Geographical Information Systems: Mining Public Assets for Commercial Interests

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Abstract

This paper is a political economic critique and exploration of the ways that the Geographic Information Systems (GIS) industry has emerged and consolidated itself by buying, analyzing and selling spatial data mined from the Internet. This includes a look at the history of GIS research and development activities and the industries that are fueling these developments. One of the fastest growing sectors is data mining and information processing where companies that are able to capitalize on the flow of information through proprietary systems or public networks like the Internet, are accumulating great wealth. What is needed is an exploration of the ways that the GIS industry has emerged and consolidated itself within this braoder context. Public adoption and usage of GIS tools via the Internet is creating competitive tensions within the GIS industry and producing complex new partnerships. What is most critical to explore at this moment are the details of the industry, who it serves, and in whose interest. As GIS software projects are often the outgrowth of direct political and economic policy and funding, industry giants are afforded greater access to purchasing huge data sets and labor to analyze and re-sell it. This process of mining public data, coupled with the steady availability of commodified consumer interactions, is increasingly moving public data to the private sphere. This paper problematizes these activities and raises new lines of inquiry about the GIS industry and its practices.

About the Author

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GIS: a critical re-definition

Considerable work has been done to critique GIS as a tool for the expansion of the commercial, for-profit sector[i]. While this paper is not looking at the impact of the consolidation of resources, money, and data systems in the GIS industry; it will instead outline the business and technology trends in the GIS industry that are leading to consolidation. This includes a look at the history of GIS research and development activities and the industries that are fueling these developments, as well as the spaces that are of interest to GIS industry leaders. My hope is that a description of the activities that are fueling this consolidation will lead to more research questions about the impact of these activities, and in whose interest it serves.

Information is more important than ever. Dan Schiller suggests that it is "the essential site of for-profit, commercial growth within the world economy[ii]," meaning, information is playing *the* most significant role in the growth of corporations and private enterprise. In the software industry, one of the fastest growing sectors is data mining and information processing where companies that are able to capitalize on the flow of information through proprietary systems or public networks like the Internet, are accumulating great wealth. What is needed is an exploration of the ways that the Geographic Information Systems (GIS) industry has emerged within this larger context, and consolidated itself in order to exploit the wealth of information and profits to be gained from buying, analyzing and selling spatial data. One perspective on the GIS industry is that it has been subsidized by public contracts and university research, which have been facilitated by state, federal and local municipal governments. Another perspective is that software companies like Microsoft, Yahoo! and Google, are made more profitable by public use of "free" tools like search engines and maps, and that seemingly public data is rapidly becoming privatized. Information can serve as both a resource and as a commodity.

Geographic Information Systems (GIS) are complex models that use layers of information to represent various aspects of the world. These layers of data include everything from the roads and buildings to consumer behavior or purchasing behavior in a particular zip code or geographically defined space. Each layer of data is organized into databases and objects that are represented in photos, maps, lines, points

and surfaces visually mapped to tell a story or provide intelligence. This kind of information includes resources that Schiller (1988) notes as public – information like the mapping of the air, earth, oceans, rivers and sky[iii] -- which are natural resources that might belong to everyone. GIS software provides access to new ways of visualizing our world, along with the political boundaries and borders within societies, and can also include information about individuals that can be aggregated into detailed consumer profiles. This is an example of Schiller's "commodified" information. Each layer of data is organized into databases and objects that can be seen in photos, maps, lines, points and surfaces that are visually represented to tell a story or provide intelligence. GIS information allows analysts to develop information models that take particular regions and combine their topography and population with demographic data to design business practices, or take action, as in the case of military strategic planning. Because these GIS is a significant part of the data mining practices that are reshaping corporate and government behavior, it is important that we look at developments in the industry and continue to research the impact of these tools.

Public use of GIS tools

Over the past forty years, information found in GIS systems has become increasingly mass-produced and marketed to Fortune 500 companies, and institutions amid some public controversies. Privately-held companies like ESRI are beginning to see encroachments upon market share as technology and media giants like Google, Yahoo! and Microsoft threaten proprietary software companies by offering "free" GIS tools to their users and low cost enterprise packages. The market leaders use sophisticated techniques that include public and private proprietary databases from which they can mine government records, police reports, census data, birth and death certificates, banking and insurance information, public health records allowable by law, marketing and consumer behavior data, credit reports, mailing lists, surveys, media reports and psychographic profiles (Goss, 2000). GIS technology is complicated and requires intensive data collection and statistical software to process and make sense of spaces and places. The business of GIS is also reliant upon the adoption of software that is interoperable across companies, governments and institutions.

While the public is searching for information using free tools like Google search, these tools and data collection methods that provide information for tools like “street views” are increasingly being contested. In 2009, the media reported impromptu protests of neighbors in Buckinghamshire, England who forced a Google “street view” car to turn around[iv]. Privacy and surveillance concerns and protests in Germany caused Google to extend its opt-out policy under pressure from the German government[v]. Other long-time problematic aspects of mapping are the effects of articulating political boundaries and borders within societies, borders that are often disputed and ever-shifting. Mapping practices also reinforce hegemonic relations and make these types of issues normative, reinforcing static representations of geography that are in fact dynamic and contested. Most alarming are the ways that GIS layers of can include information about people that can be both aggregated and disaggregated into detailed consumer profiles and sold to advertisers without the knowledge of the public. These will be important practices to follow over the next decade of GIS software development and usage.

Patrick McHaffie suggests that “even though it [information] is a ‘general purpose’ product, then it will be produced to serve a particular constituency, in particular those who serve to gain from the ‘digging,’ ‘gathering,’ or ‘harvesting’ the wealth of America and the world[vi].” According to McHaffie, these large, “general purpose” databases and systems for mapping are part of the system of our public infrastructure. What I am suggesting here is that companies are using GIS data provided from public and private sources as a mechanism for the accumulation and expansion of for-profit models through industry consolidation and a changing global environment of data mining and sharing. These industry consolidations are complex competitive and cooperative arrangements that make up a web of corporate friends, enemies, competitors and collaborators. This web of arrangements also includes active personal and political participation with legislators who control the flow of billions of federal dollars for emerging GIS projects over the next several years in the United States.

These trends in Geographic Information Systems and the collection of spatial data have become an important topic among geography and information researchers who are bitterly divided about the usage of

GIS data. One of the key concerns expressed in *The Future of Spatial Data and Society* (National Academy of Press, 1997) report from the National Research Council[vii] is that spatial data will increasingly be used to solve complex problems at a global scale. But researchers do not agree on either the methods of data collection, or who will benefit or be marginalized through the collection of this information. GIS researchers and enthusiasts as well as skeptical social scientists have been at odds as they follow developments in GIS techniques and applications. Literature in "GIS and Society" has begun to explore the political economy of GIS and the role of power in the use of GIS[viii]. Debates among GIS scholars range from the positivist perspective to the critical. On one hand, GIS is seen as an objective-scientific tool for understanding the world around us. But GIS tools do not just measure distance and space. GIS tools are also a means of gathering intelligence and information about people, places and processes. They also construct a landscape and representation of places, people and processes according to various commercial or political agendas. For example, the iphone application "Around me" maps the commercial retailers available to a user in a specific location, but simultaneously does not map public institutions, social services, friends' houses, parks or scenes that are of a non-commercial interest. These representations re-create a physical world into a commercial world through GIS technologies, and this is a symbiotic relationship. While a user lives in the physical world and their movement is tracked, it is commodified and sold back to the user in an application that is designed to promote commercial services. GIS representations through this economy of information is both one of data mining user behavior (e.g., walking down the street) and repurposing or selling back a representation of the world that is intrinsically tied to commericialization (e.g., stop by The Gap around the corner and get 20% off a pair of jeans).

Critical GIS scholars are looking at the social, political and economic ways that GIS tools are being used in society. Kwan's[ix] critique serves as an important approach to looking more deeply at the politics of contemporary GIS debates:

> While many maintain that the development and use of GIS constitute a scientific pursuit capable of producing objective knowledge of the world, others criticize GIS for its inadequate representation of space and subjectivity, its positivist epistemology, its instrumental rationality, its technique-driven and data-led methods, and its role as surveillance or military technology deployed by the state (Kwan, 2002).

Critical GIS scholars dispute the objective nature of GIS. They also challenge the idea that data will or *can be* used objectively. Human beings and human life is more complex than map boundaries. Communities are shifting and information about people is changing because humans have agency. Many believe GIS can have a negative impact on society because of the surveillance issues surrounding it; or because its usage is explicitly marginalizing due to the dynamics of power and inequality of access to information. Kwan's feminist GIS scholarship looks at whether GIS can be used as a method to support feminist research and researchers that is based on feminist agency, and is a helpful point of view for how people can deal with the tools available to envision a different usage and for interests other than corporations, such as non-profits or social action researchers. Geography researchers have spent considerable time and energy debating the effects of GIS on people and communities from many points of view[x] and Kwan's feminist critique creates more room to think about GIS from a critical perspective. Kwan does not critique the emergence of GIS as a process of furthering global expansion of multinational corporations. Instead, she urges researchers and communities to work within the constraints of GIS-dominance and find new ways to use data within a feminist or radical framework. But, companies like ESRI and Google are making money from those who are using GIS to map local neighborhoods and communities for "social good." What we need is an expansion of Kwan's re-envisioning of a feminist GIS, because the very usage and storage of data in global software systems only further entrenches them.

The Driving Logic of a Consolidated GIS industry

Goss' has a specific theory that Geo-demographic Information Systems (GDIS) are growing because, "the corporate community is eager to purchase [GDIS] because of its capacity to monitor, model and control consumer behavior, and ultimately because they promise the capability to manipulate the market and consumer identity to enhance profitability…the discourse of GDIS is consistent with a 'strategic' conception of reality and identity[xi]." There is considerable logic and efficiency in consolidating the GIS industry to the benefit of the corporate leaders who are engaged in this process. Expensive and

sophisticated software development requires a level of ubiquitous adoption across large enterprises like federal, state and local governments and agencies in order to be profitable and sustainable. An ESRI Unlimited Program license for a university in the United States is approximately $5,500, and individual licenses vary but begin around $160 per user depending on the enterprise[xii]. Transnational corporations need common knowledge management infrastructure to do business transactions across borders and within their complex organizations, as global positioning systems are fueling Wall Street, ATM machines and complex global commerce systems of shipping and receiving. In March of 2010, the federal government of the United States committed $8 billion dollars to GPS satellite upgrades to make these spatial analysis tools even more precise and effective for business and consumer use[xiii]. Thus, the GIS software and hardware industries have had considerable consolidation over the past forty years since the development of the personal computer with interoperability, standards, regulation and adopted technologies being bitterly contested, and the industry will see increased benefit from state spending on infrastructure. These agreements upon which Information Communication Technologies (ICT) have been formulated are the subject of further study because they are important concepts for understanding how and which GIS software platforms have become near-universal, and why a variety of open-source or proprietary software packages like GRASS GIS or GIS/Magik have had widespread adoption, but have not become the industry standard.

GIS Industry Leaders Emerge

The GIS industry has been consolidated into five major companies over the course of the past forty years. Though there are many proprietary and open-source solutions; a series of spin-offs, mergers and acquisitions began in the 1960s that have led to the configuration of today. The first GIS system was created by the federal Department of Forestry and Rural Development in Ottawa, Ontario. Since then, governments and universities have played a significant role in funding research and development of GIS systems that include the Laboratory for Computer Graphics and Spatial Analysis at Harvard, which spawned technologies that were used commercially by corporations, educational institutions and research centers around the world[xiv]. This intersection of public funds to subsidize the risks of developing expensive

mapping software was not possible without military contracts. GIS/GPS development was originally designed as a surveillance tool for the military. By the end of the 1960s, a handful of GIS companies were emerging, many of which continue to dominate the industry in 2009. M&S Computing (which later became Intergraph) was founded in Huntsville, Alabama in 1969. Environmental Systems Research Institute (ESRI) in Redlands, CA (1969) started as (and remains) a privately-held consulting firm with its start in land use mapping. ESRI is now the industry leader with over one-third of the global GIS market, and distinguishes itself as the leading GIS research and development company in the world[xv].

A decade later, Computer Aided Resource Information Systems (CARIS) began selling commercial GIS products as a start-up from the Department of Survey Engineering at the University of New Brunswick; although it never became a commercial leader with its December 2008 earnings at just over $23 million (compared to ESRI's $500+ million). Ironically, CARIS developed the first and largest GIS system for mapping through digitizing and scanning technology and its founder Dr. Roger Tomlinson is regarded as the "father of GIS," even though the technology was never fully commercialized. Latecomers to the GIS software industry are Autodesk (1982) and GE Energy/Smallworld (1989). Smallworld was acquired by GE Energy in September 2000 after establishing itself as a global leader in GIS. Up and coming in the GIS industry is PB MapInfo, more commonly known as MapInfo since its founding in 1986. MapInfo was recently acquired by Pitney Bowes in March of 2007 for $408 million in cash, and is now known as Pitney Bowes MapInfo Corporation[xvi]. Though there is a significant revenue difference among the top five GIS industry leaders, a closer look at ESRI will help illustrate the ways that public resources, longevity, and strategic partnerships have led to a series of alliances among corporate "frenemies."

[insert here]
Table 1: Top Five Geospatial Worldwide Companies
Revenue and Specializations (2008)

How ESRI Became the Industry Leader

ESRI's was incorporated by Jack and Laura Dangermond. Their first commercial product was Arc/Info, developed and released in 1981. Shortly thereafter, they landed their first significant project – a $10 million contract from the United States Defense Mapping Agency (DMA) to build the Digital Chart of the World (DCW)[xvii]. Within seven years, ESRI was billing $170 million dollars on projects for Mobil Oil, the U.S. Army Corps of Engineers and various federal, state and local government agencies. ESRI now provides more than GIS maps and products that are best known to corporate and academic researchers than everyday consumers and claims a "30-year history of excellence in market intelligence…that are now industry benchmarks[xviii]."

One of its many lines of business is providing intelligence and market analysis for products and services, for customers that include the Central Intelligence Agency, the Department of Homeland Security and a host of federal agencies and transnational corporations. What is significant about ESRIs growth is its ability to mine public (government) databases and load them into proprietary technology systems to which corporations and large institutions like universities subscribe. Business and government data are mined and then repackaged as "business intelligence," interpreted and sold to the very companies and government agencies from which the data is derived. In an ESRI white paper, "2009 Methodology Statement: ESRI Data—Retail Marketplace[xix]," ESRI discusses a database that provides information about supply and demand in the Food Services & Drinking Places retail market. This database has been developed with North American Industry Classification Systems (NAICS) data, and ESRI clients are able to merge this data with information from the Bureau of Labor Statistics, the Census Retail Trade and the Census Bureau's Non-employer Statistics. ESRI calculates consumer demand based on spending data and consumption estimates from over 700 various products and services, which can be analyzed spatially in worldwide manufacturing and distribution patterns. With all this data, ESRI has developed a proprietary methodology to interpret the data for middle managers and policymakers using a "Leakage/Surplus model" that calculates "the balance of supply and demand." They claim that this level of data mining and interpretation allows their clients to see how consumers are spending their money, and on what items or

services, so that companies can control the flow of product into the marketplace. Consistent with Goss' assertion, companies are increasingly spending money on information that they believe predicts consumer behavior "objectively" – despite the highly subjective behavior of human beings who make choices for a variety of reasons. The use of this information furthers the interests of global companies with access to business intelligence. Schiller's assertion that "information is a commodity" is never more evident than in the GIS software business. GIS industry leaders like ESRI have become powerful information commodity brokers and incredibly wealthy in the process. ESRI provides forecasting across several industries, including harvesting information from more than 12 million U.S. businesses, in databases and reports compiled by infoUSA[xx]. The primary industries reliant upon this kind of business intelligence and data analysis include banking & finance, education, government, insurance, law enforcement, media, natural resource managers (mining, forestry), petroleum (oil), real estate, retail service sectors, telecommunications, transportation and utilities companies and municipalities. It delivers its content through its leading product, ArcGIS, which is part of the way in which ESRI controls more than one-third of the global GIS market.

It is essential to understand this mining of information from government and corporate databases as taking place within a web (and cloud) of complex and proprietary algorithms, software requirements, computer hardware and highly-skilled training. One problematic aspect of the GIS technology is that it is both "black boxed," which obscures the inner-workings of the programming code, and it is proprietary. Furthermore, GIS management and implementation through the consolidation of the industry into a handful of companies spun out of Department of Defense projects is deployed primarily through U.S.-based companies. The degree to which power hierarchies are being reproduced digitally in geospatial programming is an emergent theme in critical information studies, and worth further study at a social-structural level. What needs to be understood, particularly by the public, is how GIS technologies are fostering digital enclosures[xxi] (Andrejovic, 2007) that portend to create greater socio-technical affordances. What we believe is happening in terms of accessing GIS data to help us find things more easily is also enclosing our movements through high levels of monitoring and surveillance.

Acculturating strategies and tools like Google Maps, Google Earth, GMail, Google Docs and others serve as a means of securing personal information, email, documents, etc. in exchange for the ability to mine such information and sell it for a profit/commercial purposes. In the current scheme, Google retains the right to search our data in exchange for "free" tools and services. The precision and refinement of the ability to identify and commodify "patterns of interaction, movement, transaction and communication[xxii]" serve as a vital resource and profit center for cloud computing companies like Google. These processes make the correlation of user data and behavior with communication and advertising exposure a likely and inevitable end. These arguments underscore how networks populated by data and aggregated geospatially is not essentially empowering, per se, in that it can be constituted in different ways that are increasingly controlled by media conglomerates. Andrejevic's detailing of the digital information enclosure, akin to the European land enclosure movement and its move from "violent expropriation into a freely agreed-upon contractual arrangement" is of critical importance. He critiques the notion of "freedom" to give up the control over the means of production and labor, replicated in the server-client model of digital spatial enclosures. Free labor is always inherent in online activities under this model of data mining and the cloud, based on the users' digital profile. What is problematic is the way in which these processes are obscured from the public and under-examined at a socio-structural level.

In the case of ESRI, its client base of Fortune 500 corporations and governments is astounding, and its communications are illustrative of the ways that ESRI is helping its client base "enhance profitability." In the ArcGIS Content Product Manager's presentation at the ESRI Business GIS Summit, Christophe Charpentier gave a forecast for ESRI's largest global GIS clients: Wal-Mart (the world's largest retailer), Carrefour (the world's second largest retailer), Starbucks (world's #1 specialty coffee retailer), Citigroup (one of the largest global financial services companies), HSBC (one of the world's largest banks by assets) and Allianz (one of the world's biggest insurers). ESRI presentations quote senior company executives talking about their desires to expand and consolidate their market presence internationally. And, ESRI is there to provide the information to facilitate these global financial transactions, mergers and acquisitions—particularly in "emerging and developing markets" like Brazil, India, Africa, Central America, Indonesia, Poland, Russia, Egypt and China.

How Public Funds Further Consolidate GIS Industry Dominance

ESRI's client roster includes, "more than 300,000 organizations worldwide including each of the 200 largest cities in the United States, most national governments, more than two-thirds of Fortune 500 companies, and more than 7,000 colleges and universities[xxiii]." ESRI applications, running on more than one million desktops and thousands of Web and enterprise servers, provide the backbone mapping and spatial analysis[xxiv]." Part of ESRI's business strategy is to be "cost effective" by 1) acquiring existing content and 2) leveraging public content or participating in co-publishing initiatives. In this way, ESRI further consolidates its industry leadership by using data that is generated or subsidized in the public domain. ESRI has a series of focus areas including: A/E/C (Architect, Engineering, Construction), Business, Defense and Intelligence, Education, Government, Health and Human Services, Natural Resources, Public Safety, Transportation and Utilities and Communication[xxv]. Because ESRI is the largest company within the GIS industry, it's important to see that their dominance is reinforced by their development of a comprehensive knowledge base for a host of projects, from human genome projects to Smart Grid technology, which is heavily funded by the federal government with a recent infusion of cash from the American Recovery and Reinvestment Act of 2009. According to *SmartGrid News*[xxvi] the Department of Energy will distribute $3.375 billion dollars in grants toward Smart grid technologies and another $615 million for "demonstration" projects as part of the Stimulus Bill. At the forefront of the lobbying effort for access to the $4 billion is the Gridwise Alliance, a consortium of over 75 companies and municipal governments that are seeking grants from the government. GridWise Alliance leadership includes executives from IBM, Google, BAE Systems, and GE Energy T&D, among others. Many companies participating in the Alliance provide services to companies[xxvii] that include Goodyear and Wachovia, not including the aforementioned ESRI client base. Its leaders have been key advisors to the Federal Government in such capacities as a member of the Energy and Transportation Task Force of the President's Council on Sustainability in 1996[xxviii], an expert witness on renewable energy for the House Committee on Science, an advisor to Vice President Dick Cheney's Task Force on energy[xxix], and a Campaign Director and Chief of Staff for a U.S. Congressman[xxx]. These leaders have intersecting

personal and professional relationships with legislators by nature of their past job appointments. Almost every member of the GridWise Alliance's executive leadership team has worked directly in lobbying the federal government for energy resources, and each of their current companies are heavily vested in the GridWise Alliance. Notably, in December 2007, ESRI joined the GridWise Alliance "to support developing technologies for the nation's energy system[xxxi]."

ESRI is not only poised to be the key GIS service provider to winning grantees in the SmartGrid funding from the Stimulus Bill, but it also stands to gain as the vendor of choice in GIS mapping projects that will be funded by the $7.2 billion broadband portion of the Stimulus Bill. In August, 2007, ESRI debuted a Telecom Mapping and Analysis Package (TMAP) that is positioned to be the market leader for municipalities and state governments looking for mapping solutions that can help analyze gaps in broadband access[xxxii]. As ESRI continues to become the ubiquitous GIS software provider, it has also entered into a series of new global partnerships with a cast of dominant industry players, including Microsoft[xxxiii], IBM[xxxiv], AT&T, BAE Systems, National Geographic, NAVTEQ, Novell, Oracle, SAP and SAS, to name a few. According to the ESRI Corporate Alliance information[xxxv], ESRI's partnerships with other technology leaders are to provide business intelligence in a variety of forms. The business of information in today's GIS software industry is the business of intelligence. This intelligence is designed to bring together discrete and often disparate bits of information into reporting and measurement tools that companies use for a variety of purposes. The buying and selling of information is a business unto itself, which is being fueled by GIS. According to an October 2003 story in Directions Magazine, "The demand for these systems is expected to increase as the marketplace grows to more than $60 billion by 2005, quadrupling the current opportunity. IBM and ESRI will take advantage of this growth as both companies jointly market the industry's first enterprise-wide GIS solution. Initial target industries include government and telecommunications[xxxvi]." Though the earnings of the top five companies have not even begun to reach these predictions, the partnership with IBM, and a focus on enterprise-solutions with the IBM's hardware and consulting services, further entrenches ESRI as the provider-of-choice among the Federal government and Fortune 500 companies that use IBM products.

Consumer Market Applications

Participatory GIS, the practice of making mapping tools available to under-served communities for the purposes of community empowerment, is worthy of its own exploration. This paper will not attempt to dissect the details of the topic. However, participatory GIS is an important aspect of the business models of Google and Microsoft. Both companies are providing entry-level and easy-to-use maps for the public, unlike the GIS industry leaders like ESRI or Bentley that are focused on commercial and governmental use. There are many open-source GIS products that are specifically being designed for non-profits, educational organizations and community groups. However, this paper is only focused on industry leaders and their projects; hence a closer look at Google because its tools are increasingly positioned as "participatory," "free," and available to the public for the purposes of empowerment.

Google Earth, a product of Google, is not ranked or benchmarked by the GIS leaders in their annual reports and communications. However, it would be incorrect to leave out the work of Google Earth when looking at the overall GIS industry (commercial and consumer), given that Google is a $12.7 billion dollar company[xxxvii] and is estimated to be worth $144 billion dollars[xxxviii]. Currently, Google is in an aggressive battle with Microsoft to create the most robust mapping technology that will capture the attention and interest of "everyday" consumers. For a company like Google whose business model is based on advertising sales and data mining, mapping everything from restaurants to hotels and museum galleries is an essential strategy for increasing market share. Google and Microsoft are both hoping their mapping technologies will provoke consumers to participate in making maps more interactive and interesting by uploading ratings, photos and feedback about locations to their proprietary GIS databases. In the Google and Microsoft models, the same idea of encouraging the public to contribute content is at play but to the commercial benefit of these industry giants. Google, Yahoo! and Microsoft use public data just as the large GIS industry leaders do, with layers of information contributed by everyday people. Much of this mapping data is paid for or contributed from the public, and is the result of long-term accumulation of information through Google and Microsoft search engine technologies. "Free" mapping services have

become and will continue to be a significant profit center as GIS technologies are more deeply embedded in the information available on the Internet. This information resource versus information commodity tension is important to understand, because GIS data is both the visual mapping of the world as we know it and is “intelligence” for sale about the world we know. Uncovering the free labor that goes into the cultivation of these GIS databases from public input is also worth exploration in a future research effort.

Google Earth is also the result of corporate acquisitions, something that could not have happened without Google’s tremendous assets and public contributions through taxes and state subsidies. The original map product, EarthViewer 3D was a product of Keyhole, Inc.[xxxix] and has aggressively morphed into Google Earth (a free web-based technology) and Google Earth Pro, a commercial subscription product priced at $495/year. Keyhole’s satellite mapping technology was originally funded by the venture capital arm of the Central Intelligence Agency in the U.S., In-Q-Tel, which engages companies to provide intelligence across several agencies including the CIA, Department Intelligence Agency (DIA) and National Geospatial Intelligence Agency (NGA). In it’s current inception as Google Earth, it is also credited as having created the public interest and demand for mapping and directions by the public, and continues to fuel consumer use with its iphone application made available in May of 2008.

There is the GIS technology business, and there is also the business of the technology. The GIS industry leaders have been able to create interoperability and consistent standards in the technology, which is part of their “co-opetition.” Many industries reach a point of maturity where standards are implemented and regulated as a way of ensuring that technologies can both stabilize and proliferate. By contrast, smaller open-source mapping companies like uDig, Quantum GIS, and GRASS GIS have been surfacing as projects created by research labs and government projects. The open source software developers producing GIS software find their commercial viability in consulting (in the form of technical support) and licensing, and are attempting to contribute to GIS software systems that are free or nearly free. Like other computer programming arenas, standardization of languages and technologies is determined by the larger industry players. Open-source GIS software developers are contributing open source GIS code so that anyone can use GIS technology without having to buy proprietary software like ESRI or Autodesk.

But these companies do not have the kind of financial resources to proliferate their technologies among large corporations, governments and educational institutions and still have to make their software compatible with the industry software languages. The lack of capital makes it near impossible for them to compete with or displace the GIS industry leaders in the commercial or consumer arena.

GIS Friends and Enemies

Previously mentioned is the powerful ESRI-Microsoft partnership that positions ESRI to maintain its dominance as the commercial enterprise-wide GIS software technology. The number two and three players in the GIS industry and Bentley and Autodesk. In the May 2009 Annual Report from Bentley[xl], the company announced its "groundbreaking agreement" to create interoperability between the two companies' (Bently and Autodesk's) software libraries. By doing this, it is their hope that in the Architectural, Engineering and Construction (AEC) industry users of either Bentley or Autodesk software will be able to use software in a variety of configurations that will be compatible with each other. This is another move toward consolidation of technology solutions in the GIS industry. Bentley's Annual Report says that over $16 billion dollars are wasted "due to inadequate AEC software interoperability." Further consolidation of geospatial software solutions among the industry giants is an expression of how resources are being accumulated and used to control system requirements and solutions.

GE Energy's Geospatial group entered a partnership with Oracle in 2007 in an effort to expand business intelligence solutions. Oracle is a leading systems integration company. Oracle's current spatial technology will move to the forefront in this partnership, and GE will begin to migrate away from its current Smallworld software. This vertical integration of services is a critical point to note in the development of market position and consolidation. One industry reporter captured it this way:

> "GE Energy is in a unique position with utility customers. The company not only supplies the geospatial software, but other hardware and systems as well, including electrical transformers, billing and metering. GE Energy controls a hardware and consulting relationship with customers that might be characterized as monopolistic as well as opportunistic. Supply customers with transformers and throw in the network management

> piece as well. GE Energy's area of expertise is electrical distribution and the company can develop end-to-end solutions that would make it impossible for others to compete in that space[xli]."

What is most important in this new alliance is that GE Energy and Oracle stand to displace "middlemen" like ESRI and Intergraph, who are software solution providers. With Oracle as a leading IT infrastructure solution, GE Energy can dominate in a number of utility, energy, transportation and AEC industries that already use Oracle. GE also has significant reach and partnerships with global corporations, which Oracle intends to use to further compete with Microsoft as the IT platform of choice.

Conclusion

Any one of the industry leaders could be examined more closely to illustrate the political economic dynamics of GIS software industry. Microsoft is battling Oracle and Google for dominance in two different lines of business: enterprise and consumer. ESRI and Intergraph are battling Bentley and GE Energy for dominance in business intelligence. Consolidated partnerships that allow one team of companies to beat another – yet all of them edge out any competition or possibilities for participation by newcomers and small, open-source players. At the same time, a complex interplay between each of these software giants exists as IT departments run Oracle solutions over Microsoft servers. There are no polar opposites, but rather a network of "frenemies[xlii]" (in business, it's a partnership of friends and enemies and who can be both a partner and a competitor at the same time). This dynamic can also be described as "co-opetition", a new term that describes how companies that are typically competitors divide opportunities among themselves and cooperate to consolidate or share resources where it will be advantageous to both, while still competing with each other in other aspects of business[xliii]. Businesses like IBM promote this "cooperative competition" idea as a necessary element of the networked economy. Julie Bowser, IBM executive, writes:

> In the past, people saw business as a "winner takes all" or "zero-sum" game. The networked economy moves away from these purely competitive plays to recognise co-operative relationships that leverage value created by those in the network. Competition -- the other aspect of co-opetition -- occurs after businesses have created value in the market and seek to

allocate market share, price, cost and other finite benefits[xliv].

In this paper, I have outlined the ways that the GIS industry was spawned by government and military projects and the political and economic interests that are being cultivated through contracts and lobbying organizations. The industry has also consolidated itself around 5-10 key players with annual revenues in GIS software at $100 million dollars or more, and this consolidation is generating unprecedented commercial growth. Future research can include a closer examination of how GIS software companies are using public information and consumer labor to populate their databases and make greater profit. This distinction between labor and leisure in online behavior, and for whose commercial benefit is an interesting question. Further questions can also include a look at the types of hardware and devices that are being used in the GIS industry and how the GIS software companies are entering strategic vertical alliances with hardware and telecommunications companies. More importantly, the tensions between GIS information as a resource for the public and GIS information commodification needs further exploration.

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