Participatory Modeling Methodology: Tightening the GeoWeb Design Loop

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Outline

1. GeoWeb as convergence of three realms
   - Spatial Data Infrastructure, Online Participatory GIS, Volunteer Geographic Information
   - A Synthesis of Values for Design
2. Coupling architectures for the GeoWeb
   - Service-oriented architecture
3. Participatory Modeling Methodology
   - System development, use, and evaluation
   - Tighten the design loop
4. Conclusions and Directions
   - Results of tightening the design loop
   - A fourth realm? CyberGIS high performance computing

1. GeoWeb Realms of GIScience & Technology

- Spatial Data Infrastructure (circa 1990)
- Online Participatory GIS (circa 1999)
- Volunteer Geographic Information (circa 2005)

Look at a brief overview of these realms…

Motivation within realms

- SDI - increase data sharing
- OPGIS - broaden public governance and community voice
- VGI – enhance distributed information collection

All involve values, interests, and concerns, but perhaps from different perspectives…

US SDI

Spatial Data Infrastructure, e.g. three levels

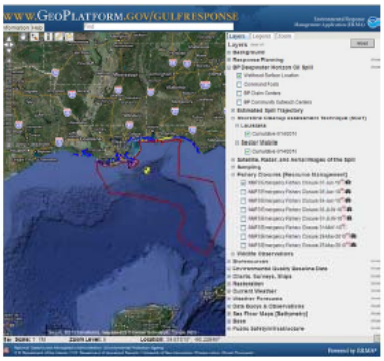
- 12 Federal Agencies – geoplatform.gov
- 50 States (National States Geographic Information Councils)
- Regional (e.g. Washington State Geographic Data Archive)

Data.gov

http://www.naco.org/meetings/participate/Presentations/Federal%20Geographic%20Data%20Committee%20and%20National%20Geospatial%20Advisory%20Committee.pdf

www.geoplatform.gov

Common geospatial data, services, and applications contributed and administered by authoritative sources and hosted on a shared infrastructure, for use by government agencies and partners to meet their mission needs and the broader needs of the Nation.



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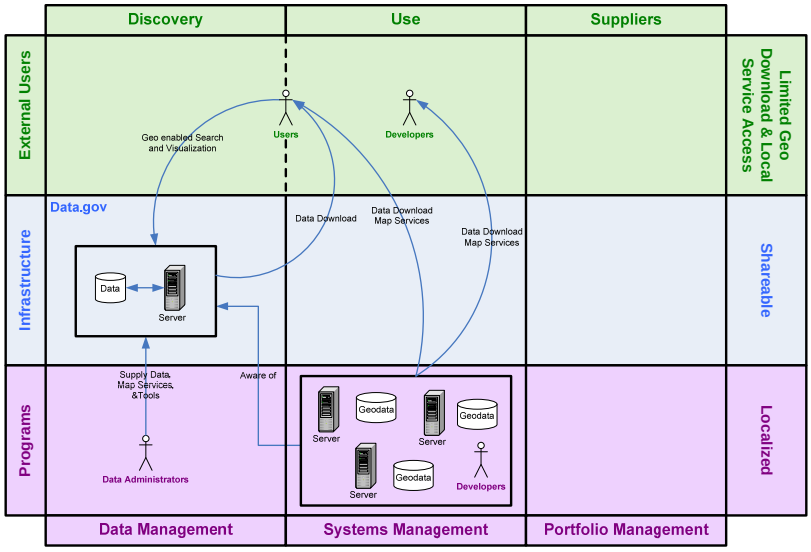
US Federal SDI – current architecture

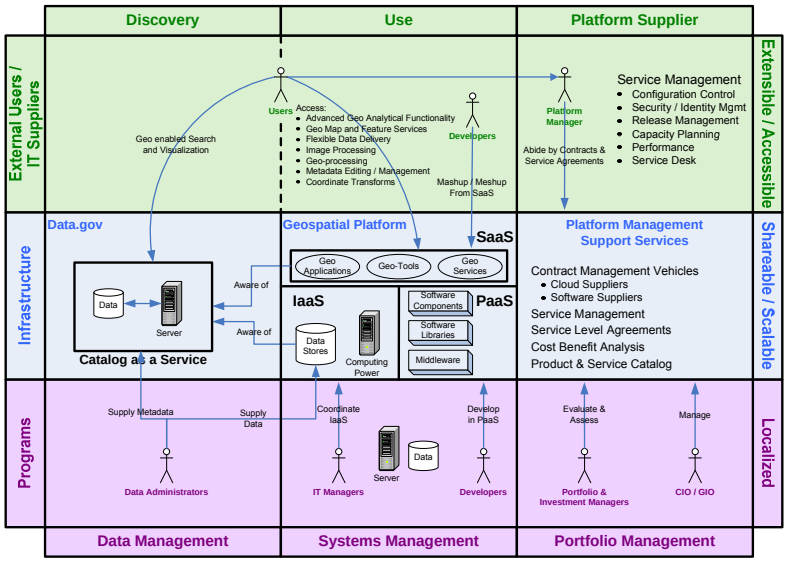
Data.gov Geospatial Capability – Without Geo Platform



Jerry Johnston, US EPA, presentation to NGAC "Status Update: Geospatial Platform"
http://www.fgdc.gov/ngac/meetings/march-2011/intergovernmental-subcommittee-update.pptx

US Federal SDI – next architecture

Data.gov Geospatial Capability – With Geo Platform



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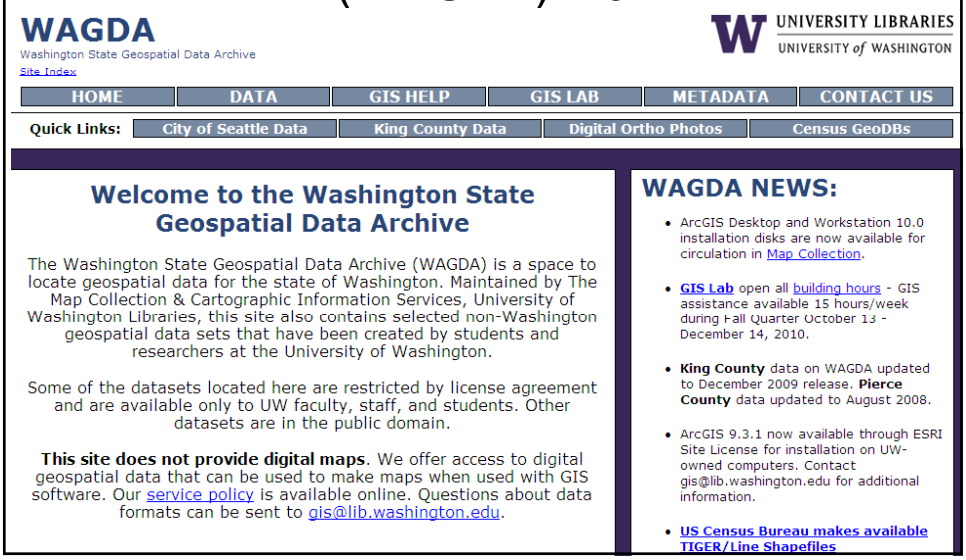
US – States Level

(National State Geographic Information Councils)

- GeoSpatial One-Stop Nodes
- Metadata only

Regional SDI
Washington State Geospatial Data Archive (WAGDA) 1.0



Acquiring Data – Data Access

- Data Access
  - Multiple Services (currently in development)

Function	Direct Connection	Geodata Service	Image Service	Web Feature Service/Web Coverage Service	Web Mapping Service	Geoportal
Fast data view	●	○	○			
Remote data analysis	●	●	●	●		
Complete and ready metadata	●	●	●			●
Geodatabase versions	●	○	○			○
Exportable data	●	●	●	●		●
Interoperability			●	●	●	●
Modifiable access permission	●	●	●	●	●	○
Replication/Editing	●	●	●	●		

● supported - ○ unverified - (blank) not supported - (grey) not preferred

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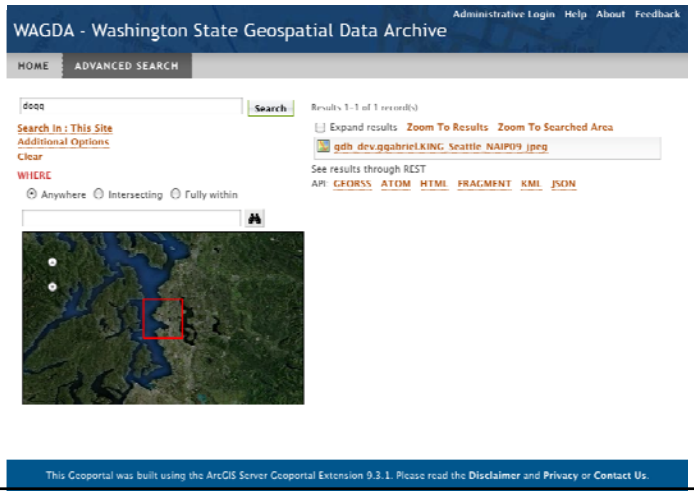
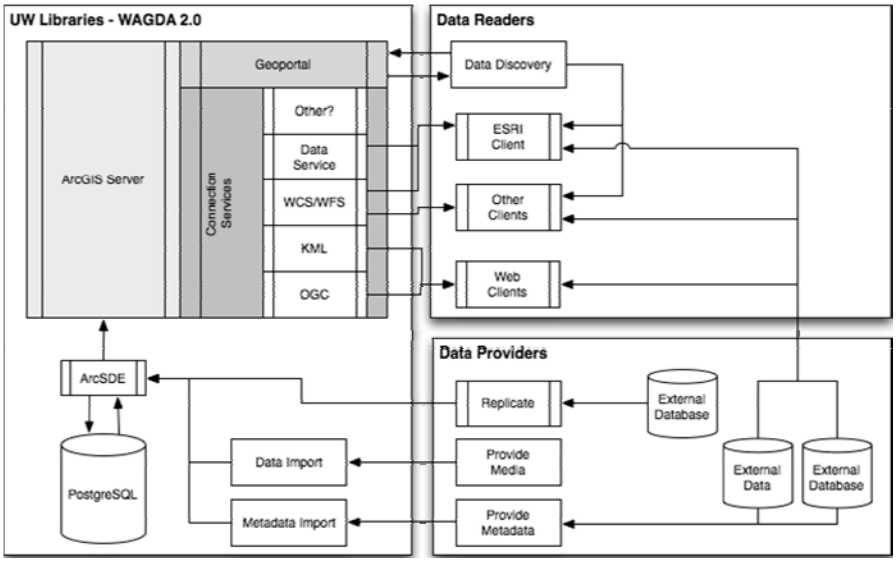
Regional SDI
WAGDA 2.0

- GeoPortal – wagda.lib.washington.edu/geoportal



WAGDA 2.0 Architecture



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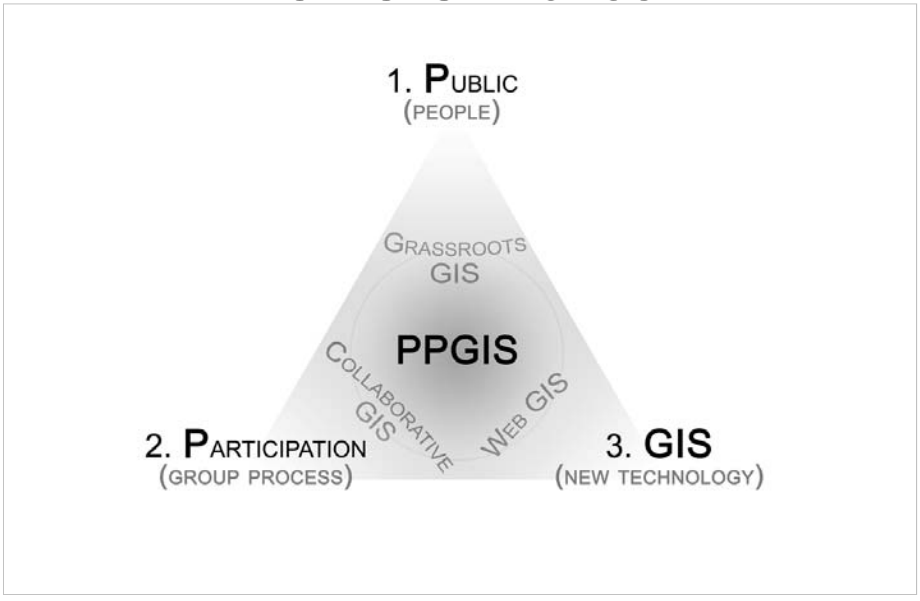
OPGIS

- Online Participatory GIS
- Widespread growth since 1999

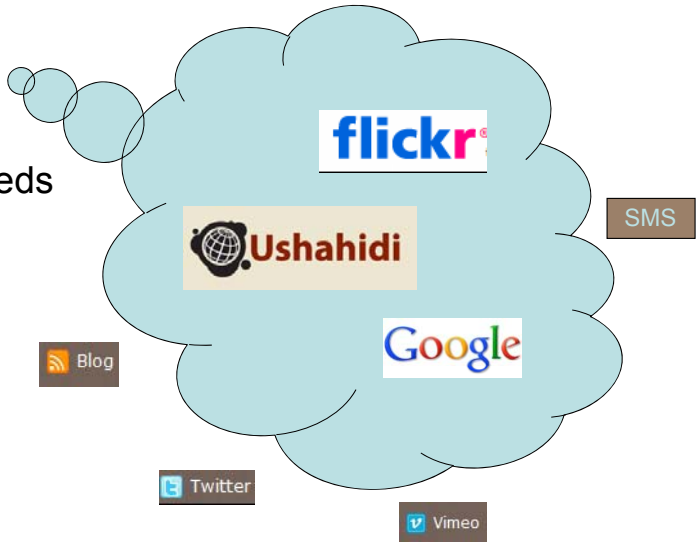
OPGIS Niches



VGI

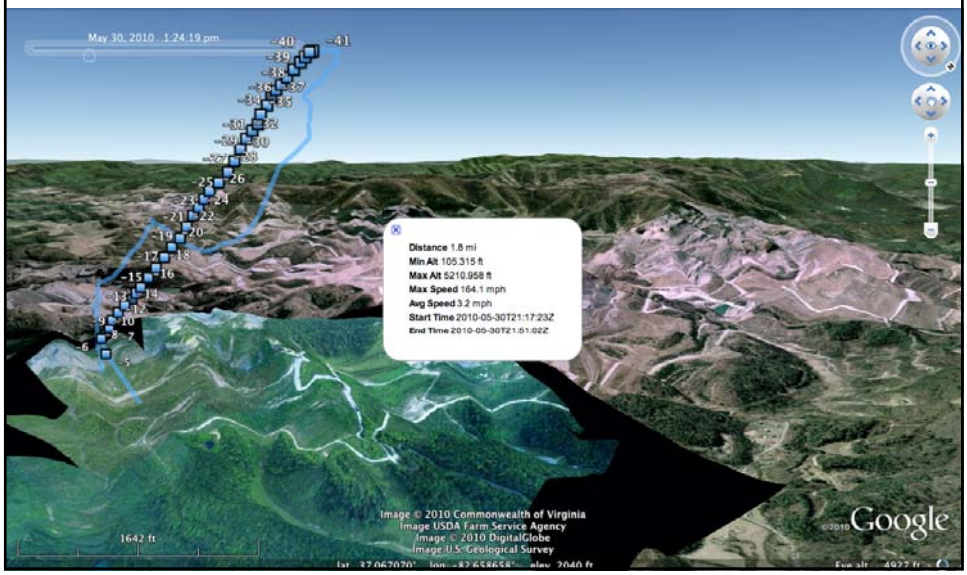
- Volunteer Geographic Information
- Wide array of developments since 2005

VGI
Mashups
and
Real-time feeds



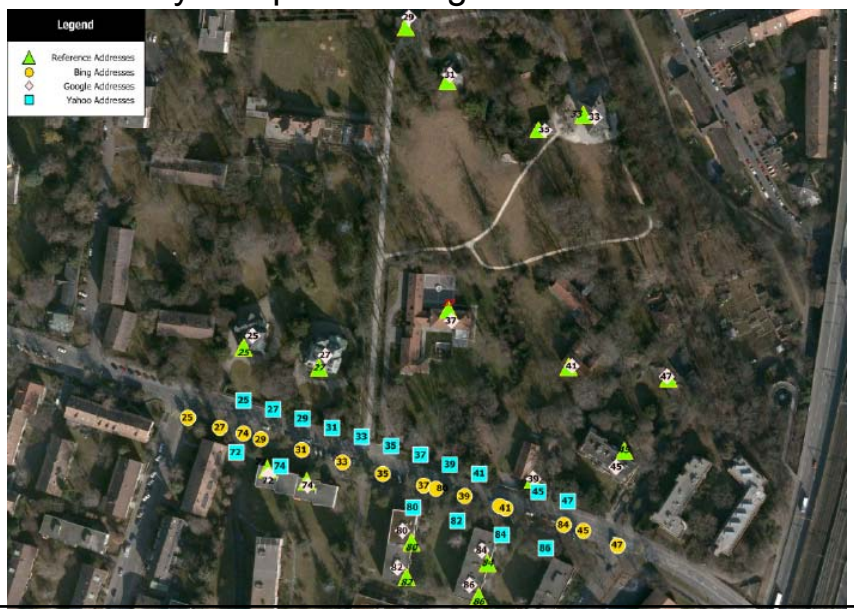
VGI - balloon sensor launch

Balloon trajectory



Volunteer Geographic Information

accuracy comparison of geocoded addresses



Synthesis across SDI-OPGIS-VGI
What is being valued?

- SDI – people interested in efficient, effective, and equitable access to data
- OPGIS – people interested in stakeholder public values, goals, and concerns
- VGI – people interested in personal values, goals, concerns about what is important

Is their a convergence of "value" in light of geospatial information technology?

Shared interests?
Common values?

All realms…

- Engage participants
- Enable participants
- Structure participation

…as human-computer-human interaction

…for data, information, evidence, and knowledge production on the GeoWeb

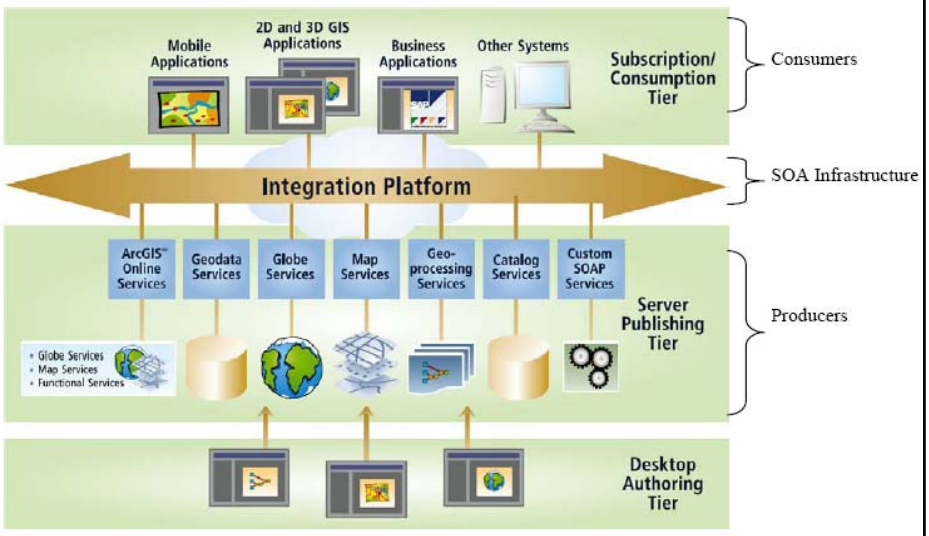
Coupling SDI-OPGIS-VGIS enables distributed and participatory GeoDesign

- GeoDesign – geography by design (Steinitz 2011)
- For example, a regional stormwater runoff monitoring network to better understand and act upon non-point source pollution
- GeoDesign can enable large-scale participatory monitoring designs using GIS
- GeoDesign as sustainability management requires SDI, OPGIS, and VGI resources configured into regional enterprise GIS also called consortium GIS

2. Coupling SDI-OPGIS-VGIS

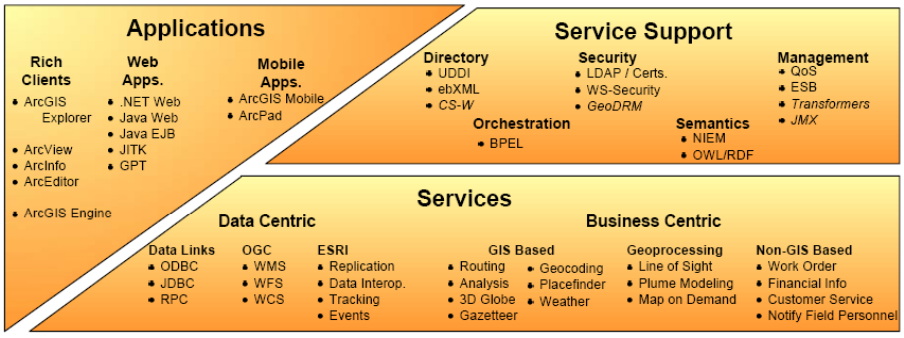
- What architecture design(s) might help us couple SDI-OPGIS-VGI resources?
- Service-oriented architecture (SOA) is an approach proposed by many
- SOA – a collection of protocols and components for integrating service resources
- SOA infrastructure connects…
  - Consumer services: User interface clients
  - Producer services: Data and software capabilities

Esri example of integration platform



http://www.esri.com/library/whitepapers/pdfs/geospatial-soa.pdf

Expansion of SOA Infrastructure, by example, for coupling SDI-OPGIS-VGI



http://www.esri.com/library/whitepapers/pdfs/geospatial-soa.pdf

What methodology Helps Guide Coupling of SDI-OPGIS-VGIS Resources?

- Coupling among three technology realms is a complex choice problem
- Need systematic approach to help guide coupling strategies
- Participatory Modeling Methodology brings diverse perspectives into play

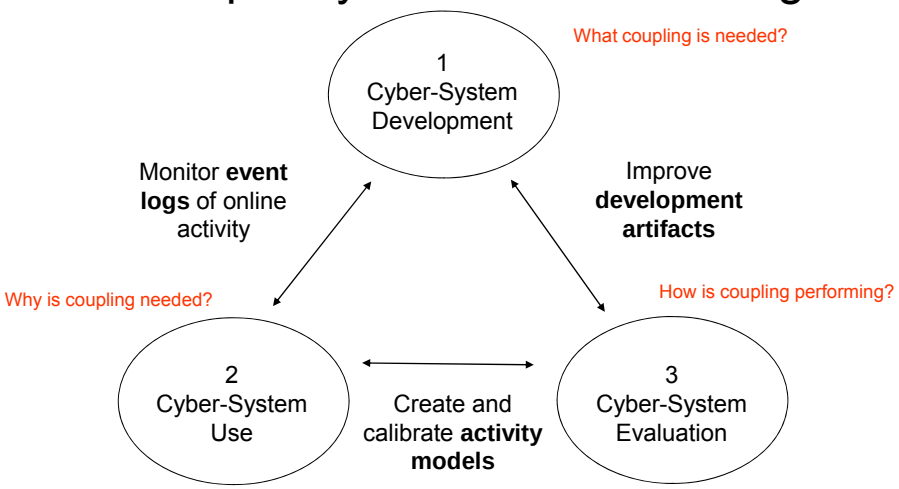
3. Participatory Modeling Methodology (PMM)

- Approach that links system development (information technology), system use (complex problems), and system evaluation (social-behavioral science) for improving outcomes from systems.
- One application: participatory interaction modeling explores the science of interaction design
- Participatory interaction designs are intended to structure participation, while incorporating motivation and information technology

What, Why, and How of Component Coupling?

- What resources are to be coupled?
- Why are resources to be couple?
- How are resources to be coupled?

PMM Framework for Participatory Interaction Modeling

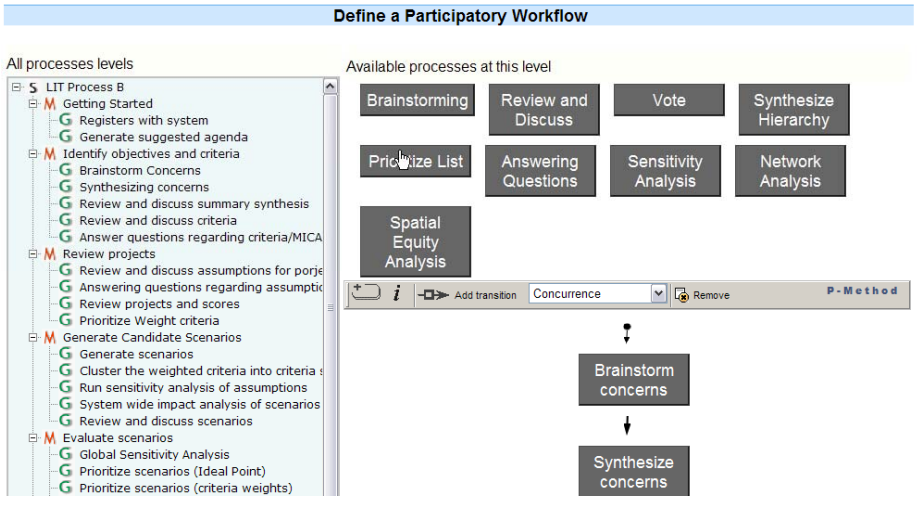


three roles in human-computer-human interaction:
(1) developer, (2) user, (3) analyst

Three domains anchor the GeoWeb design loop

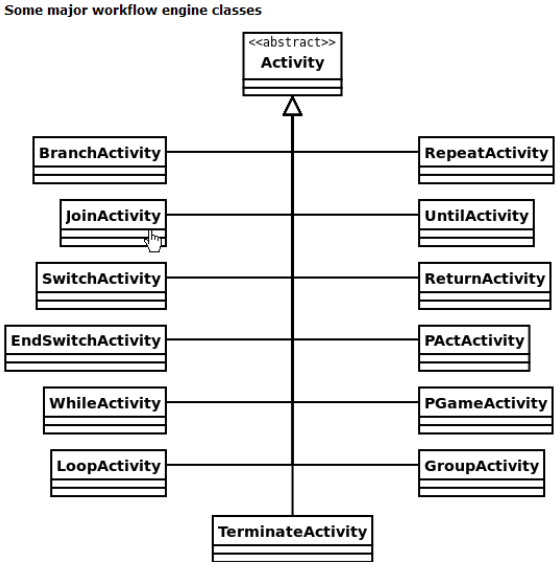
1) **Cyber-Systems development** **incorporate participatory technologies**
2) **Cyber-Systems use** **by participants address pervasive complex problems**
3) **Cyber-Systems evaluation** **involve social-behavioral studies to improve designs**

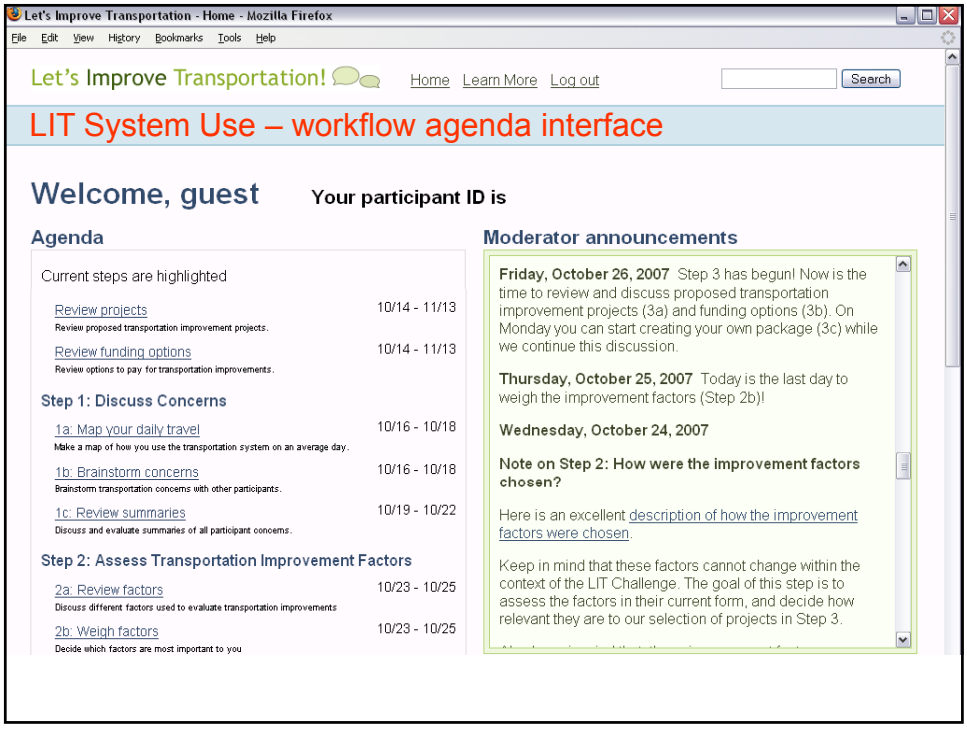
Workflow Manager
System (Design) Development

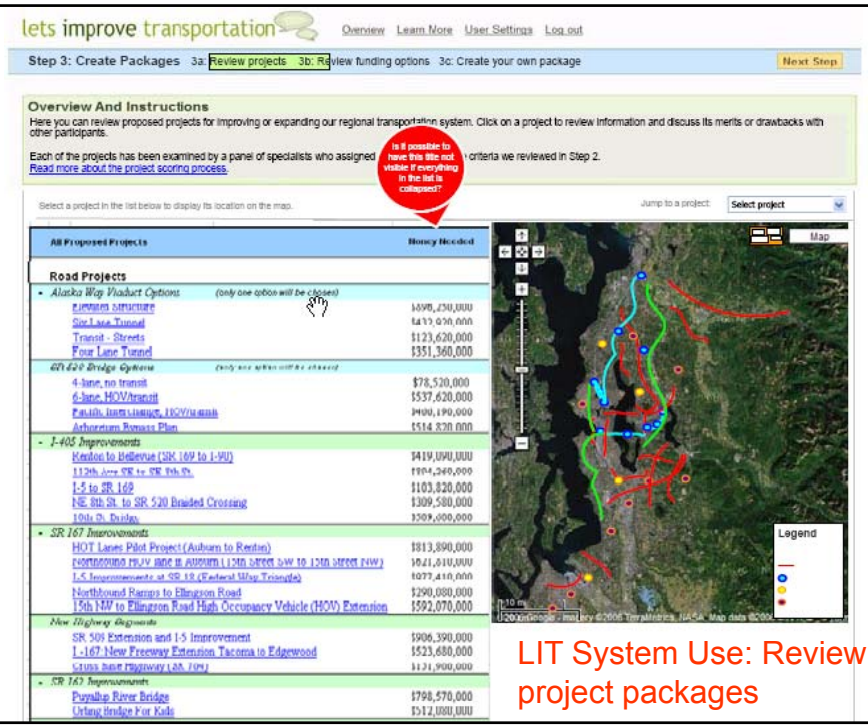


Workflow Manager

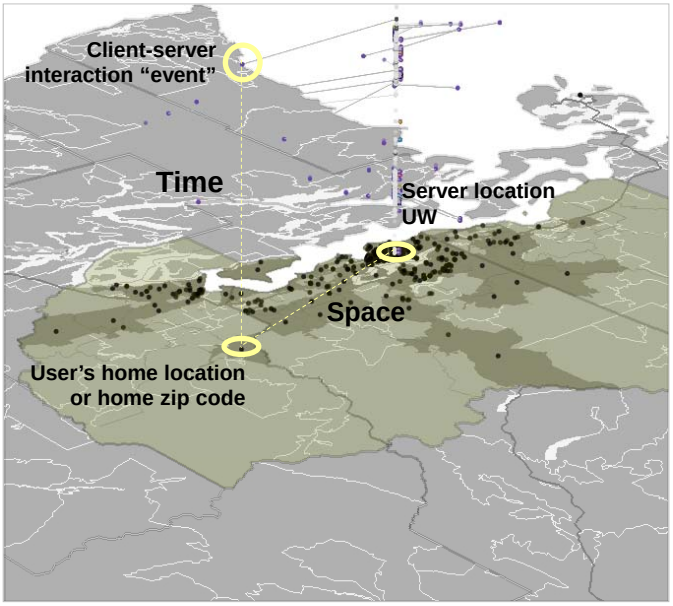
System Design - Class Diagram





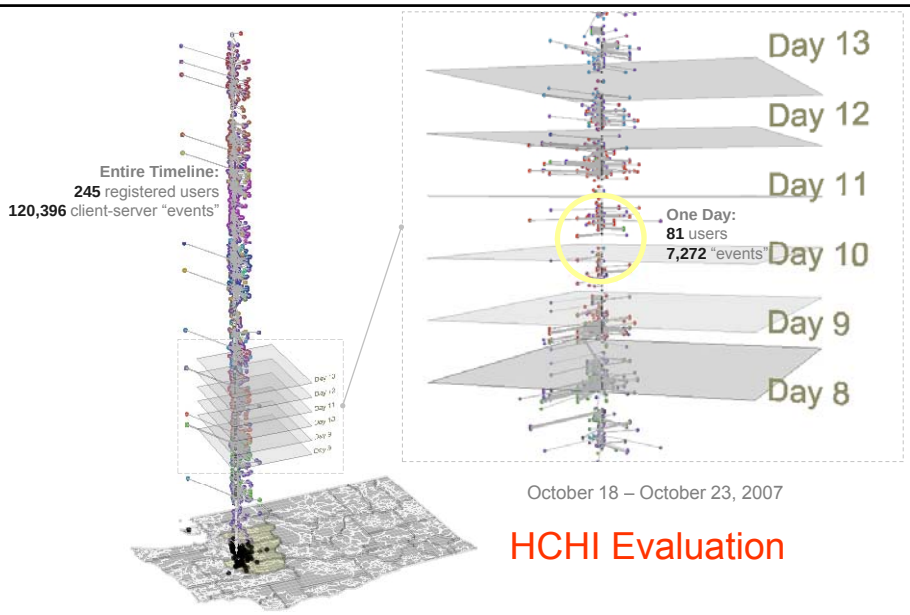


LIT System Use: Review project packages



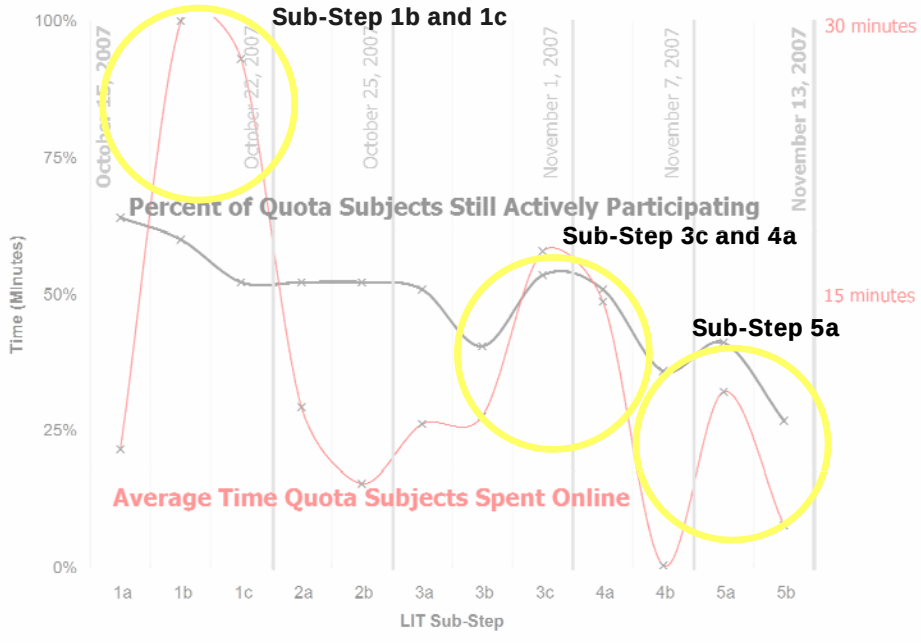
System (HCHI) Evaluation

System log: Client-server interaction "events" captured during decision making occur in time and space



Spatio-temporal Timeline: Three Counties around Seattle, WA, October 11 – November 25, 2007

What it suggests: Evolving structure of an analytic-deliberative network constructed from client-server interaction "events"



Evaluation: Participant activity contained peaks and valleys of intensity

Roles for Tightening the Participatory Design Loop among the Three Domains

Artifact Abstraction Level	Developer Role	User Role	Analyst Role
Use Case Narrative	X	X	X
Class Diagram	X	X	X
Activity Model	X	X	X
Architecture Diagram	X	X	X
Mock-up	X	X	X
Prototype	X	X	X
Event Log	X	X	X

X = Produced by X = Consumed by

Design Loop Outcomes

Tightening the GeoWeb design loop improves outcomes…understanding about:

- Participatory GeoWeb technology design
- Effectiveness of complex problem solving
- Participatory workflow patterns of knowledge production

Research Focus
PMM on GeoWeb

PMM - linking system development, use and evaluation

…on the

GeoWeb - coupling of SDI, OPGIS, and VGI

…enables many research directions, but two in particular…

1) Scaling participation
2) Spatio-temporal modeling for GeoDesign
3) CyberGIS to support those 2

1. Scaling participation

a) down-up - scaling up moves the research toward topics about regional places

b) in-out - scaling out moves the research toward very large numbers of people participating

c) low-high - scaling high moves the research toward nuanced analyses and rich deliberative processes

How can these dimensions help us understand convergence of SDI, OPGIS, and VGI?

2. Spatio-temporal Modeling for GeoDesign

For example, couple Regional SDI, OPGIS, and VGI to enable GeoDesign contributions for stormwater runoff monitoring of water quality

3. CyberGIS to support directions…

CyberGIS – a forth realm

- a fundamentally new software framework comprising a seamless integration of cyberinfrastructure, GIS, and spatial analysis/modeling capabilities using “services approach”, and
- promises widespread scientific breakthroughs and broad societal impacts due to new level of performance for intense computational problems.

4. Conclusions

- Cyberinfrastructure-enabled participatory GeoWeb will continue to grow, connecting people with similar interests more than ever before
- Need systematic and robust, but at the same time comprehensive and flexible, framework for participatory systems design to guide that growth
- Synergistic activity among SDI, OPGIS, and VGI developments can help formulate consortium GIS for regional governance

Conclusions - 2

- Synthesize comparative architectures that lead to improved designs of GeoWeb solutions; a need for computer-enabled case study synthesis
- Tightening the design loop will require metrics for development, use and evaluation
- Enabling participatory geospatial thinking, learning and decision making using cyber-enabled tools will require nuanced metrics.

Thank you!

Comments / Questions?

Acknowledgements

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