Mapping the Future: George Washington's or George Orwell's?

GIS in the Rockies 2002
Luncheon Address presented by
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Yogi Berra was quite right when he said "Prediction is difficult, especially about the future." Given that I agree with him, why would I undertake to talk about the future of mapping and geographic information systems? The answer is that I don't propose to make a lot of predictions. Instead, I'm going to ask a lot of questions and invite you to think about them with me. And as we consider the changes that are underway and those we can envision, we may want to keep in mind this observation from Charles Darwin: "It is not the strongest of the species that survive, nor the most intelligent, but the ones most responsive to change."

As we look at where things are in science and technology and the trends we think are underway in GIS, some of the questions that come up include
"What services will citizens be expecting from their government?"
"What business opportunities do I see?"
"Where do we WANT the mapping sciences to be 10 or 20 years from now?"
"What can ***I*** do to contribute?"
And another question that seems particularly fitting to consider at a conference sponsored by five professional societies:
"What will people want from their professional associations?"

Why are the two Georges named in the title of this talk? George Washington was a professional land surveyor. We know that from the age of 16 until he died at age 67, he surveyed more than 200 tracts of land. He valued accurate maps so much that he created the office of Geographer to the Continental Army. George Orwell observed the social and political happenings of his time, including the first and second World Wars, and wrote **Animal Farm** and **1984** to share with us his concerns about the role of government. So I used the names of the two Georges as shorthand to indicate that some of the things that may come about will be valuable and some may be scary.

Trends that are already underway include the growth of the Internet, incorporation of GIS into the enterprise, the availability of high-resolution satellite data, convergence of photogrammetry and remote sensing, and the international movement of jobs. Mapping tools are now as readily available as word processing and spreadsheets on office desktops. MapQuest downloads more than 10 million maps every day[1]! SimCity has been so popular that Maxis developed SimTown for children. Now, children are gaining empirical understanding of town planning and spatial modeling.

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[1] http://www.sun.com/smi/Press/sunflash/2000-09/sunflash.20000912.1.html

As we spend the next fifteen or twenty minutes thinking about the future of the mapping sciences, I invite you to set your imagination free to envision all sorts of possibilities. Rear Admiral Grace Hopper had in her office a clock that ran counterclockwise, to emphasize that just because something always has been done a certain way doesn't mean it cannot be done another way.

To look at where we are today and where we might go, let's consider this model: take data as a basic element. Processing the data yields information. The accumulation and processing of information leads to knowledge. And (we hope) the accumulation of knowledge leads to wisdom so that we apply our knowledge for the benefit of all. We can envision this as a pyramid, with lots of data forming the base, then information, moving up to a smaller amount of knowledge, with benefits at the pinnacle.

Just a decade ago, this pyramid did not have much of a base, and even today getting enough of the right data for a project remains a challenge. The GeoData Alliance is working to develop a model data distribution agreement, so that issues of rights and liabilities and compensation are addressed. While surveying and aerial photography continue to be used to collect basic data, GPS units and Earth observation satellites now have major roles in helping us acquire more and more data all the time. And looking at plans for future satellites, we can imagine that this century will see constellations of satellites with all kinds of sensors, so that every kind of data --panchromatic, multispectral (and hyperspectral), thermal, radar and lidar -- can be collected every day over any place on Earth. What business opportunities will that create?

When data is plentiful, it will move through the economy like a commodity. Just as people consume wheat by buying bread or bagels or doughnuts, never buying wheat, so too will people consume data by buying information, not data.

Work is underway on the concept of computers on future satellites processing data into information. There are nine sessions at next month's ASPRS meeting at the Adams Mark downtown on the theme of future intelligent Earth observing satellites (FIEOS).

The Army is funding a five-year $6-million project for research leading to a new generation of robotic aircraft and land vehicles[2]. The goal is to enable the U.S. military to conduct smarter, more-detailed reconnaissance missions with limited human intervention. Unmanned aerial vehicles or UAVs are already in use, collecting data in the visible and near infrared parts of the spectrum. The new robots will be able not only to collect many more kinds of data but also to process it and use the results of the processing to modify their own path. By reducing the need for transmissions from the robots, the researchers will also reduce the probability of them being detected.

So perhaps in the future it will not be data that is transmitted from the satellites at all!

[2] http://www.egr.duke.edu/News/Stories/49.html

Let's look at some other developments: A number of banks are interested in the development of radio-frequency identification tags (RFIDs)[3]. So far researchers have been able to reduce the size of such a tag to 1 mm across and 1/2 mm thick. Each tag is unique, so specific objects can be identified. The antenna is a coil of wire. No battery is needed. When the object, a large denomination dollar or Euro, for example, passes near a reading machine operating at the right radio frequency, the antenna picks up a small amount of electromagnetic energy. It uses that energy to power the chip so that the tag can broadcast data in the chip back to the reader. And someone in the Office of Homeland Security is going to want to map the various places certain bills have traveled!

Usage rates for PCs and the Internet and mobile phones vary from place to place. We might think about who would benefit from seeing these variations mapped, and whether adoption and usage rates of these technologies give us any insight into what circumstances will be required for GIS to move into the mass market.

59% of all US households had a PC in 2000[4]. And can you guess which three cities have the highest PC-ownership in the country? Salt Lake City, San Francisco and Washington, with PC-ownership above 70%[5].

45 million people in the US accessed the Internet in August[6]! The number of Internet users worldwide was estimated in May to be 580 million, a 25% increase in one year. The global average is 10% of the population has internet access, while in Africa, the average is less than 1%[7].

The number of mobile phones is expected to surpass the number of fixed ones this year[8]. In August, a survey reported that ten million internet users in the US go online via a cell phone or PDA[9]. Thirty million Africans now have a cell phone, up from 2 million four years ago[10]. Japan has 71 million mobile subscribers; 34 million of them read e-mail and access compatible Web sites from their cell phones[11]. Is your organization's web site set up to deliver content to cell phones and PDAs?

J-Phone, one of three licensed mobile phone operators in Japan, introduced a mobile phone with a built-in digital camera in October 2000. These phones allow users to take color photographs and e-mail them to other mobile phones or PCs. This is a second-generation, or 2G wireless capability. 3G wireless was introduced in Japan last year, and enables users to

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[3] **The Economist** Feb 9, 2002
[4] http://www.scarborough.com/scarb2002/press/pr_hh_pc.htm
[5] http://www.scarborough.com/scarb2002/press/pr_hh_pc.htm
[6] http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905358375&rel=true
[7] http://www.nua.ie/surveys/how_many_online/index.html
[8] **The Economist Technology Quarterly** June 22, 2002
[9] http://www.comscore.com/news/cell_pda_082802.htm
[10] **The Economist** February 16, 2002
[11] http://www.frtechbiz.com/displayarticledetail.asp?art_id=59475

transmit realtime video[12]. What GIS possibilities might be enabled when our mobile phones have such transmission rates?

The particular technology development that brings George Orwell to my mind is called "Digital Angel," from Applied Digital Solutions[13]. They originally introduced it as an implantable chip. It is a radio-frequency device designed to carry a unique ID number and other personal data. It's about the size of a grain of rice and can be injected by syringe. It collects data from embedded bio-sensors and includes an antenna that receives the GPS signal. The prototype was unveiled in October, 2000 in New York. A company employee was tracked through the streets of Manhattan via GPS, and his location was relayed wirelessly to the Internet and displayed on a large screen before the audience. On another screen the employee's pulse and body temperature for the past two weeks were displayed. Privacy advocates protested the idea of implanting the chips. The company removed the word "injectable" from the web site and substituted "wearable."

There are two questions that I keep thinking about in this context: Which is more important, safety or freedom? Which do I value more, privacy or security?

Just as with any other technology, the technology itself is not really the problem. The challenges arise in what people do with the technology. The thought that I could track a beloved relative who has Alzheimer's or locate a pet that got free seems appealing enough. The thought of being tracked myself has no appeal at all!

In 1995, the Chief of Staff of the Air Force tasked Air University to look 30 years into the future and identify concepts, capabilities and technologies that would be required to remain the dominant air and space force in the 21st century. The resulting study is called Air Force 2025[14]. It includes discussion of implanting microscopic chips so that forces can be highly flexible and mobile, with improved security. In the study, they admit that today implanting chips raises ethical and public relations concerns. They project that by 2025 we will have become so used to implants, with chips that help blind people see and other medical marvels, that the public will consider the defense of national interests sufficient justification for implanting chips in all military personnel.[15]

Makes you want to re-read **1984**, doesn't it?

Let's look at a few other notes about technology and government.

Just last week, a study[16] was released by Pew Internet & American Life that found that 88 percent of local elected officials in the US use email and the Internet in the course of their official duties. Sixty-one percent of the online officials use email every day, and 25 percent of them say they receive email from constituents every day.

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[12] http://www.frtechbiz.com/displayarticledetail.asp?art_id=59475
[13] http://www.digitalangel.net
[14] http://www.au.af.mil/au/2025/
[15] http://www.fas.org/spp/military/docops/usaf/2025/v3c2/v3c2-4.htm#Implanted%20Microscopic%20Chip
[16] http://www.pewinternet.org/releases/release.asp?id=52

A study[17] of digital democracy, defined as the application of digital technologies to permit Internet access to law, candidate information and electronic voting technologies, found Arizona is the best US state in terms of digital democracy, and Colorado was tied with several other states for second place.

Surely in the coming decades geographic understanding will become universally more sophisticated than it is today. And the young adults who grew up playing SimTown and then SimCity will feel at home using virtual reality to explore the interconnections of systems and the impacts of decisions -- making them a more informed electorate, perhaps even voting on the Internet!

Digital agents are being developed to do our shopping for us and sort our e-mail and accept or decline our appointments. I can imagine that before we are halfway through this century, we can turn loose computer agents, not only to shop for us but also to request satellite acquisitions for us, assemble spatial data from various sources and analyze it for us!! And call us on our cell phones or message us on our PDAs and provide us the information we require.

The Luddites of the 19th century, who took hammers and axes to machines in an attempt to prevent mechanization of jobs, have their descendants in the 21st century. The current example is the longshoremen's strike on the West Coast. Some technophobes predict that information technology will destroy millions of jobs. Historically, technological change has both destroyed and created jobs, and the growth in jobs has outpaced the loss.

For those of us who are not Luddites, another question arises: will changes in information technology necessarily widen the gap in wages between the haves and have-nots? Given that some computer programs available today make medical diagnoses identical to those of qualified physicians, we may find that computers can lower wages for skilled work! If computers take on such work as accounting and law, the result might be a lessening in the gap in wages!

One scenario of the future is that we will become the "there"s and the "there-not"s, meaning some of us will be able to do our work anywhere, and others will have to be "there" to do such things as physical labor, face-to-face service, or factory work. It is an interesting paradox that technologies which focus explicitly on spatial location may allow us to be "there-not"s! The flip side of our freedom to work anywhere is that jobs can go anywhere, and we have seen our industry re-shaped in the Internet age by the flexibility technology has given us.

Now I want to return to a theme I raised earlier: What will people expect from their professional associations in the 21st century? And what can we do so that people continue to get value from belonging to them?

[17] http://www.nua.ie/surveys/?f=VS&art_id=905358238&rel=true

The National Research Council says that it used to take seven to fourteen years for half of a worker's skills to become obsolete, now it takes only three to five years! And at the same time that we need ever more training to maintain job skills, the state of the economy encourages employers to reduce their training budgets. This means those of us who want to remain competitive must make our own training opportunities. One possibility is that professional societies may play a greater role in providing education and training as a service to members.

Conventions and workshops and seminars are ways we communicate the substance of our profession. Advances in technology and broadband access will make webcasts easier and more affordable for societies to offer, and will enable us to gather at virtual conventions. This will not spell the end of conventions, because people like being able to look someone in the eye, shake her hand, and share a meal. This option will simply enable us to upgrade our skills on a more continuous basis.

One program area societies can give priority attention to is public relations. While the majority of our effort is rightly dedicated to the substance of our profession, we do also need to publicize GIS and the mapping professions. What we know and what we do are important to society; unfortunately, the general public knows very little about geographic information systems and their value. To address this, we can expand our idea of what it means to be a professional to include a community role. GIS Day, an annual event which will be on November 20th this year, provides an example of how to contribute to our local communities. It also illustrates the power of public relations.

Standards are another area presenting professional societies an opportunity and a challenge. The importance of standards will increase dramatically as the use of geographic information systems continues to grow. And as mapping tools move into the mass market, we will face increasing challenges in maintaining standards of scientific rigor.

In closing, I hope that this survey of developments and likely trends has stimulated your imagination. We have capability and capacity and access to GIS; our challenge is to use GIS to gain knowledge and wisdom, and to use that wisdom to liberate all human potential. Let us take inspiration from Ralph Waldo Emerson, who said "Nothing great was ever achieved without enthusiasm." I invite you all to share your enthusiasm so that together we can map the best possible future.