Land use planning technology
Intellectual Property Review, Market Background,
Interviews, and Analysis

Overview

RTI International was tasked with providing land-use planning information to support the Cooperative Institute for Coastal and Estuarine Environmental Technology's analysis of the technology gaps related to land use planning tools, and its goal of maximizing the benefit of research and technology-related investments. This information includes an intellectual-property (IP) landscape review, market background, interviews with industry experts and end-users, and analysis.

IP Landscape Review

RTI reviewed the IP position of the following market players:

- Criterion (Index Software) – no patents; builds on ESRI
- Placeways (CommunityVIS) – no patents; builds on ESRI
- "What If" (Richard Klosterman) – no patents for company or him; builds on ESRI
- Quest in Vancouver – no U.S. patents
- ESRI – no patents

In addition, RTI found no patents to have claim language related to geographic information systems (GIS) and either land-use planning or the environment.

Searches using patent language beyond the claims related to GIS and either land-use planning or the environment yielded some IP. It appears that the following entities have patents in this space:

- IBM
- Autodesk
- City of Scottsdale
- Earth Satellite Corp.
- Wireless Valley Communications

Published patent applications in this space are held by:

- IBM

- Autodesk
- Columbia Technologies (subsurface)
- FMSM Engineers (rivers)

Ultimately the IP issues in this space are not related to patents. It appears that IP is held as either trade secrets or copyrights, with few patents being sought or granted.

Market Background

The following market research is based on an effort RTI did in May 2005. Thus the information is somewhat dated but does offer some insight.

Core GIS Market

Daratech, a market-research provider, has traditionally defined a core GIS market that includes software, hardware, services, and data. For 2003, Daratech estimated this core GIS market at $1.84 billion, up by 5.1% over 2002. Their most recent forecast for 2004 was for an increase of 9.7% over 2003 to more than $2.02 billion.

Almost two-thirds of this core GIS market is for software. In 2003, Daratech estimated total GIS software sales of $1.175 billion, with ESRI and Intergraph accounting for nearly half of the industry's total software sales. Based on Daratech's 2002 estimates of market share, the core GIS software market was split as shown in Table 1.

Table 1. Core GIS Software Market Share

ESRI	34%
Intergraph	13%
GE	7%
Autodesk	7%
Leica	6%
MapInfo	6%
IBM	5%
SICAD	5%
Logica	3%
Other	14%

Source: Daratech

After software, services account for the next largest segment of the GIS core market, with sales of $ 447 million in 2003.

In terms of customer segmentation, Daratech estimated that $815 million of core GIS sales for 2003 were from the regulated industry sector, which includes utilities, telecommunications, transportation, and education. The public and private sectors accounted for purchases of an additional $533 million and $437 million, respectively. Using Daratech's 2002 estimates, Table 2 shows the relative contribution based on each of the relevant industries.

Table 2. Core GIS Market – Major Verticals

Sector	Industry	Purchases
Regulated	Utilities	23%
Public	State/Local	20%
Public	Federal	16%
Regulated	Telcos	14%
Private	Earth Resources	10%
Regulated	Transport	5%
Private	Arch/Eng/Civil	4%
Regulated	Education	4%

Source: Daratech

Typified by ESRI, the traditional GIS industry has leveraged proprietary systems and data formats to maintain control over their installed base, with limited and grudging support for interoperability.

Key value chain categories and related issues include the following:

- GIS Software Vendors – ESRI and Autodesk
- Database Software Vendors – Microsoft and Oracle. As suppliers of 'pure' database back-ends for GIS applications, these organizations are moving quickly into the GIS space.
- End-use Customers and Service Providers

Emerging GIS Market

In a 2005 study, RTI documented that the GIS market was beginning to undergo a fundamental change that could significantly impact the positioning of products in this sector. At the highest level this change can be described as the incorporation of geospatial information into a wide variety of applications that enables GIS to enter the mainstream. This new geospatial industry has been cited by the Department of Labor as one of three high-growth jobs industries (along with biotechnology and nanotechnology).

This high-growth potential is emerging from a variety of factors: the impact of the World Wide Web, an explosion of geographically-enabled sensors (global positioning systems, cell phones, radio frequency identification, etc.), and the provision for geospatial capabilities in non-GIS applications.

The new spatial information management market as described by IDC consists of the established GIS market, geospatially-enabling technologies (GET), and simple Web and desktop applications. The established GIS market is typified by the core GIS market as described earlier and focuses on clearly geographically oriented applications.

The nascent GET market is focused on adding geospatial capabilities to more general purpose business information systems. Oracle is the current leader in this area, but IBM, SAP, and Siebel are also engaged in expanding their systems in this direction. Microsoft is not yet a major factor in enterprise business applications per se, but they should also be noted as a factor in this sector since, like Oracle, they are providing increasing geospatial capabilities into their database offerings

The relevant opportunities are listed below:

- GET Providers – While this market is small by comparison to the core GIS market, key database and enterprise application vendors are quickly positioning themselves for what they perceive as a significant market opportunity. A key to this opportunity will be the migration of traditional GIS users from pure GIS systems like ESRI's to geospatially enabled business applications.
- Web Enabled – Due to the nature of Web-enabled applications such as Google Maps that have no clear linkage to clients' legacy GIS systems, this avenue will enable formerly unrelated players to emerge. Google, Yahoo, and other players in this sector cannot be neglected.

RTI Analysis Based on IP Review, Market Background, and Original CICEET Interviews[1]

Coastal land-use managers use geospatial tools for a wide variety of tasks. However, the more tasks that a given tool can perform, the more complex it becomes, and thus, the harder it is for end-users to learn/master. Based on the CICEET interviews, coastal end-users need a geospatial tool that is easy to use (preferably no training/downloading) required.

[1] RTI's analysis was based, in part, on earlier interviews conducted by CICEET. The interviews presented later in this appendix focus on DSS tools and were not considered for this analysis (with the exception of the Bill Wheaton interview).

It will be extremely difficult (if not impossible) to develop a tool that meets the needs of all coastal land-use managers and at the same time is easy to use. Therefore, it seems critical for CICEET to focus on the specific analysis needs of a very clearly defined sub-set of coastal end-users (e.g., town/municipal planners in the coastal zone).

The traditional GIS market is changing as the incorporation of time-based data is added. New players from the traditional Enterprise-Resource-Planning space like IBM, Oracle, and SAP are emerging as future leaders.

If CICEET decides to investigate this topic further, one approach might include the following steps:

1. **Narrow down target end-users.** Because it cannot be everything to everybody in this space, CICEET should focus on the needs of a specific subset of coastal managers (e.g., municipal planners in the coastal zone who need access to easy-to-use, inexpensive, Web-based tools)
2. **Survey this subset of end-users to identify <u>very specific</u> geospatial analytical needs.** Identify specific geospatial analysis needs, beyond more general concepts like "easy-to-use, Web-based." If a common analysis need can be identified (i.e., 85% of planners need X task performed – see Wheaton interview), then move to next step. If not, consider abandoning this topic as a funding option.
3. **Identify a state that would be a good location for a pilot tool-development project.** Focus on finding states that are already committed to collecting/maintaining the necessary data (very important), already have best-practices protocols (i.e., a uniform or generally agreed-upon methodology/approach for a given land-use-planning task), and would be willing to partner in order to pool funding resources. (Connecticut's NEMO Program appears to be a good starting point.)
4. **Set up an in-state meeting to obtain consensus/buy-in from municipal planners and funding entities.**
5. **Issue an RFP for development of a Web-based, easy-to-use tool that meets the needs of your end-user sub-set.** This step would be predicated on the following conditions: if enough consensus/buy-in is obtained from the target set of end-users and if a suitable partnering state can be identified (e.g., one willing to maintain the data needed to support such a tool over the long term).

Another potential angle for CICEET in this space is to focus on decision-support tools that are needed prior to geospatial analysis (i.e., tools that help end-users ask the right planning questions up front). An approach similar to the one presented above could be used; however, additional steps might include 1) examining existing decision support tools (so as not to reinvent the wheel), and 2) identifying and working with entities that have already established best practices in this arena (e.g., NEMO). Although more investigation is needed, RTI envisions a "TurboTax" approach where end-users go through a Web-based tool that asks a series of questions. The tool then recommends data layers to consider in the analysis, as well as the types of analysis that should be performed.

A longer-term possibility for CICEET is to consider facilitating collaborative efforts with the newer players and other parties of interest. CICEETs money in this case would be used to bring the right parties together and compile various funding sources to the benefit of the environmental applications. For instance, there is interest in this space from the Federal Emergency Management Agency, Homeland Security, Department of Defense, etc. RTI could investigate this option by discussing the effort with agencies and companies we have previously interfaced with on this subject.

RTI Interviews on "Decision-Tree" DSS Tools for Coastal-Zone Land-Use Planning

Key Points

- There have been several attempts to program decision-tree Decision Support System (DSS) tools for land-use planning; however, none of the experts interviewed (including two commercial software developers in this realm) were aware of any tools that are widely adopted or widely applicable.
- The decision-tree DSS tools that do exist seem to be parts of more comprehensive software applications. For example, Computational Hydraulics Int. (CHI) has written two wizards (like TurboTax) around the USEPA SWMM program.
- A representative from CHI said it would be interesting to merge and generalize their wizard methodology. They were interested in finding any good public-domain code that could help in this endeavor.
- One expert said that no "tool" exists that prompts a community to address specific land-use questions. He noted that it is "too bad that community issues are even more complex than the U.S. tax code." He said that he would conservatively guess that thousands of questions are needed to prompt issues that are locally appropriate.

- Another expert indicated that recommendations for geospatial analysis are typically made by water-resource engineers rather than software programs.

Other Items of Note

- The Center for Land Use Education (Wisconsin) is in the process of creating a series of fact sheets to help citizen planners better understand the various planning implementation tools. Drafts can be found at http://www.uwsp.edu/cnr/landcenter/implementationtools.html.
- Wisconsin's Lake Superior Coastal Mapping Portal seems to be the type of tool that CICEET end-users are looking for—easy to use, no downloads, Web-based. The Web site is http://maps.aqua.wisc.edu/lscmp/wlscmp_index.htm (project funded by the NOAA Coastal Services Center). A good "working" example of the tool at the county level is available at http://www.bayfieldcounty.org/LandRecords/mapviewer_start.htm

Interview Summaries

Bill James
Computational Hydraulics Int. (CHI)

Bill James works with CHI, a consulting engineering firm based in Canada that specializes in stormwater management. CHI develops software products related to stormwater-management modeling. According to James, there have been several attempts to program decision-tree DSS tools, and CHI once wrote a program called "BMP-planner." However, he said he is unaware of any product that is widely adopted or widely applicable. James said the problem is that best management practices (BMPs) are typically categorized on an "either/or" basis, whereas many real implementations are variably composed of many BMP attributes (for example permeable pavement designed to trap pollutants).

CHI has written two wizards (like TurboTax) around the USEPA SWMM program, which James said would be a better approach because SWMM is analytical and science-based. CHI's present wizards focus on either permeable pavers or pollutant-trapping devices. However, James said it would be interesting to merge and generalize the methodology.

James said he suspects that several state authorities have generated code for a decision-tree DSS tool. He said that if we find good code in the public domain, CICEET should let CHI know.

Jen Jorgensen
Scientific Software Group (SSG)

Jen Jorgensen works with Scientific Software Group. SSG "is an international leader in providing state-of-the-art software for environmental and water-resources engineers. SSG provides environmental software, groundwater software, groundwater modeling software, surface water software, air pollution software, geotechnical software, borehole logging software, and more" (from SSG Web site). Jorgensen said that she is unaware of any decision-tree DSS tool for planners. She added that, to her knowledge, recommendations for geospatial analysis are made by water-resource engineers.

Linda Stoll
Outreach Specialist
Center for Land Use Education
University of Wisconsin-Stevens Point

Linda Stoll is an outreach specialist with the Center for Land Use Education, a joint venture of Cooperative Extension and the College of Natural Resources at the University of Wisconsin-Stevens Point. Prior to her position at the Center for Land Use Education, Stoll was "the executive director of a regional watershed organization and an environmental planning consultant." Stoll was unaware of any decision-tree DSS tools for planners; however, she forwarded RTI's inquiry to Doug Miskowiak, who is their "GIS guru." Stoll said that the Center is in the process of creating a series of fact sheets to help citizen planners better understand the various planning implementation tools. Drafts can be found at http://www.uwsp.edu/cnr/landcenter/implementationtools.html. She added that they soon hope to have the first eight tools in final form and will welcome comments. They will add more tools this summer.

Doug Miskowiak
Land Use/GIS Specialist
Center for Land Use Education
University of Wisconsin-Stevens Point

Doug Miskowiak is a GIS/land-use specialist at the Center for Land Use Education in Wisconsin. Miskowiak said that, at this point, no tool exists that prompts a community to address specific questions. He noted that it is "too bad that community issues are even more complex than the U.S. tax code." Miskowiak said that if a community is following a typical rational approach to planning, then the process includes mechanisms to identify community issues and opportunities. Issues and opportunities are wide ranging (from all-terrain-vehicle access, to water

pollution, to road improvements). He said he would conservatively guess that thousands of questions are needed to prompt issues that are locally appropriate. Once a decision-support process identifies the major issues, opportunities, concerns, or desires, then a range of geospatial tools exist that can more fully explore the issues to provide insights to decision makers.

For more specific info about decision-support tools for citizen planners, Miskowiak recommended looking at a bulletin he wrote when he worked for UW-Madison, Land Information and Computer Graphics Facility (LICGF), available at http://www.lic.wisc.edu/pubs/Citizen.pdf. Another recommended bulletin that addresses the kinds of questions a GIS can help address is available at http://www.lic.wisc.edu/pubs/toolkit.pdf. He added that LICGF has a host of other bulletins that might also be helpful.

Leesa Souto
Director of Public Education
University of Central Florida (UCF)
Stormwater Management Academy

Leesa Souto is a public outreach specialist at UCF's Stormwater Management Academy. The focus of her work involves educating the public on nonpoint-source pollution issues and identifying tools to help resolve these issues. Souto recommended the following resources:

- The Center for Watershed Protection, Unified Subwatershed and Site Reconnaissance—field assessment method designed to assess the likelihood for pollution load contributed by upland areas. More information is available on their Web site (http://www.stormwater.ucf.edu) or through Jennifer Zielinski at 410-461-8323.
- University of South Florida Watershed Atlas—GIS overlays of drainage basins, water monitoring data, program information, species, etc. The contact is Shawn Landry at 813-974-4590.
- EPA—Souto said that Don Waye (202-566-1170) is a great resource for information on the tools that are available.

Souto also said she remembers watching a presentation on the use of GIS for total-maximum-daily-load decision making, but she couldn't find the source.

Daniel Thevenot
DayWater European Project Coordinator
Education and Research Center on Water, City and the Environment
University Paris XII-Val de Marne, ENPC, ENGREF

Daniel Thevenot coordinates the DayWater project in Europe. Thevenot said that the major aim of DayWater is to facilitate the decision of urban stormwater source-control management using an Adaptive Decision Support System (ADSS). This system does not include a specific tool that asks end-users questions and then recommends data layers to consider and the types of analyses that should be performed. However, such questions are partially taken into account through the development of a chemical priority pollutant list and the related Chemical Hazard Identification and Assessment Tool (CHIAT) tool, and the determination of some key terms through the initial dialogue with the ADSS user (through a procedure called 'Guided tour').

Thevenot said that CICEET can browse the DayWater ADSS prototype at http://www.daywater.cz (using "guest" as both login and password). More information on the project is also available at: http://daywater.enpc.fr/www.daywater.org/.

Bill Wheaton, Manager
Program for Geospatial Science and Technology
RTI International

Bill Wheaton coordinates GIS tasks in support of diverse research throughout RTI and for external government and commercial clients. Wheaton has an extensive background teaching GIS to industry and government. In addition, he has developed GIS methodologies, databases, and programs to support a wide range of GIS projects, including those related to surface water quality, groundwater quality, human and ecological risk assessments, air quality, survey research, and environmental contamination.

Wheaton said that any general-purpose geospatial tool will require some training. Therefore, to meet the needs of CICEET end-users (e.g., Web-based, no training, easy to use), CICEET should focus on creating a simple turnkey tool that does one thing. He recommended identifying the specific geospatial analysis step(s) that 85% of all targeted CICEET end-users (e.g., focus on towns/municipalities) need to perform. Then, build a tool that can perform that specific function.

A second approach recommended by Wheaton is to focus on federal regulations that require these municipalities to perform geospatial analysis. He cited wetland regulations as an example. Municipalities may need a fast way to identify the best

wetland restoration sites in a watershed to mitigate for wetland destruction caused by a specific development project. A tool could be built around this potential need.

According to Wheaton, Web-based geospatial tools are limited in the type of data that can be uploaded by end-users. Therefore, the majority (if not all) of the geospatial data required for analysis will have to be preloaded onto the servers that support the tool. This can reduce the flexibility of the tool and requires a good up-front understanding of the data layers required for analysis. In addition, Wheaton said that despite the desire to have simple tools, analytical models are by nature very complicated. He noted that models used to analyze geospatial data in a flat coastal area will be very different than those used in rocky areas.

Wheaton said that data access can be a big issue in this field. Unless counties already own the required data, localities will have to purchase it (i.e., local detailed data is often not free). He added that maintaining the data can be very expensive. Wheaton noted that in his experience cities and counties have represented a weak market for these types of tools because they can’t afford to use them.