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Global View, Local Setting: Visualization in a Science Museum Exhibit

Abstract: Metro's Data Resource Center (DRC), in collaboration with Environmental Systems Research Institute (ESRI) and the Oregon Museum of Science and Industry (OMSI), is developing a visualization tool to engage a broad spectrum of the public in basic principles of land-use planning. This will become part of a new Technology Hall at OMSI. The design goal of the new wing is to highlight how technology is being used to solve problems and better understand our world. To support this goal, the use of GIS technology in land use and transportation planning will be featured. A highlight of the exhibit will be a multi-scalar display utilizing ArcGlobe technology along with highly detailed local land use and building data. ESRI and Metro recognize that the educational goal of the exhibit is closely allied to their own, shared vision of public empowerment through GIS.

INTRODUCTION

This paper describes the process of conceptualizing and building an interactive public participation geographic information system. The project is the culmination and coordination of ongoing ventures that have been evolving within separate organizations with similar goals. The paper explores the dynamics of a multi-disciplinary group of geographers, designers, planners and educators as they work together to create a specific experience for a museum audience about how technology affects our world. The story also explores the technical solutions applied, both standard ESRI applications and custom developed programs.

OMSI

In September 2001, OMSI received a grant of $1,833,275 from the National Science Foundation (NSF) to support the development of an interactive exhibition for its 6,000-square-foot Technology Hall. The grant will help OMSI renovate the hall with a series of hands-on exhibits, computer simulations, audio and video components, text, graphics, and artifacts. Designed for families, underrepresented groups, school groups and the rest of OMSI's general audience, the exhibits in the new hall will explore the role technology plays in people's lives. Exhibits will

help visitors become more comfortable with technology, grow aware of its history and consequences and understand how they can use it to change the world around them. Related activities conveying a deeper understanding of the general principles of technology will be offered in the adjacent 750-square-foot Technology Lab.

Experts from local industry, universities, schools and other science museums are helping OMSI develop the exhibits. Exhibit content will also align with state and national science standards, including those established by the International Technology Education Association (ITEA). The ITEA is the largest professional educational association, the principle voice, and main information clearinghouse devoted to enhancing technology education.

The NSF requires that OMSI match the funds donated on a two-to-one basis. Since the total cost of the renovation project will be approximately $3 million, OMSI has been seeking additional donations to make up the roughly $900,000 match. OMSI's first donation toward this goal came from Intel, which provided $150,000 for design and construction of exhibits within the Hall. Support from Intel in two earlier phases of this three-phase project was pivotal in enabling OMSI to secure the NSF award. Additional funding and in-kind donations have been received from numerous sources, including IBM Beaverton, Elo Touch Systems, InFocus Systems, Inc., Infogames, KPTV, Metric Halo, Zapf Creation and Planar Systems, Inc. Representatives from many other local organizations, including Cisco Systems, Inc., FEI Company, Hewlett-Packard, Microsoft, Pixelworks, Vernier Software and Technology, and Portland State University have been instrumental in helping OMSI identify resources and develop partnerships.

METRO

Metro, the nation's only directly elected regional government, serves more than 1.3 million residents in the three counties and 24 cities of the Portland metropolitan region. Metro is responsible for transportation and land-use planning, solid waste management, regional parks and greenspaces, and technical services to local governments. Metro also manages the urban growth boundary, a planning tool that defines the relationship between urban growth and rural lands (Metro 1991).

Effective analysis of regional dynamics requires a comprehensive, detailed understanding of land-use and demographic patterns (Metro 1995). In 1989, the idea of a seamless, parcel-specific database began its evolution into a regional land base information system. This development has progressed from a computer assisted drawing (CAD) file into a mature GIS environment that has grown more 'intelligent' through substantial data conversion. Public access to these data have been facilitated through a desktop version on CD and an online interactive

mapping application that offers layers of geographic information individually, or in combination, to anyone who has internet access and a web browser.

Metro's Data Resource Center (DRC) built these interactive tools on the framework of the internationally acclaimed Regional Land Information System (RLIS), which is based on parcel data derived from assessment and taxation records from three counties. Additional layers have been built in reference to the parcel base, including street centerlines, digital ortho-photography, vacant lands, topography, soils and natural hazards. Metro data and map coverages are seamless across the region, eliminating problems that arise from data gaps and overlaps at city and county boundaries.

As our technical capacity has matured, GIS and public involvement professionals have been scoping development options for the next stage, an interactive planning support system capable of engaging citizens in land use decisions (Bosworth 2002). However, funding resources, technical skills and creativity will be essential if this tool is to be intuitive and compelling enough to be effective. After internal strategy discussions, a citizen-led call elicited a response from exhibit developers at OMSI and representatives of ESRI. A team then assembled to define the needs that this project would address. There was clearly enough commitment, support and technology to enable such a venture. Discussion explored specific multimedia alternatives capable of providing rich spatial visualization.

At brainstorming meetings, participants seemed interested in using a physical kiosk where users could change such factors as population density and transportation infrastructure in a regional model. Results would then be projected on a compelling three-dimensional surface. After using the tool, users should understand some of the concepts that planners consider, and how land use choices affect them as citizens. Perhaps this will encourage them to participate in the public process as they become more comfortable with concepts and more invested in the results. The team agreed that the product must be sustainable, focused, objective and informative while remaining relatively simple, entertaining and user-friendly.

Figure 1 – brainstorming using a prototype of GIS "viewing table"

THE OMSI EXHIBIT AS A PUBLIC INTRODUCTION TO APPLIED GIS

Maps have long been used to provide a spatial framework to support decisions for the intelligent use of the earth's resources and to manage the built environment. Such spatial simulation is familiar to many people who routinely use maps to answer questions about the reality they represent e.g. "what's the shortest route from A to B". Looking at a traditional map gives us knowledge of where things are, what they are and how they are related.

GIS is a technology that expands on this "what and where" level of analysis. Users can interact with GIS to perform queries, execute analysis, create simulations and develop models to gauge how qualities vary with time and distance. Interactive maps allow the viewer to not only ask "where", but to find out "who", "when", how" and "why". The map then becomes a powerful tool for understanding how humans interact with their environment.

ArcGlobe adds the third dimension to spatial simulation. Users can now explore complex geographic information from a more intuitive perspective. This dimension takes the simulation one step closer to the spatial reality it represents.

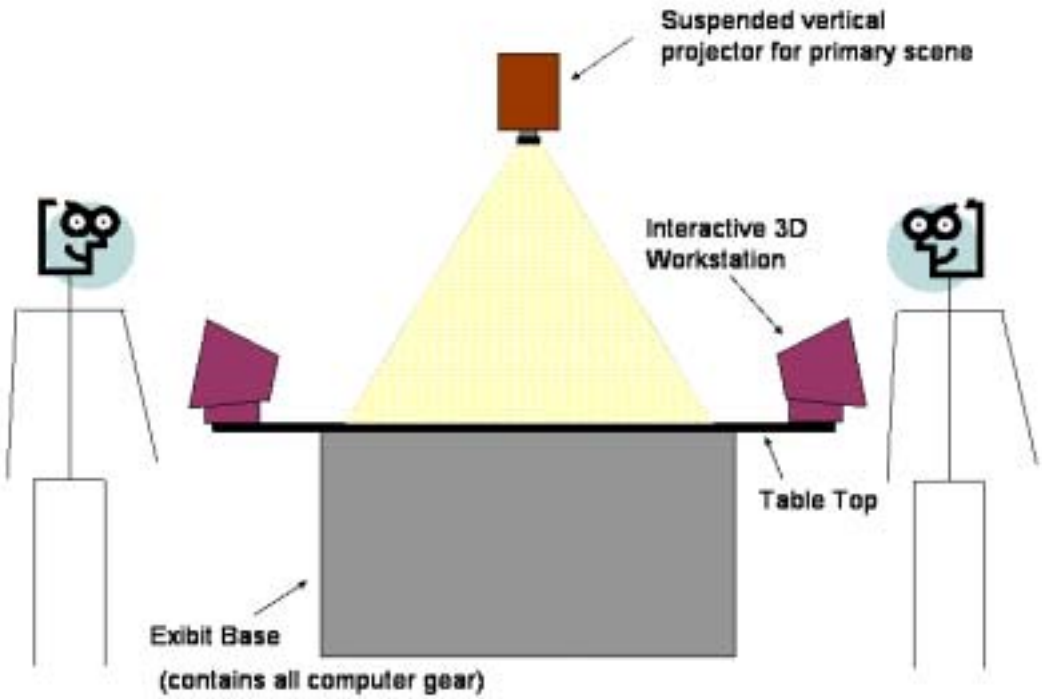
Advanced spatial simulation will raise awareness about the region in which the majority of visitors reside. Exploring their local surroundings from a regional perspective is an important first step toward encouraging a sense of stewardship and involvement in the larger community. The exhibit will introduce visitors to real-world applications of GIS in the Metro area, illustrating that the value of a technology lies in how we use it, rather than in the technology itself.

EXHIBIT DESCRIPTION

The exhibit is comprised of three elements:

1. **Central Projection Table** - A large table featuring a map projection of the Portland/Vancouver metropolitan region. The table can accommodate multiple visitors around its perimeter. Different suites of data are overlaid onto the base map in a rotating sequence. Each dataset offers visitors a different view of the mapped area. Examples include natural hazard maps, earthquake hazard, flooding, landslides; aerial photos, maps incorporating demographic information, education level, unemployment, and population density; land use/zoning maps, and vegetation and soil maps. Real time GPS tracking data may also be incorporated into some of the scenarios. For example, projections of Doppler radar data showing real time cloud cover and weather patterns can be illustrated on a regional map, and TriMet buses and trains can be tracked on a street map.

Figure 2 – Conceptual Design



2. **Multimedia Visitor Stations** - Several multimedia visitor stations are located around the perimeter of the central table. Each multimedia station offers a variety of interactive experiences for individual or small groups of visitors. The following activities have been identified for initial development:

   Explore Virtual Portland - The visitor explores all or part of the Metro region using ArcGlobe-based visualization technology to "fly" through a virtual landscape. The landscape should be recognizable to the visitor, and if possible feature accurate representations of signature buildings, bridges and other area landmarks.

   Urban planning game - A simple planning simulator that allows the visitor to select and implement different urban planning options and view the results. The game might incorporate elements of real planning decisions currently under consideration in the Metro area and a visitor polling/feedback mechanism.

   Find your house - Visitors use GIS visualization software to find their house and explore the region from a database of zoomable aerial photos. This activity might include a print option so that visitors can take home an aerial photo of their home

PARTNER ROLES

Current partners in the OMSI project and their anticipated roles include:

- OMSI - project lead, site of exhibit, provision of hardware, overall design
- ESRI - GIS software, interface development, consulting services
- Metro - regional planning content, data, model/interface development, consulting services

EXHIBIT DEVELOPMENT

Each of the project partners have assumed specific development tasks for each element of the exhibit:

Central projection table

OMSI - idea development, design, materials, fabrication, installation, Metro – data development and delivery; ESRI - GIS software and expertise.

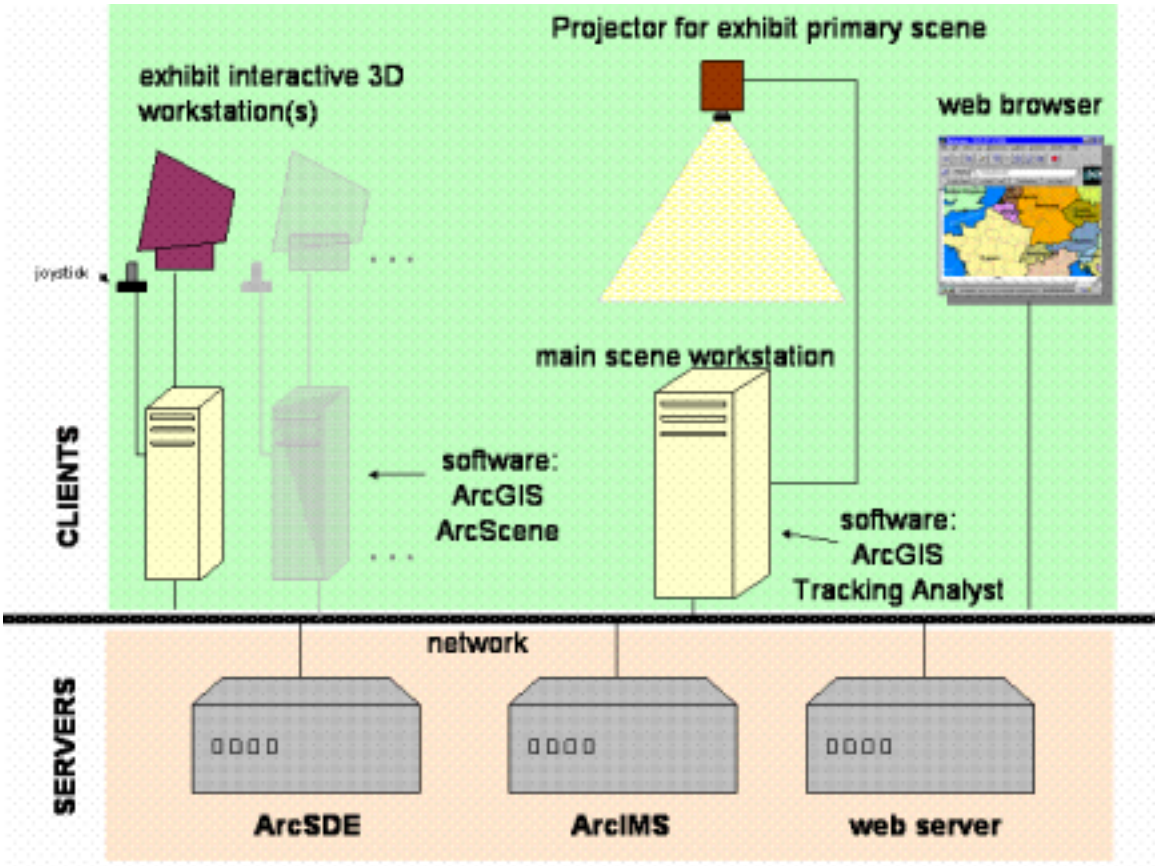
Multimedia visitor stations

- Hardware design, fabrication and installation: OMSI
- Explore Virtual Portland: Metro - data, ESRI - GIS software, OMSI - visitor interface design
- Urban planning game: Metro - data, computational engines, planning expertise, OMSI - visitor interface and game development
- Find your house: Metro - data, ESRI - imaging software, OMSI - visitor interface design

ESRI INSIDE

In general, this suite of applications will highlight a number of ESRI products. ArcGlobe will be the application driving the Virtual Portland exhibit. The primary table will be driven by an ArcIMS application, allowing 4 individual users to act as "clients" to the IMS server. Find your house will hit off an instance of SDE with digital ortho-photos of the region. All user interfaces and other end-user tools will be developed within the VB environment using ArcObjects and deployed via ArcEngine. Future applications will likely include TrackingAnalyst to display real-time data streams of traffic and/or transit operations.

Figure 3 – ESRI applications



RECOGNITION AND MUTUAL BENEFITS

Involvement with the project held a range of benefits for exhibit partners. The various partners expressed the following in terms of expected recognition and perceived benefits from involvement with the project:

- ESRI wanted to feature the exhibit in their marketing and educational publications and thus advertise their involvement and the role of their products. They were interested in exploring duplication of the exhibit for installation in other locations, for example, other museums and governmental agencies. ESRI also wanted an explanation of GIS technology to be incorporated into the exhibit. ESRI recognized that the educational goal of the exhibit was closely allied to their own vision of public empowerment through GIS.

- Metro wanted its role in regional planning to be explained, encouraging individual citizens to participate in the public process as they explore their connections to the larger community. Metro requested that current regional issues be featured when they enhance the exhibit. Metro was especially interested in engaging a broad spectrum of the public in basic principles of land-use planning. As such, the exhibit needed to:
    1. Promote a sense of place and identity for the metro region.
    2. Develop planning games that address the local role played by individual citizens in maintaining sustainable neighborhoods.
    3. Discuss the tradeoffs encountered when balancing community priorities with personal choices.
    4. Utilize more complex planning games in future phases of the project.
    5. Enhance the capabilities of Metro's Data Resource Center through this process, enabling more advanced analysis and visualization.

  Metro also wanted to see a collaborative spatial decision-making tool evolve from this framework to help Metro staff, advisory committee members, elected officials and interested citizens reach consensus in land-use priorities.

TIMELINE AND MILESTONES

OMSI staff defined an overall timeline for the project, plus milestones to ensure that collaborative efforts remained on schedule:

By November 2003
- Work groups for each exhibit component were defined.
- Work groups produced an initial assessment of technical feasibility for each exhibit component.

This information informed the overall project scope and budget.

February 2004
- OMSI finalized the scope and budget for the project.

March to August 2004
- Exhibit component development, prototyping, and visitor testing

September 2004
- Final concept design and shop drawings

October 2004
- Fabrication and installation

November 2004
- Exhibit opens

ACKNOWLEDGEMENTS

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REFERENCES

Bosworth, M., J. Donovan, P. Couey (2002) Portland Metro's Dream for Public Involvement, in W. Craig, T. Harris, and D. Weiner (eds) Community Participation and GIS, Taylor and Francis, pp. 125-136.

Metro (1991) Regional Urban Growth Goals & Objectives, Portland, Oregon, pp. 5–35.

Metro (1995) 2040 Growth Concept Report, Exhibit A, Portland, Oregon, pp. 1–17.