers.

Quality internet mapping services can best be described as those which profit from the interactivity and multimedia opportunities implicit within electronic devices[9]. It is not simply enough to translate the all too familiar paper based product directly online. Utilising the implicit interactivity of the internet is key.

Interactive Functionality

Simple functionality, such as tools from which users can generate and email a customised route, will assist publishers in differentiating the internet service from paper. With end users now rapidly questioning the amount of time spent accessing unsatisfactory sites it will be only those few compelling services, which effectively couple mapping content with customisation and interactivity, that earn the repeat usage of a demanding map user.

Sophisticated internet solutions are now also possible which promote mobility and are expected to completely revolutionaise the way users interact with geographical information. Several European mobile phone operators are now trialing the next generation devices which utilise WAP (Wireless Application Protocols) to distribute map related services (www.webraska.com). Such technology will enable the map user to access internet mapping services while actually in the field and not restrict internet usage to the desktop.

Necessity of Brand

Making users aware of internet based services, and enabling them to easily access such services, is indeed a difficult task. Most first time users tend to locate services via major portal sites (ie www.yahoo.com). The internet is 'intangible' and often the only aspect with which a user can identify is the actual brand associated with particular services. The relationship, established between service providers and end users, must be packaged in a way that users instantly recognise and appreciate.

It is true that existing publishers over traditional mediums are able to benefit from their prior established brands when migrating to the internet. Michelin, who have a strong brand in European paper maps and travel guides, were able to benefit from their dominant consumer awareness when migrating their mapping services to the internet (www.michelin-travel.com). However, the internet also provides tremendous opportunities for new web-specific brands to quickly develop rapport. For example, MapQuest.com was a brand virtually unheard of 3 years ago and is now quickly becoming a 'household name' within the United States.

CONCLUSION

There are indeed many critical success factors that publishers must address when attempting to deliver internet mapping services. Unfortunately, many of the issues highlighted in this paper are currently unresolved, some even creating more questions than they do answers. Publishers of successful internet mapping services will be those who are quick to address

Figure 3. An example of an internet based mapping service, combined with real-time traffic information, and delivered to a WAP enabled mobile phone.

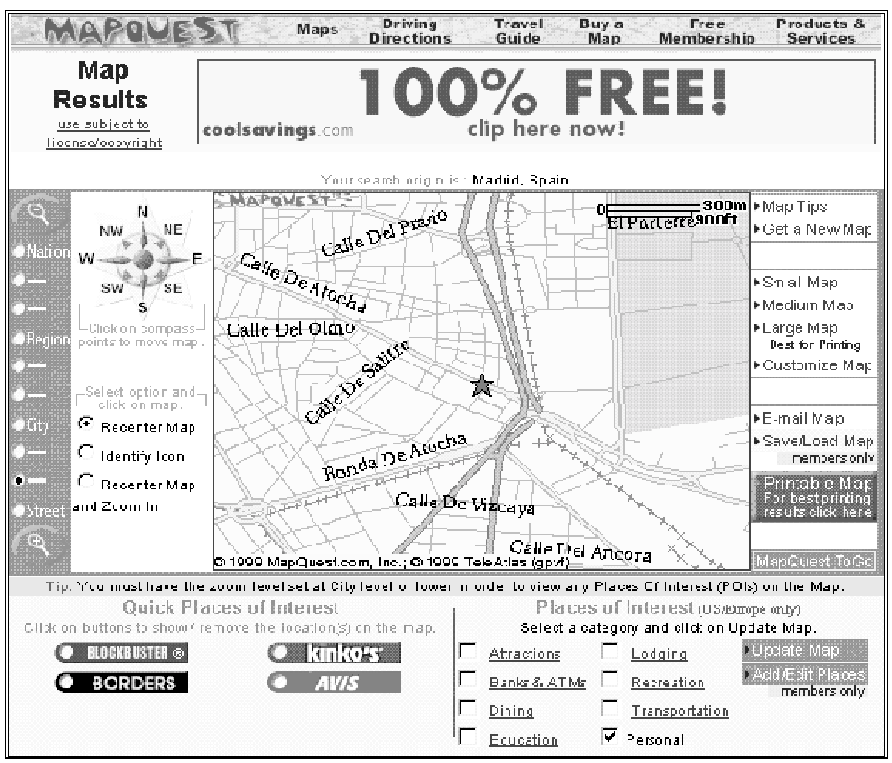

Figure 4. MapQuest.com is now an established global internet mapping brand (www.mapquest.com).

these issues and work towards appropriate solutions. Fortunately, the pace of internet growth will ensure that this occurs sooner than latter.

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Building an Atlas of Cyberspace

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What is Cyberspace and can cartographers map it? Cyberspace is the multifaceted digital space in and of computer networks. At the very heart of Cyberspace, and its golden children, the Internet and the Web, are a rich and deep foundation of spatial metaphors, both literary and visual (Adams 1997, Graham 1998). Given how deeply ingrained spatial metaphors are throughout the emerging Cyberspace, it would seem that cartographers have much to contribute in mapping out this new geography and advancing our understanding of it. Scholars in a number of disciplines have done valuable work critically examining Cyberspace through the lens of geographic space at varying scales; for example, urban planning (Graham & Marvin 1996), architecture (Mitchell 1995, Anders 1998), urban sociology (Castells 1996), and geography (Kitchin 1998, Crang et al. 1999). The field of information visualisation has emerged in the 1990s from computer science and computer graphics, and has contributed significantly to mapping Cyberspace (Card et al. 1999). Also, we should also not overlook the expertise in the graphic design community in charting Cyberspace (Jacobson 1999).

There is no one single map of Cyberspace that can show everything, just as there is no one map of the geography of a country like Britain. Instead, we compile atlases to show the complex and many fold geographies of a country. A comprehensive atlas of Britain covers all aspects - the landscape, the soil, the buildings, the roads, the people, disease, crime, wealth and poverty, rivers and rainfall. In just the same manner, an atlas of Cyberspace will contain many different kinds of maps, mapping the myriad distinct virtual spaces of Cyberspace (e.g. telephone & fax, email, web, chat rooms, multi-user games, intranets, and electronic financial flows). There are also different dimensions of the spaces to be mapped and understood (infrastructure, protocols, content and traffic). As yet, you can not buy an atlas of Cyberspace in the shops, but over the past couple of years I have attempted to construct one by combining the best maps of Cyberspace from many diverse sources. Appropriately enough the current version is available on the Web at <*http://www.cybergeography.org/atlas/*>. In the rest of this article I present five exemplars from the Atlas showing how different aspects of Cyberspace are being mapped and the diversity of cartographic forms being employed.

It is important to realise the Cyberspace is not new, it builds on decades of technological evolution in computing and telecommunications. While maps of Cyberspace have been drawn since its earliest times, for example there are the black and white line drawn maps of topological structure of ARPANET, the cold war forefather of today's Internet (figure 1). The maps were drawn for the engineers who built and managed the network and they are strictly utilitarian and functional, simply showing the nodes of the network - the advanced research labs of universities and corporations doing defence related research - and the links between them on an outline of the Continental USA. Figure 1 shows an example from October 1980, but a whole series were produced through the 1970s and 1980s from which one can trace the growth and eventual decline of the ARPANET. This map is particularly interesting for me, as it shows the satellite linkage from the US to London, installed in 1973, which connected to UCL where I now work. This wavy line on the map is significant as it represents the first wiring of the UK into the Net.

Maps like these, from the early days of wide-area networking and internetworking, are in some senses the ancient maps of Cyberspace. They are becoming important as historical documents recording the growth and spread of networks of which there is now little physical trace. For this reason they are frequently employed in books on the history of Net (e.g. Salus 1995, Hafner & Lyons 1996, Abbate 1999), after all what better means of illustrating a network that has disappeared than a map of it. For further examples, see the historical maps section of the *Atlas of Cyberspace* at <*http://www.cybergeography.org/atlas/historical.html*>.

Mapping the infrastructure - the nodes and wires - is a common representation of Cyberspace. Look around the web sites of telecommunications companies and ISPs and you will almost always find some kind of marketing map propounding the power and capacity of their network to potential customers. (Many examples are shown at <*http://www.cybergeography.org/atlas/isp_maps.html*>.) Computer scientists and network researchers who are trying to understand and better engineer the Internet also employ maps in their work. A notable example, which extends cartographic form beyond a conventional planar view of the world, was the work of Tamara Munzner and colleagues, who mapped the nodes and wires of Cyberspace in three-dimensions onto the globe (Munzner et al. 1996).

They mapped the geographic topology of part of the Internet called the MBone, visualising the links between routers as arcs traversing the Earth high in space. The result is a visually striking and powerful image of Cyberspace, in many ways matching people's popular imagination as arcs of light encircling the globe (figure 2). Their maps were created as 3d models in Virtual Reality Modelling Language (VRML) and they are available online allowing the map reader to download them, with an appropriately configured Web browser, and explore them from any position or angle.

(See <*http://oceana.nlanr.net/PlanetMulticast/*>)

Other researchers mapping Cyberspace have chosen to lose the familiar, and perhaps constraining, framework of real-world geography, latitude and longitude and country boundaries. Instead, they map Cyberspace onto abstract grids of their own choosing. One of the best recent examples of this approach are the massive and richly

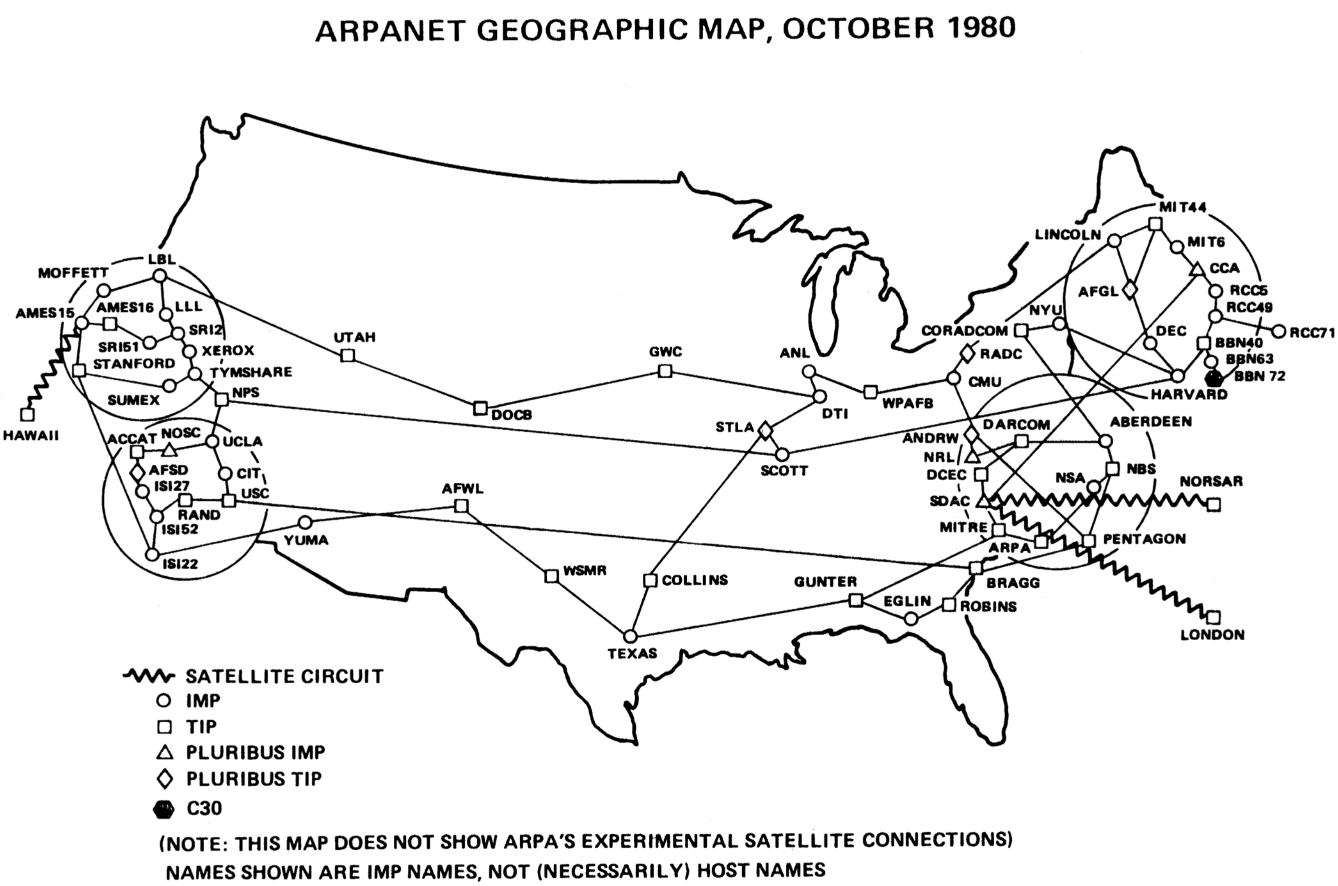

Figure 1: An arc-node style map of ARPANET in October 1980. (Source: CCR 1990, copyright: The Computer Museum, Boston, MA.)

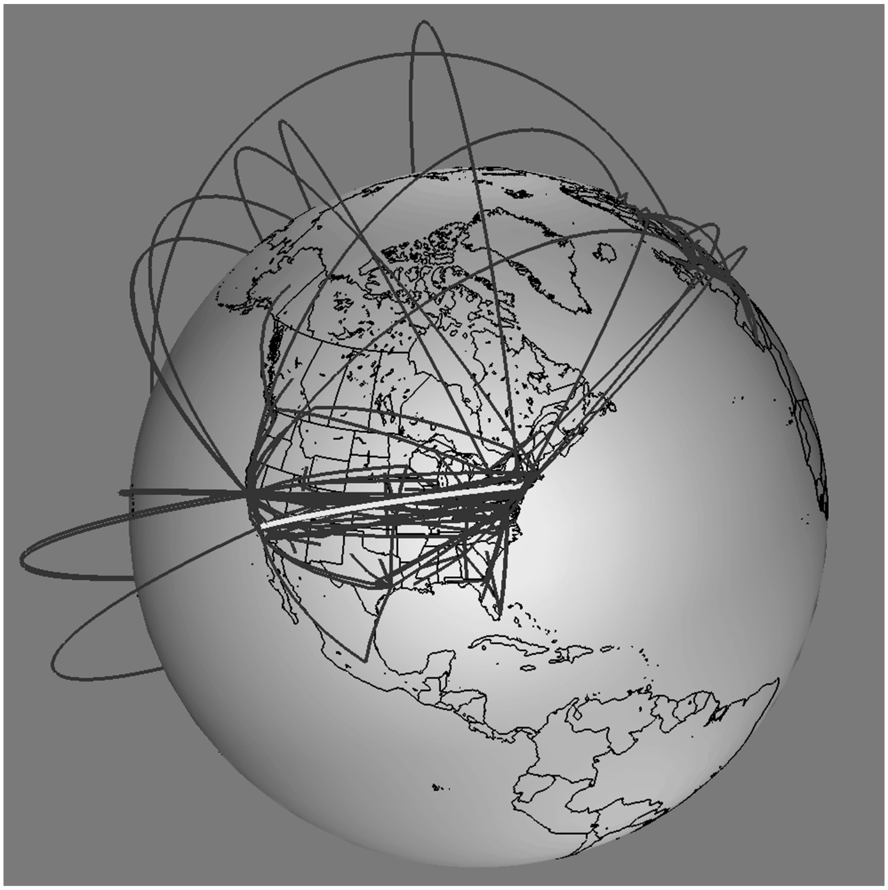

Figure 2: Three-dimensional global MBone map by Tamara Munzner, K Claffy, Eric Hoffman and Bill Fenner. (Source: Munzner et al. 1996)

detailed visualisations of the Internet produced by Bill Cheswick, a researcher at Lucent Technologies-Bell Labs and Hal Burch, a graduate student at Carnegie Mellon University (Burch & Cheswick 1999).

Cheswick and Burch use the Internet to measure itself, tracing the routes data packets take to reach several thousand sample nodes which reveals how the many intermediate computers and networks connect together to form the Internet. They map the results as a huge graph containing nearly one hundred thousand edges (figure 3). This maps Cyberspace with the appearance of a human lung from an anatomy book, with its incredibly fine lattice of filaments laid bare for all to see. In addition, the map is an image of considerable fractal beauty.

For many people it is more important to map what is "on top" of the infrastructure, rather than focus on the computers and wires. How can we map the actual information content and human interactions of Cyberspace. The largest information space on the Internet at present is the World Wide Web, comprising upwards of 800 million publicly indexable pages, on over three million servers (Lawrence & Giles 1999), that are all interconnected by hyperlinks to form the eponymous web. Users have difficulty navigating through this vast Web space to find the things that interest them in a timely fashion. What they need, perhaps, is a map of the Web from a distance, floating above it somehow, so they can get a broad view of the information landscape.

An obvious approach is to map the structure of Web pages and the hyperlinks between them as a graph. This has been attempted with little success beyond visualising individual Web sites, because the graphs quickly grow so large and dense as to be impossible to use as navigational maps. In addition, mapping the Web's structure does not really tell us much about the actual content of the pages. An interesting alternative strategy is to map this information content as a landscape using the terrain metaphor from conventional topographic mapping. There are several academic projects and commercial applications which produce information terrains, with the best current example being NewsMaps (http://www.newsmaps.com/). Figure 4 shows an example of a NewsMap map from mid June 1999. It maps the information content of 951 online news reports on the Kosovan war.

NewsMaps uses sophisticated analytical software, developed by Cartia (http://www.cartia.com/), to process and in some senses understand the content of an information space, in this case a large collection of online news reports on the Kosovan war, determining what are the key topics and how they relate to each other. This statistical abstraction of the information is mapped as a continuous terrain, with virtual mountain peaks representing the most popular topics in the news reports. The higher the peak the more significant the topic. Spatial proximity is used to layout topics, so the more related two topics are, the closer together they will be drawn on the map. The maps are interactive and can be explored on the Web, helping people gain an overall sense of the topography of the information space and track down particular news articles or Web pages of interest. The fundamental research into the processing techniques behind NewsMaps was funded by US intelligence agencies to aid them in understanding,

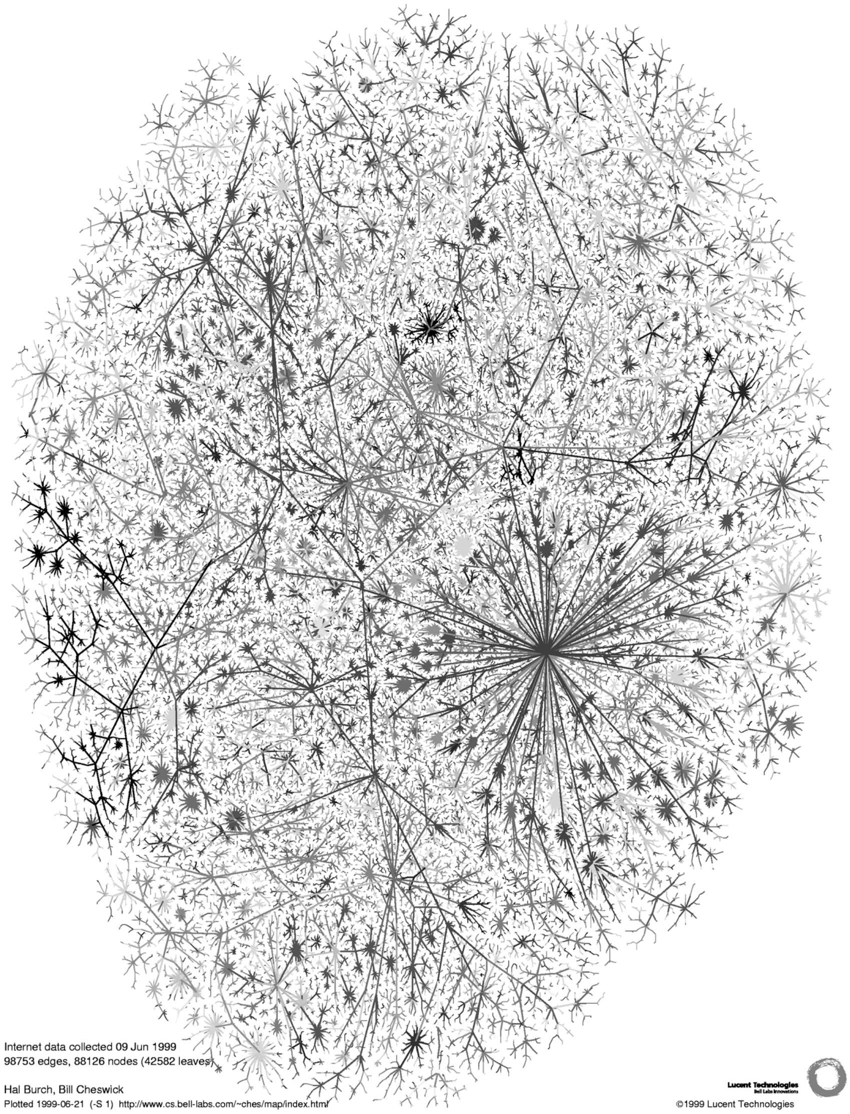

Figure 3: The Internet Mapped as a Graph, by Hal Burch and Bill Cheswick, 9th June 1999. (Copyright: Lucent Technologies)

through visual mapping, their vast information resources.

People talk to each other in Cyberspace. Some of the most popular activities, beside the rather solitary act of Web browsing, involve real-time conversations (via short typed text messages) between real people. Millions of people meet and talk in all manner of chat channels and rooms. All this raucous chatter is the vibrant social heart of Cyberspace, but how can it be mapped? Researchers, Fernanda Viégas and Judith Donath at MIT's Media Lab, are developing what they term "social visualization" to map these Cyberspace conversations. Figure 5 shows one of their innovative mapping techniques called Chat Circles (Viégas & Donath 1999).

This maps the participants of chat rooms as different coloured circles. The size and brightness of the circles is dependent on how much and how open the people talk. Circles also cluster together to conduct particular conversations, just like the groups that form at a party. Overtime the dynamic of the conversation can be seen as the circles grow and shrink, and drift to different groups. A major aim of their research is to provide a more visually appealing and useable interface to real-time conversations than the austere windows of scrolling text of conventional chat software. This highlights the fact that much of the effort in mapping Cyberspace is really about providing better interfaces to existing online information or activities, which is becoming possible through interactive computer graphics and greater network bandwidths (Holtzman 1997, Johnson 1997).

There are many more example maps we could look at, visualising different aspects of Cyberspace, and using many different graphic styles. Many are experimental, work in progress, only providing a fragmentary, imperfect view of Cyberspace, just like the Mappae Mundi's gave of the ancient world. However, they are still worth examining because they having a powerful impact on how people are conceiving the shape and form of Cyberspace. Like the Mappae Mundi, today's maps of Cyberspace provide a visual structure for thinking about the world, a world that is now virtual.

Martin Dodge is a researcher, computer technician and part-time PhD student in the Centre for Advanced Spatial Analysis, University College London, Gower Street, London, UK. His principle area of research is the geography of Cyberspace and he maintains an Atlas of Cyberspaces at http://www.cybergeography.org/atlas; he can be contacted at m.dodge@ucl.ac.uk.

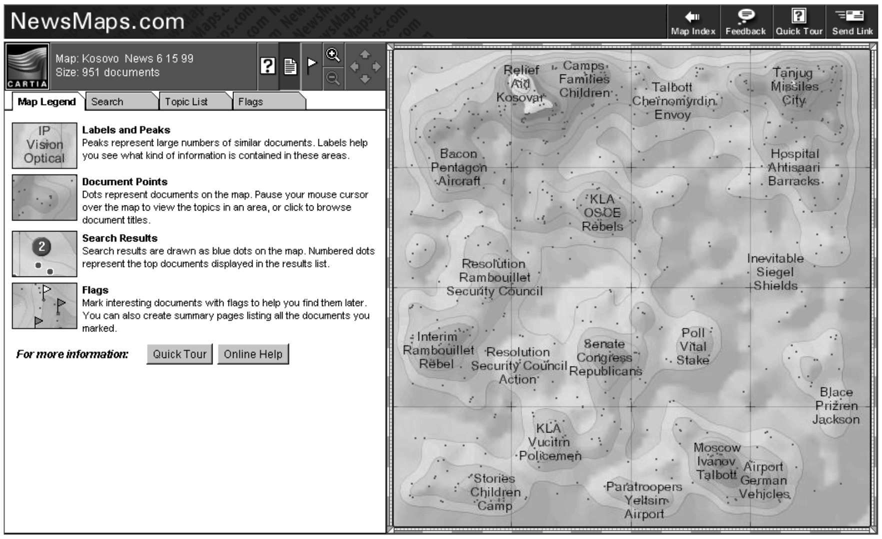

Figure 4: NewsMap information landscape map of Kosovan war news report from June 1999. (Source: http://www.newsmaps.com/)

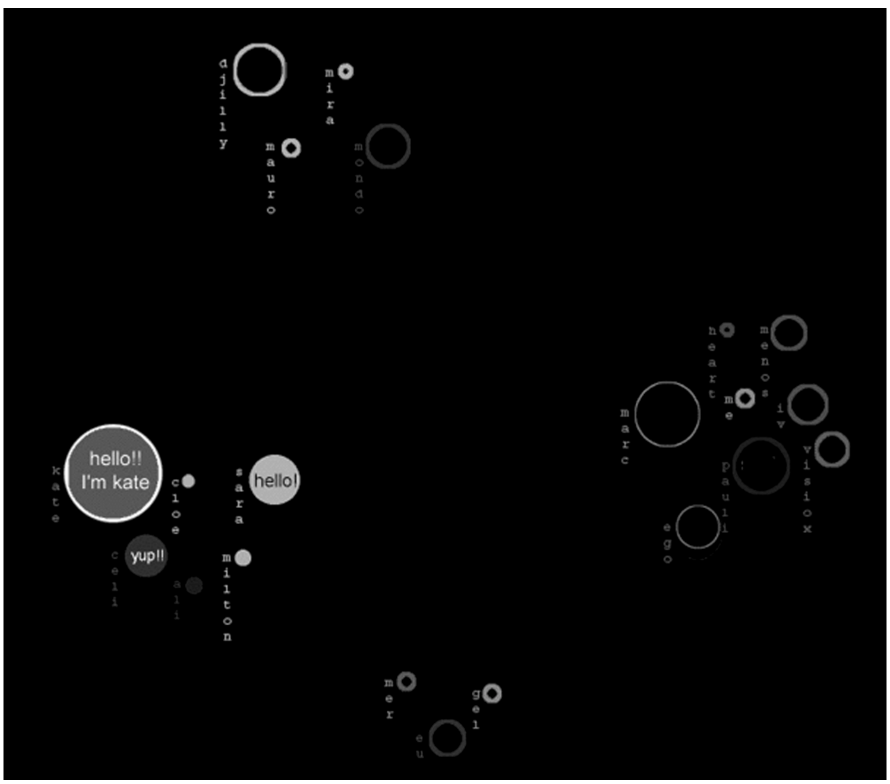

Figure 5: Chat Circles by Fernanda Viégas and Judith Donath. (Source: http://www.media.mit.edu/~fviegas/circles/)

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news release

A beautiful new “Shaded Relief” map of North America has been published as part of the National Atlas of the United States. Digital elevation data and computer software were used to produce a stunning portrait of America’s terrain.

The terrain is “illuminated” from the northwest with a simulated sun angle of 45 degrees. 23 distinct color tones depict broad elevation ranges. Within each color range, the lightest color tones represent fully illuminated steep slopes and the darkest tones represent steep areas in shadow. This is a particularly effective method for portraying relief since this “hill shading” technique produces an easily interpreted image of the landscape and a good impression of general elevation.

The map measures 39" by 43.5", is published at the scale of 1:10,000,000, and covers all of North America.

The “Shaded Relief” map is available from USGS Information Services, Box 25286, Denver, Co 80225. The price is $7.00 per sheet, plus $5.00 handling per order. The stock number is TUS5682. Credit card orders may be faxed to 303-202-4693. Please include the credit card number and expiration date.

The National Atlas of the United States of America is designed to promote greater geographic awareness through the development and delivery of products that provide easy to use, map-like views of our natural and socio-cultural landscapes. Visit the national atlas online at http://www.usgs.gov/atlas.

cuac minutes

CUAC May 7, 1999, 9:00 a.m.

GOVERNMENT PRINTING OFFICE (GPO)
Robin Haun-Mohamed

Our first speaker was Robin Haun-Mohamed, Chief of the Depository Administration Branch of GPO Library Program Service (LPS), who set the stage for CUAC’s primary mission of getting maps and cartographic and spatial data into the depository program. Robin began with a synopsis of the Federal Depository Library Program (FDLP). Depository libraries date back to the formation of the Government Printing Office in 1895. There are 1350 depository libraries in the United States, and 50 of those libraries are Regional libraries that are mandated to receive all material distributed by the FDLP and keep it in perpetuity. The other libraries are selective in nature. They have the opportunity to select the items they wish to receive for the year, and they may deselect at any time. After material is 5 years old or older, they may discard this material by sending lists of these items through their Regional libraries. All depository libraries must be open to the public and provide free access to all government data. All government information must be processed and made accessible on whatever catalog or access tools the library provides.

Products distributed by the Depository Program include paper, microfiche, and tangible electronic formats. Dissemination to libraries in an online-only format has now also begun for some information products. The maps in the program include those from USGS, BLM, Forest Service, National Park Service, NOAA, FEMA, and NIMA.

The services that the Program offers to federal agencies include paying for the distribution of the products through a very efficient distribution system. They can provide a list of libraries that receive agency products so that an agency can know who the likely users of their products are. GPO catalogs the products using the OCLC network. Long term access for users and for agency use is assured. The FDLP sponsors programs that include opportunities for federal agencies to speak to the librarians in attendance. When printing is done by GPO, printing of publications for the Depository Program comes out of the GPO budget and not the agency budget. When printing is obtained by the agency outside GPO, then printing of copies for the depository program must be paid for by the agency.

Robin talked about GPO's mandate under Title 44 of the U.S. Code that states that all government, publicly funded publications will be made available to GPO for the distribution to libraries in the FDLP. Exceptions are publications that are for internal use only or documents that are classified.

Their biggest challenge is cooperative publications that depend upon sales for cost-recovery. These are publications that are done with endowment funds, private funds, and / or agreement with a second or third party. Although these are more of a challenge to obtain for the FDLP, GPO still will ask for them. Robin explained the technicalities of how orders are received from regional offices, like the Denver Regional Printing Office and how the cost to the agency works for different types of print orders. Fugitive documents— those that escape the distribution program— remain a constant challenge. The Library Program Service has a position devoted to contacting agencies to try to get an appropriate number of copies. If sufficient paper copies cannot be obtained, an order for fiche copies is made. This process is paid for by GPO.

Online-only products are new for them. In the electronic environment they refer to dissemination instead of distribution. For these products they ask the following questions: Does it fit the scope of the program, and does it look like it will be around long enough to make a permanent record for it? If so, they catalog the product and send information to the depository libraries via the online U.S. Government Publications Catalog or via some other locator service, such as the *Browse Electronic Titles,* which is an agency listing and then a list by title. The URL is put into the cataloging record.

To deal with constantly changing addresses on the Web for the online-only products they disseminate, they use the Persistent Uniform Resource Locator (PURL) which is software provided through OCLC that will allow an address to be found on the Web even if it changes from what it originally was when the record was created. They also still put in URLs. This project is about two years old now and is still in a developmental stage. Robin made this plea to the agencies: When a change is made to an agency Web site, please notify GPO so appropriate changes can be made to the links to the site in the record. If a site or data at the site is being given up, GPO especially wants to be informed so that the material can perhaps continue to be made accessible through the GPO server or through a partnership with a depository library.

GPO and the FDLP serve at the direction of Congress. The FDLP's budget is around $30 million, under the Superintendent of Documents, who also directs the sales program. There are around 150 people employed in this part of GPO.

Robin next addressed specific concerns with the distribution of depository map products. There are ongoing problems with the distribution of NIMA products. Previously NIMA maps were distributed directly from the agency, just as USGS maps are. About a year ago, the distribution responsibility was given to the Defense Logistics Agency, and there have been problems ever since. There have been no changes to the selection profiles for the last six years, and there are other problems as well. GPO now has brought the distribution of NIMA maps back into GPO. But now GPO is still having problems with getting accurate numbers of maps from NIMA. Most are arriving with insufficient copies to ship. They are still in negotiation with them to resolve the problems. Shipping lists will be separate for these maps, and they will be dropped into the depository boxes or a separate mailing to separate housing sites.

USGS

Robin and others from GPO have been working with USGS for the past couple of days on their distribution process, and updating this process. Through a new memorandum of understanding, shipping (or sending) lists for USGS maps will now come in depository boxes, or separately for separate housing sites.

The National Wetlands Inventory Maps have begun to arrive from NARA in Seattle where they are being produced. They are much improved, beautiful fiche. We probably have lots of duplicates, because some of them were very poorly filmed and many were redone. We just need to make sure that we have one complete set and treat others as duplicates. There is a problem with the new set from Seattle, however, and that is what is holding them up. They were filmed six to a set even if there were not enough to fill that many fiche, so there are lots of blank fiche. Robin will need to reformat them before she has all of the copies made for the libraries. The 1st generation silver master runs about $8 / fiche and goes to NARA as part of the GPO collection every four years, while 2nd generation silver is used to reproduce from and then it goes to LC. If GPO needs it later, it can go to LC to get it. The diazos, which are what the depository copies are, cost just 6 – 10 cents each. Originals go to cataloging, but after they are cataloged they are boxed up and go on to NARA and LC.

NOAA

Print-on-demand of nautical charts was announced last year. The nautical charts are being printed under a CRADA, which frequently means cost recovery and that the product will fall outside the program. NOAA did offer to send one copy of each chart to GPO, however. GPO negotiated for just one chart a year out of the six that were being produced. They will distribute these to libraries. If a library needs the charts more often GPO would facilitate that arrangement with NOAA.

NATIONAL ATLAS

This is a CRADA product and is available on the Web. There are three map sheets that have gone to the depositories that are part of the Atlas and these have been cataloged and are in OCLC.

CENSUS

There is a new release of the TIGER line files. These should be in our libraries very soon.

NEW PRODUCTS

There are two new products. GAP analysis data CD-ROMs and the RMP Submits. Depository libraries are being surveyed regarding these products. All libraries must respond, including Regionals. The USGS Biological Resources Division Gap Analysis Program (GAP) is the primary Federal program for mapping and assessing the status of biodiversity in the U.S. Data for each state will appear on 1 to 4 CDs depending on the size of the state and data complexity. The viewing software for the GAP Analysis data is on disc 1 only, which is the California disc. Anyone wanting to select their own state only should remember to also select the California disc in order to get the software.

Risk Management Program requires that chemical plants, power plants and all industrial facilities that are required to submit information to EPA submit a Risk Management Plan (RMP). RMP Submit is an EPA software package for facilities to use in submitting Risk Management Plans. This has been prepared under Congressional direction. The Plans were supposed to be a Web product. However, a senator became concerned about putting this type information on the Web, especially with the danger of nuclear and / or terrorist attack, and stopped the plan. The part of the data that will not be on the Web is called the Offsite Cost Analysis, or OCA data. GPO is still hoping to get some of the data, minus the sensitive portion. It is not certain at this point whether this information will become available. What is currently available, and being surveyed for is a CD-ROM product that will require the depository library to store the software and information from the user on their hard drive until the plan is copied. This is the reason that a survey is necessary.

QUESTIONS

Robin then posed some questions for CUAC. She has asked that we address these issues before the end of our meeting.

- What is the role of physical maps in depository map libraries, especially in light of the transition to electronic data?
- What is the role of shipping lists . . . is there a possibility that GPO could go to a shipping list posting on the web?
- What is the role of the availability records in the cataloging of maps. The availability records are the ones which identify the different editions of maps.
- What is the trend between GIS collections and the paper map collection. What is the interelation between the two. Are they existing together or separately. What impact do we see on the program?

FOREST SERVICE
Steve Gregonis

Our next speaker was Steve Gregonis, the Region II GIS Coordinator for the National Forest Service (NFS). The main points of his discussion were data dissemination and archiving data. Over the last few years, NFS has set priorities on assembling a GIS base for use in planning. This data, in turn, is made available for analysis. They are having a problem with standards—roads, vegetation, etc. Other problems are occurring with the texture of the data—how detailed the data is. Steve's group is attempting to raise their level of service so that it can be offered to NFS and the individual National Forests. For example, NFS is using GIS extensively in compiling each National Forest's 5-year Service Plan. GIS is speeding the updating of those documents. The 5-year plans are public documents that come through the Depository Program.

Most of the digitizing for the base maps and many of the layers for Region II have been completed. The problem arises in archiving the data—whether it be in paper or digital format. As NFS tries to archive the data, they are having problems finding out where the data originated. In order to correct this, NFS is attempting to attach metadata to each data set using the Federal Geographic Data Committee standards. But the task of adding metadata is daunting. Currently, Steve's Region has thousands of sets of data, but only a few have metadata.

The data is being made available. Several of the Service Plans will soon be released on CD-ROM. However, most of the data sets are only available through the agency that compiled it. In response to this, the Region is attempting to put together a library of regional data. NFS is working in cooperation with local authorities, including state and local governments, to establish data clearinghouses. On a national level, NFS is attempting to standardize their data so that information can be shared. They have set up three modules (infrastructure, vegetation, water), and hope the data will be able to fit into these categories. The project is very big and will take time to be completed.

Archiving GIS data has caused many problems for NFS. One of the biggest is that GIS data can change without notice. Steve explained that in the GIS field, most expect this. Currently, the whole way of archiving data is somewhat informal, but because of some recent Freedom of Information inquiries, that is becoming more formal. Steve pointed out that there is a big difference between archiving a map and archiving data.

FOREST SERVICE
Dave Wolf

Dave Wolf, Forest Service Geometrics Group Leader for the Rocky Mountain Region (Region 2), continued the discussion. He stressed that hard copy maps would still be available because that is the way the public wants them. In addition to the print, we will begin to see more products in electronic form, CDs, and on the Web. Mr. Wolf asked if libraries wanted print and electronic products, to which the answer was yes.

The updating universe has changed. Where traditionally printed updates to maps were produced on a cyclic basis, electronic databases are under continuous revision. The question is when to produce a printed update. The Forest Service is partnering with USGS to produce updates of the quad maps for forest lands and visitor maps. Production of these updates is progressing.

Mr. Wolf decried the lack of national coordination in the Forest Service to handle production and distribution questions. No standards are being adopted concerning new base map features identified in electronic products. What products will be produced, what will be archived, and will it be free? He gave the example of the National Forest maps that are produced from sales receipts. The data for producing the maps is integral to the mission of the agency but the printed product is not. Does that meet the criteria for inclusion in the depository system?

Mr. Wolf left us much insightful information on the mapping efforts and practices of the Forest Service and many questions federal agencies producing maps and map librarians need to contemplate and answer.

BUREAU OF RECLAMATION
Dave Eckhart (for Mike Pucherelli)

Dave Eckhart works with the Remote Sensing and Geographic Information Group of the Bureau of Reclamation (BOR) at the Denver Federal Center. This Group builds spatial databases for the Bureau and other agencies. The data comes from several sources:

- paper maps
- models (for instance, there is a current project relating to modeling dam failure which uses DEM and TIGER data)
- remotely sensed data (this is the source of the bulk of their data)

Examples of some of the remotely sensed source data that BOR uses include: conventional and digital aerial photography; LIDAR for high resolution DEM data; AVIRIS from NASA; AVHRR meteorological satellite data; Landsat data (used mostly for crop imaging); data from the French SPOT satellite and from Indian satellites; radar data; and airborne video (mostly for river information).

Much of the work the Group does relates to crop mapping, using high resolution data to define boundaries and low resolution (Landsat) data to determine what's growing on the land. Also, they are involved with water quality mapping for large reservoirs.

Regarding the archiving of their data sets, metadata is part of final output. The Principal Investigator for a project is responsible for making sure the metadata is completed and that it meets Federal Geographic Data Committee (FGDC) standards. The metadata is made available on a Bureau server. The user must browse by project names—the metadata on the server is not searchable by keyword. Most of the digital data, however, are not available except by contacting the person listed in metadata. The Remote Sensing and Geographic Information Group does keep a digital copy of the data in its office, but the original is sent to the client. In general, final products from projects are not accessible except from the client, and it will probably have been updated from the time it was delivered to them by the

Bureau's Remote Sensing and Geographic Information Group.

In the next few months over one hundred clearinghouse servers containing metadata will become searchable from the FGDC Clearinghouse home page. These nodes will be hosted by many agencies dealing with spatial data, such as the BOR and the USGS. Due the vast size of the data, however, actual data will probably not be online any time in the near future.

BUREAU OF RECLAMATION
Debbie Fugal

Debbie Fugal, Records Manager at the Bureau of Reclamation, provided a brief overview of her operations. All government agencies are required to create records related to the work of the agency. The creator of each record determines whether the record is permanent or temporary. Permanent records belong to the National Archives, which requires submission of records in paper, not electronic, format. The permanent record cutoff is the end of each calendar year. The records are transferred to the Federal Record Center 10 years after the cutoff. The FRC then transfers the records to the Archives 30 years after the cutoff.

With the increased use of various electronic formats, submission of Bureau of Reclamation records to the National Archives has been at a stand still. GRS 20 (General Records Schedule, National Archives) will enable agencies to schedule electronic records by February 2000. If an agency's electronic database is certified by DOD, Archives will approve records management in electronic format and transfer custodial responsibility of the electronic records to the agency. The Bureau of Reclamation will be using RIMS, which is one of the three databases approved by DOD. The other two are TRIM and FOREMOST.

Each agency will be responsible for maintaining their records in an electronic format that is continually accessible. It is the intention of the Bureau of Reclamation to migrate permanent electronic records, including e-mail and web site information, as necessary to maintain accessibility.

NATIONAL PARK SERVICE INTERMOUNTAIN SUPPORT OFFICE
Brian Carlson, GIS Specialist

The Intermountain Region is comprised of 84 National Parks and Monuments. The GIS Program Office in Lakewood, CO, provides technical assistance to those units in providing GIS development, with GIS issues and needs, and with support to the units. Offices are located in Denver and Albuquerque and are staffed with six permanent employees, three temporary employees, and six students. Two cooperative agreements exist: the first with the University of New Mexico Albuquerque and the second with the University of Denver. Three students from each institution gain experience with their work at NPS and with GIS.

Of the 84 Park Service units, 63 units utilize some level of GIS. Sixteen are staffed with full-time GIS personnel. ArcView3.1 (ESRI) is the standard software used, and ARC / INFO is utilized at 16 park units.

During Fiscal Year 98, $90,000 was provided to distribute to the 84 units in the Intermountain Region. Funding was used to support a GIS meeting on a biannual basis, hardware, software, and training salaries.

During Fiscal Year 99, $88,000 was provided to distribute and 47 proposals were submitted with 10 proposals chosen for funding. In addition, $15,500 was set aside for metadata training.

During Fiscal Year 2000, $88,000 will be available. A call for proposals and review is underway. Funds have been set aside for an Intermountain GIS conference and a metadata initiative involving training. Additional funding sources are also being pursued.

Forty-eight requests for GIS technical assistance have been received, some similar to earlier project proposals. They have involved data searches and assessments, global positioning system (GPS) data collection, scanning, digitizing, metadata, data conversion, and General Management Plan support. The General Management Plans operate on a 10-15 year cycle

Specific projects have included: a cultural landscape inventory at Golden Spike NHS utilizing GPS to locate features; an ethnographic overview of Capitol Reef National Park; a wetlands assessment of Great Sand Dunes NM; National Historical Trails Mapping; a geological map of Fossil Butte NM; and a bighorn sheet habitat suitability analysis of Mesa Verde National Park.

The Intermountain Region of the NPS has embraced metadata and the development of standards as required by Executive Order 12906. The NPS has developed metadata collection guidelines and are in federal agency compliance.

Within the Intermountain Region, as of August 1998, 25 datasets were online, compliant and searchable. As of May 1999, 220 datasets are available online. Software evaluations have been completed, and training for GIS professionals is being provided. The Intermountain Region of NPS has provided three classes and trained approximately 30 people in metadata collection utilizing "metamaker."

They are currently trying to streamline the process by customizing to make "metamaker" easier to use. Projects involve an inventory of data themes, identifying and prioritizing data, determining proprietary versus non-proprietary data, participating in the Colorado Ecosystem Project (which is a metadata library project), and developing an implementation plan for the 84 parks in the eight states. They are providing assistance for the parks and writing grants to help take care of metadata backlog.

Additional information may be obtained through the internet. The National NPS GIS Programs web address is http://www.nps.gov/gis and the Intermountain GIS Program web address is http://129.24.219.53/gis/intro.htm.

A question and answer session followed and provided additional information.

- Regarding digital information: the Intermountain Regional Office maintains a core set of dataset themes while the individual park unit may contain the core and more.
- Regarding other regions having university cooperative programs:
  Intermountain and Alaska regions are the two largest, with the Intermountain responsible for more parks than any other region. The cooperative program has existed 12 years with Albuquerque having the longer coop agreement. The University of Denver program just started last October.
- Recently a map showing congressional districts and parks in the region has been completed for the Intermountain Region Office.
- The Office is developing digital line graphs (DLG) for parks, and is working with other agencies.
- The Office is working with ESRI on vegetation of parks—very detailed–developing interim publications.
- Through the FGDC the Intermountain Region data are available via the Internet and are searchable. All files are in e00 format.

COLORADO FEDERAL GIS USERS GROUP
Brian Carlstrom

Brian Carlstrom, GIS Specialist with the National Park Service Intermountain Support Office, gave a brief overview of the Colorado Federal GIS Users Group which meets periodically to share information on projects that are underway. The meetings are open to any federal agency with GIS functionality. Participants include the Bureau of Land Management, Bureau of Reclamation, Federal Emergency Management Agency, Bureau of the Census, and the National Park Service. Ingrid Landgraf is the point person for the Users Group, which has been meeting for about 2 ½ years. Members of the Users Group share information on an FTP server maintained by the National Park Service.

U.S. GEOLGICAL SURVEY
Craig Skalet, Chief of the Information Services Branch

In his presentation, Craig Skalet gave a brief, general overview of what USGS is and described some of the changes that have occurred in the Agency. He discussed the National Mapping Program and its products. He put special emphasis on the Rocky Mountain Mapping Center and its efforts to improve the promotion and delivery of map products. He also provided a historical view and update of the Landsat Earth Remote Sensing Satellite Program.

USGS Overview

The USGS has undergone a number of changes under the leadership of its recent directors - Dr. Gordon Eaton and Charles Groat. During this time there has been a general realization at the top that earth science problems must be attacked in an integrated fashion. Until this time, there existed four independent divisions: National Mapping, Geologic, Water Resources, and Biological Resources (which came into existence about 2 years ago). The goal recently has been to reorganize USGS with linkages at the bureau level programs, which previously had operated separately. Integrated science and interdisciplinary science goals were to become and continue to be the priority at USGS. Emphasis now has to be placed on a culture, which focuses on integrating science and interdisciplinary science goals and which embraces the concept of integration and teamwork across the divisions. To promote this concept, Dr. Eaton instituted the formation of councils: Science, Operation, Information, and Human Resources. The Science Council brings together and deals with the programmatic issues of the Bureau. The Operational Council, where interdisciplinary teams are formed, works to integrate all information on a particular subject "in one place, in the same reference system and easily accessible." The result is that during the last five years USGS has made great strides in this new direction. In addition, USGS has tried to become more connected with its customers and other agencies (Dept. of Interior and Land Management agencies). Also, there is a focus on the need for cooperative agreements with other agencies. In fact, in several places across the country, interdisciplinary teams have been formed to do base studies. The Information Council deals with the information infrastructure, seeking to provide a mechanism for consistent communication and to facilitate that communication across the Bureaus. Projects such as the Ohio National Atlas and the Gateway to the Earth are examples of what can be accomplished in this new integrated environment across the divisions. The main goal is to provide information on the Internet in a cohesive manner—that is, where the customer can get to a list of all types of information (hazards, water quality assessment, the basic data sources, the basic cartographic data) about a particular piece of territory.

In spite of the issues and concerns that come with an attempt to bring four very different divisions of the USGS together with their separate funding, USGS will continue to create an environment conducive to integrated science, cooperative efforts and interdisciplinary science goals. More programs that focus on end-user partnerships and partnering with the private sector also can be expected.

National Mapping Program Division (NMP)

The division has five operational centers with the overall mission "to ensure that the nation's needs for fundamental geo-spatial data and information are met." This division is broken up into three main problematic areas: production, research, and Earth Science management and delivery. The five operational centers are located across the country: (1) Western Mapping Center—working in the digital ortho-photo area; (2) the Rocky Mountain Mapping Center—a production and distribution center for traditional products; (3) Mid-Continent Mapping Center—a production center; (4) EROS Data Center—working in satellite imagery area and remote sensing; (5) Headquarters and Mapping Applications Center—provides the civilian and federal community access to classified material, and also serves as the headquarters for the USGS. Programs address the areas of mapping data collection and integration, earth science information management and delivery and geographic research and applications. Of the three programs, Earth Science management and delivery is the main focus of the Rocky Mountain Mapping branch and operation, of which Craig Skalet is chief. This center is involved in the area of managing scientific data and delivering it to the customers—whether delivery is by the Internet, by the business partners network, or clearinghouses. The programmatic scope of this program includes six main areas: outreach, information dissemination network, information management system, archive, distribution and inventory management, and reproduction and replication. Outreach encompasses press releases, the K-12 educational programs, conference attendance, trade shows, and legislative education. The Information dissemination network is the nine earth science information centers. Information management centers are any of the software networks that make up the systems that help do the job of information dissemination. Archives for the programmatic data is called the operational database. Distribution and inventory management is the maintenance and retrieval of map products from the warehouse to the appropriate customers. Reproduction and replication is use of the photo lab and doing the "as is" and minor revision processes.

The discussion of the graphics program (the paper map products) looked briefly at some of the following areas: the increased use of alternate and varied "best available" sources, the current views on restructuring the maintenance of the graphics, the proposals to focus on the best selling maps and funded partnerships and the place-based programs liaisons. A lengthy discussion followed on the topic of the distribution, revision, and current status of updating the map products.

In the area of distribution, the emphasis is on the customer and enhancing services provided to them and the maintenance support for these products. Progress has been made in delivery of products in that the turnaround time is about 4-5 days for map orders. To date, the business partners are subsidizing the retail customers. The price of a map ordered from USGS today is $4.00; the operation is not profitable. USGS does not wish to continue the present level of retailing in the area of map products.

The current process of map distribution is being looked at so that it can be revamped. USGS would prefer to be more of a wholesaler in this area than a retailer—thus not competing with their business partners (retailers) for sales. Maps sold now at $4.00 actually cost the agency $23.00, which covers receiving orders, pulling, preparing for shipment and distributing. The business partners now subsidize the retail customers. In the future, USGS would like to bulk distribute to business partners, give them a discount, and have them set the price for sale to the public.

The development of the web catalog is one effort to encourage and increase the use of business partners, by providing them with a tool to promote some of the most popular products to customers. The goal would be to have the business partners handle most of the retail orders. The catalog is now in the very early stages, but a demonstration was given. The catalog will probably consist of the thirty best sellers. It would allow the customers to see a list of maps, what the map looks like in some shape or form and, where the map dealer is within the vicinity of the customer. Input from the business partners is being sought over the next two months in the development of the catalog; and in September 1999, the catalog should be ready for testing.

Map Products

Craig began this discussion by stating that the issues and concerns of the graphics program—mapping information and its production—are being addressed. The huge amount of funds which have been invested in these 56,000 map products was noted as well as the need to insure that this investment is valued as a national asset that should be continued. Each topographical map costs about $40 – 50,000 and there are 56,000. In discussing the sales history, it was pointed out that annually 2.7 million maps are sold, bringing in about 5.6 million dollars. Then about one-half million maps are distributed free. Sales are decreasing and the agency is not doing a great job in maintaining the quality and accuracy of the 1:24,000 topos. Monies allocated for graphics products have become less and less during the last twenty years due to the addition of new and important products like the DOQ, DEM and others. But the biggest promotional item of USGS is its 1:24,000 topographic maps because they are what the public associates most with the USGS. Thus, to insure that this national asset continues will require the division to restructure the production, revision, and maintenance associated with these paper products.

At present, funding is needed to do map revisions. This will probably involve looking at recovering some of the cost from sales, and there is also a push for funding initiatives to address new monies from Congress to deal with it. Money that is collected for sales can go back into the distribution and sales operation of these maps, but monies which are collected can not be used to do actual revisions of the maps, which would cost about five to six dollars. Some feel that at least the reprint process should be recoverable. The reprint process costs about $.25 per map and the minor revision process costs about $.75 per map. Revisions would involve about 2,000-2,500 maps per year. 15 million dollars annually would be needed to do all revisions. But at this time, appropriated funds can not be used to pay for revisions and monies collected from sales can not go back into the revision.

Currently, USGS and the Forest Service are doing map revisions, with the Forest Service doing about 600-700 and the USGS about 800-900. This cooperative arrangement with the Forest Service should take care of updating about 10%. The goal in the map maintenance area is to have a topographic maintenance strategy in place by 2000 that will increase map revisions by a factor of three from the FY 1996 level - from 300 to 400 a year to 1,000. The strategy is to look at all maps and build a five-tier classification for maps which will determine their cycle of revision based on sales statistics. There would be about 1,000 maps at the top tier—those where at least 15 are sold each month. Revision for these will be on a 5–7 year revision cycle. The next level (level 2) might be on an 8 year cycle; level 3 might be on a ten year cycle and level 5 would be those maps where 0-1 per month are sold and that is a large percentage of the total. There would also be a similar tier to establish the type of revision done—minor, or basic revisions or “as is”.

Others factors concerning the maps are also being looked at: Where are the maps that are being sold in higher rates? What are the mapping priorities for the country? Why would the consumer buy a new map?

Currently topos will continue to be distributed in paper format and the cooperative program with the Forest Service will take care of about ten percent of the revisions. The strategy at USGS will be to focus on revision of the maps which are high selling—about 1000 with the overall strategy to update the topos.

Other topics discussed:

- There is discussion about reprinting the top 100-150 of the high selling 15-minute quads.

- One more Topographic Users Conference is planned. Information gathered from the two topographic users conferences (held in Reston / D.C. area and Denver) were useful in redirecting and planning the USGS programs.

NMP Array of Products

Attendees were also given a packet, which described the array of products offered through the National Mapping Program. Databases and products mentioned or discussed were:

- The National Hydrography Database (NHD) which is a cooperative venture with EPA and the Water Resources Division of USGS and derived from hydro digital land graphs and EPA RF 3 data.

- The National Elevation Database (NED) derived from the digital elevation models (DEM).

- The digital orthophoto quad (DOQ) and the digital elevation models (DEM). Completion time frame for national coverage is 1-2 years.

- The digital raster graphics (DRG) and the digital line graphs (DLG). Provision of access to this data will be through an arrangement / agreement with Microsoft and the TerraServer. This would provide a mechanism for direct feed-in. This data can already be looked at and obtained through the EROS Data Center. It is expected that there would be a fee for the cost of distribution, even though this information would be available online only. The DLG used to identify and replace changed information.

- Satellite Imagery product lines – the main line satellite offerings of earth observation for the last three decades:

a. Declassified Intelligence Photos (1960-1972)
b. Landsat Multispectral Scanner (1972-1992)
c. Landsat thematic Mapper (1982-1996)
d. AVHRR LAC / HRPT (1986-1996)
e. Landsat 7 (1999-)

LANDSAT 7[1*]

The program started as a USGS initiative in 1966 - the idea for the mission coming from USGS scientists who recognized the successful use of remote sensing technology in previous manned space missions. A number of agencies have been involved since the inception of the program. The agreement was for NASA to build, launch, and operate the satellite, while USGS would receive, archive, process, and distribute the resulting products. EROS Data Centers would handle the data products, and international ground stations would handle the products for local applications. During this period the Department of Agriculture and the Department of Commerce joined effort to develop this program. In 1972, NASA launched the first satellite (ERTS 1 or Landsat 1). In 1975, NASA changed the name of the program from ERTS to Landsat. In 1979 after the launch of Landsat 3, efforts to commercialize the program began. The Landsat operations were to be transferred from NASA to NOAA. The goal was to transfer Landsat to the private sector. In 1984, a contract was signed with NOAA to commercialize the Landsat system. Then in 1985, the commercial operator (EOSAT, a partnership of Hughes and RCA) was named to operate the system under a ten-year contract.

EOSAT

- operates Landsat 4 and 5
- will build two new spacecrafts (Landsat 6 and 7)
- has exclusive rights to market Landsat data collected prior to date of contract (9 / 27 / 85) until expiration date (7 / 16 / 94)
- has exclusive right to market data collected after 9 / 27 / 85 for ten years from date of acquisition
- will receive all foreign ground station fees

In 1988, EOSAT's contract with NOAA was re-negotiated to incorporate changes requested by Congress and EOSAT. In 1989, NOAA funds for the Landsat operations were exhausted, and EOSAT was directed to turn off satellites. This was the beginning of funding problems and interim solutions, which lasted through 1992. During 1992, the National Space Policy Directive #5 outlined a strategy to ensure the operations of Landsat missions 4 and 5 and to prepare for the launch of Landsat 6. DOC (Department of Commerce) was instructed to ensure the operation of Landsat 4 and 5 until Landsat 6 was launched and operational. DoD (Department of Defense) and NASA were instructed to develop and launch Landsat 7 and define the continuity requirements after Landsat 7. A management plan for the Landsat program was developed, which assigned responsibility for the space segment to DoD and the ground segment to NASA. DoD signed a contract with General Electric to construct and launch Landsat 7. In 1993, Landsat 6 was launched. With the loss of Landsat 6, international confidence in the program was damaged, and this increased the probability of the loss of data continuity. In 1994, NASA, DoD, and NOAA worked to develop a successful implementation strategy for the program. Later that year, NASA, NOAA, and USGS met about the Landsat ground system and signed a "Management Plan for the Landsat Program," which described the program objectives and the agency responsibilities. In 1999, Landsat 7 was launched. There is no plan for Landsat 8. USGS has stepped in to take over the ground operations. Today, Landsat 7 is a USGS / NASA operation. Together the agencies will work on executing assessments of user requirements and what is next after Landsat 7. It is anticipated that any future ventures will be a USGS / NASA effort. USGS has taken two to three million dollars out of the production budget to support Landsat 7. A technical working group has been formed, and USGS has some responsibility for the data management and the ground stations operation. There are production rates of 250 scenes per day, 140 coming into the EROS Data Center, 40 going to Alaska, and 70 going to Norway. The plan is to produce and distribute the user's product at the cost of reproduction. That accounts for the price being what it is. USGS will assume full responsibility for the Landsat 7 operations in 2001.

EROS Data Center will be pricing the data. Pricing today: $475 a scene for the level zero, which is raw data not analyzed or manipulated. If you go up to 1R and 1G, it's $600 a scene. They have not set a price on the next level of data. This is another pricing look—the turnaround theme for delivery: when raw data comes in it can probably come out the next day. But if it has to be manipulated, it takes another day, and level 1P takes three days. All Landsat data is copyright free. The pricing history of Landsat data was if it was ten years or older the cost was $450 per scene. Otherwise, it was $4,500 per scene and not many products were sold until they were ten years old. The sales history of Landsat data is being reviewed and in the future, the older data will have varied pricing based on a mixed scale variable. Since the government will own the data, the pricing will be more reasonable.

Digital data will not be distributed free to libraries. One idea is to distribute the data with some kind of subscription service charges. Regional consortia being formed such as the one in California, another in the Northern Plains (the Dakotas, Kansas, and Wyoming) and another in Virginia were mentioned as possible sites to pipe Landsat data and other digital products. This idea is being investigated and the problem is how to price the data.

In general, the National Mapping Program has to continue to focus on its data and information maintenance. It must provide a national approach for availability and access to this data. It must play a robust cooperator role in seeing that standards are defined and also establish boundaries for database quality and content.

Issues raised with questions during and after the presentation:

Q: What was GPR?
A: Government Performance Results Act.

Q: GNIS – Why is getting connected to the Web site a problem?
A: The Agency had not expected the popularity of the web service and had not anticipated such high usage. The web site will be going to a distributed cluster configuration of several platforms using a Sun server with the design moving on an upgraded oracle base to correct the access problem. The new design will be completed within a two-month time frame. (It was also noted that the data did exist on a CD and that the 1998 CD is a DOS base software).

Q: Where are you on updating of those best selling maps?
A: Our plan is to focus on the high selling 1,000.

Q: Can you not make the argument that you could maintain the updating by recovering cost from the sale price, if you don't get other funds?
A: Yes, that's a piece of it, too, because I am arguing that let's make that $15 million, $12 million and I will take the "as is" parts and minor revision parts, change the pricing of the maps, and try to market maps better, to get more map sales and cover that piece.

Q: Are you going to hold a third topographic users conference like the one held here (Denver) about a year and a half ago? (One was also held in Reston / D.C. area). What became of the results from those conferences?
A: Mark took that information and fed it into the program plan. I didn't actually participate in that, but my assumption is that the info was applied to standards, changes or modification, program redirection, those sorts of things. I think a third one is planned.

Q: Can we get a list of the map dealers that offer overnight map delivery?
A: List will be sent to attendees.

Dealers that offer overnight map delivery are:

Map Link
30 S. La Patera Ln, Unit #5
Santa Barbara, CA 93117
(805) 692-6777

Omni Resources Inc.
1004 S. Mebane St.
Burlington, NC 27216
(336) 227-8300

Allied Services
966 N. Main St.
Orange, CA 92867
(714) 532-4337

Timely Discount Topos Inc.
9769 W. 119th Dr., Ste. 12
Broomfield, CO 80020
(303) 469-8488

Powers Elevation
13900 E. Harvard Ave.
Aurora, CO 80044
(303) 321 2217

Map Express / Speedy Topo
441 Wadsworth Blvd., Ste. 124
Lakewood, CO 80226
(303) 274-4440

Carolina Global Maps, Inc.
PO Box 5012
Greenville, NC 27835
(800) 248-6227

Quick Maps Co.
PO Box 150123
Lakewood, CO 80215
(303) 238-5427

Fast Maps
PO Box 260879
Lakewood, CO 80226
(800) 426-8676

NOAA
Dan Seldin for Fred Anderson

Fred Anderson was not able to attend this year's meeting in Denver. Dan Seldin, NOAA liaison, interviewed Mr. Anderson via phone before our meeting, and submits the following report:

NEW PRODUCTS

There were no specifics on new aeronautical products, but if new Terminal Area Charts or Helicopter Charts are released, they will automatically go into the depository program.

New NOAA / NIMA catalogs have recently been produced and should have been sent to depository libraries.

TRANSFER OF DEPARTMENT OF TRANSPORTATION

Aeronautical Charting will stay with NOAA for the rest of the fiscal year.

FAA must be re-authorized by the end of May. It is normally re-authorized at the beginning of the fiscal year, but problems with Aeronautical Charting caused Congress to re-authorize for only 6 months at the beginning of the fiscal year. When the problems were not solved at the end of 6 months, the authorization was extended 2 more months. Secretary Slater is working with the Senate. The FAA and DOT want Aeronautical Charting in TASC, but 2 major interest groups, Aircraft Owners and Pilots Association (AOPA) and National Business Aviation Association (NBAA), want it in the FAA. They are afraid that a fee for service organization like TASC will raise prices. Jane Garvey, the FAA Administrator, does not want AC&C as part of the FAA.

With all the disagreements, no one knows where Aeronautical Charting will go; it could even stay in NOAA.

NAUTICAL CHARTS-PRINT ON DEMAND

The nautical charts are produced by the NOAA Office of the Coast Survey. They are proposing that the printing of the nautical charts be printed by a contractor, using a large format raster plotter on electronic request from the public or chart agents under a CRADA. 3M Company has been selected as the contractor, with a subcontractor named Voemela in St. Paul, MN to do the actual printing and distributing. If this plan is adopted, these might not be government products that would be in the depository program. Fred Anderson spoke to the Director of the Coast Survey, who said that it has not been decided whether the nautical charts would be CRADA or NOAA products. There are questions about liability and laws that require NOAA to reimburse the U.S. Treasury with funds from chart sales.

3M is undertaking market testing of print on demand nautical charts through chart agents in New York, San Francisco, and South Florida. If the market testing is successful, the program will go nationwide and NOAA would phase out producing the charts through lithography. These print on demand charts would cost more, estimated at $20 each, be of poorer quality, but be more up to date.

If map librarians want to express an opinion on the print on demand proposal, contact Nancy Foster, the Assistant Administrator of NOAA. Her e-mail address is nancy.foster@noaa.gov.

* Additional historical information has been added from the USGS website.

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announcements

Symposium on Maps and the Internet
October 11, 2000
Knoxville, TN

NACIS and the Commission on Maps and the Internet of the International Cartographic Association are sponsoring a one-day symposium that will precede the annual NACIS meeting. The symposium will consist of 2-3 paper sessions and breakout sessions that address the terms of reference of the newly established commission. A web page for the commission can be found at: http://maps.unomaha.edu/ica/. Papers given at the Symposium will be considered for a special issue of *Cartographic Perspectives*. If you are interested in presenting a paper or attending the symposium, please contact the Symposium organizer at: Michael_Peterson@unomaha.edu.

Submission Guidelines for *Cartographic Perspectives*

The editors of *Cartographic Perspectives* welcome contributions. There are several content areas that are available for submissions.

FEATURED PAPERS

Each issue of *Cartographic Perspectives* includes featured papers, which are refereed articles reporting original work of interest to NACIS's diverse membership.

REVIEWS

The Book Review Editor solicits reviews of books and atlases.

CARTOGRAPHIC TECHNIQUES

Articles that concern all aspects of map design and production are solicited by the Cartographic Techniques Editor.

ONLINE MAPPING

Articles that concern all aspects of Internet related mapping applications are solicited by the Online Mapping Editor.

MAP LIBRARY BULLETIN BOARD

The Map Library Bulletin Board Editor solicits reports on the current status of map libraries.

Complete information on guidelines and who to contact for submissions to each section can be found on the NACIS website: www.nacis.org

NACIS

Student Web Map Contest 2000

A New Map Contest!

The North American Cartographic Information Society (NACIS) invites you to participate in the second annual NACIS Student Web Map Contest. The contest is designed for the new millennium—it recognizes the importance of the Internet, new media, and interactivity in cartography today. The purpose of the contest is to encourage student map design excellence and promote the dynamic use of emerging new technology. Jacqueline Shinker, from the University of Oregon, and, Nathaniel Vaughn Kelso, from Humboldt State University, each won $500 first place awards in last year's contest—you can explore Jacqueline and Nathaniel's winning websites at www.nacis.org.

About the Contest

• Like the maps to be judged, the contest itself will be administered entirely on-line. A panel of cyber judges will evaluate student map entries by going to url's submitted via an automated entry form.

• There is no entry fee. The contest is open to North American students.

• Maps may be submitted between now and October 7, 2000.

• All contest finalists will receive award certificates. Top prizes of $500 will be awarded in two categories: Map Animation and Interactive Maps.

• The winners will be announced and demonstrated during our annual banquet on October 13, 2000 at the NACIS XX meeting at Knoxville, Tennessee.

Enter the contest by visiting **www.nacis.org**