CSEDU 2010, Valencia

Desktop to Laptop to Cloud:
Challenges for Teaching and Administration

Dr. Michael Gould

Director of Education
ESRI, Redlands California

Contents

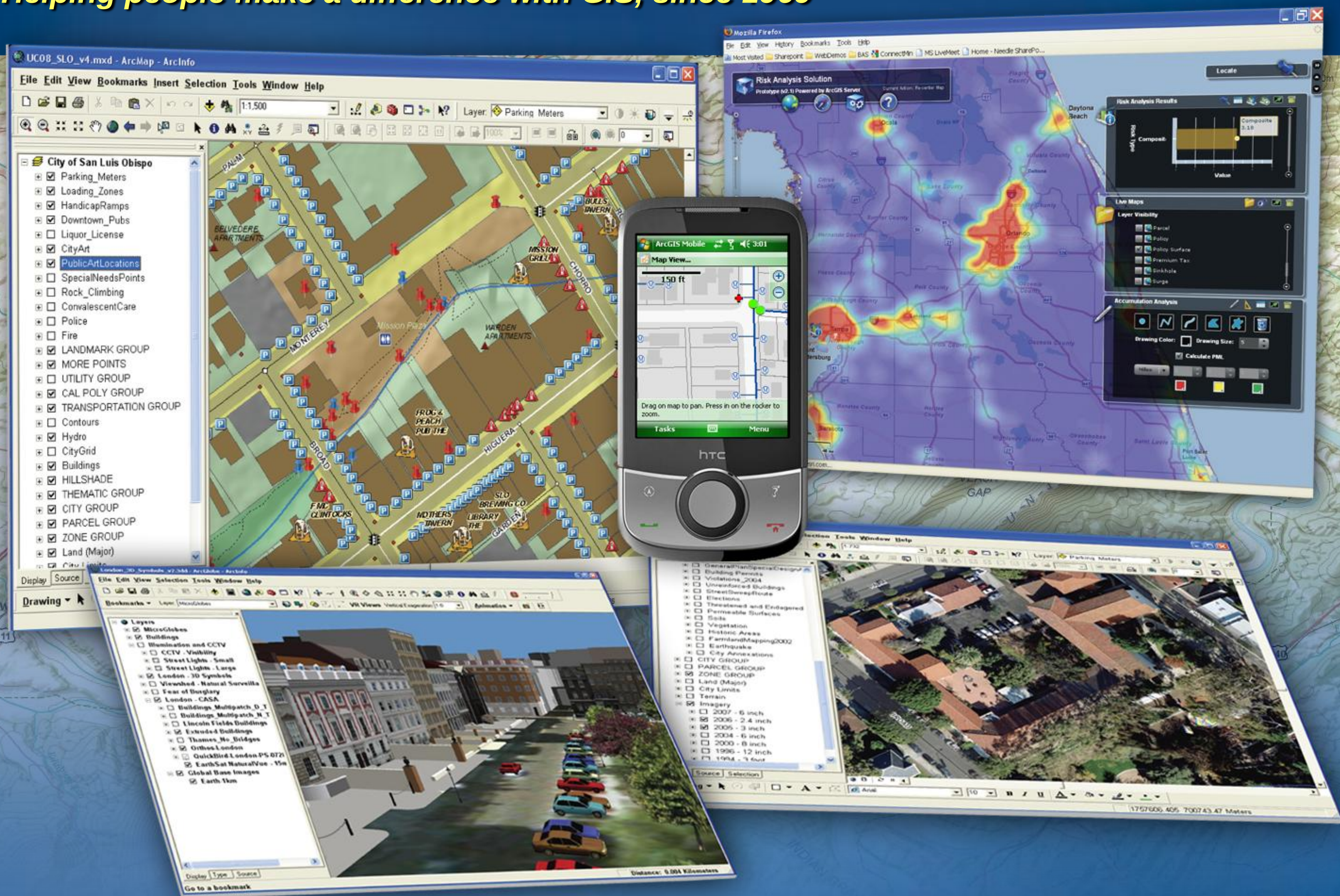
- Context: Computer Supported Spatial Thinking
- Hardware and Software Evolution
- Ubiquity of Computation for Learning
- Challenges to Teaching and Administration

Context

- Have you ever heard of ESRI?
- Environmental Systems Research Institute
- Geographic Information Systems (GIS)?
- Seat 21E: “Computer maps”
- Do you know Google Maps?
- If so, you still don’t know GIS…
- One definition: GIS = Computer Supported Spatial Thinking

ESRI

Helping people make a difference with GIS, since 1969



ESRI Education

Virtual Education Team

Education managers in Europe

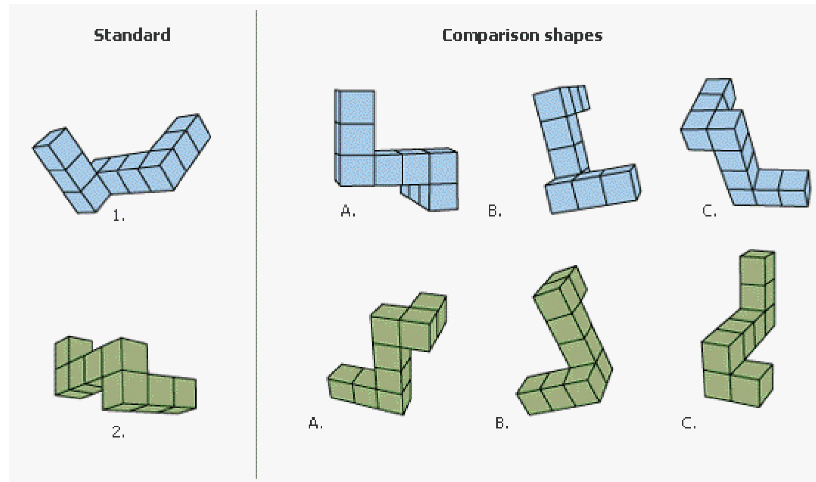
What is Spatial Thinking?

- Howard Gardner ‘s (1983) Theory of Multiple Intelligences.

- Linguistic intelligence ("word smart")
- Logical-mathematical intelligence ("number/reasoning smart")
- Spatial intelligence ("picture smart")
- Bodily-Kinesthetic intelligence ("body smart")
- Musical intelligence ("music smart")
- Interpersonal intelligence ("people smart")
- Intrapersonal intelligence ("self smart")
- Naturalist intelligence ("nature smart")

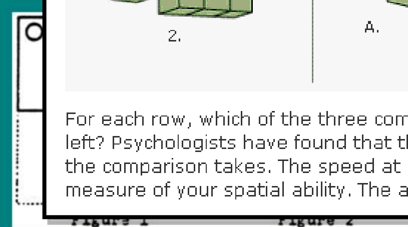
Gardner's Spatial Thinking

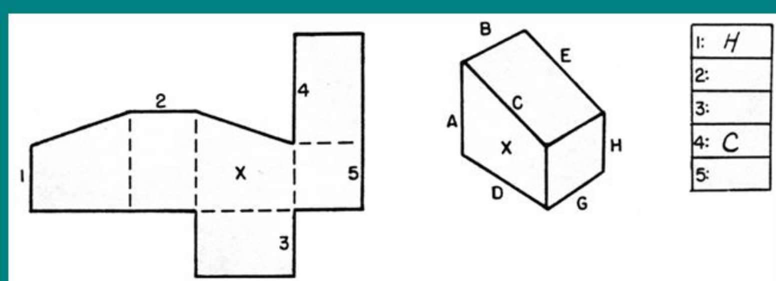
Mental Rotation Test



For each row, which of the three comparison shapes on the right is identical to the shape on the left? Psychologists have found that the farther you have to rotate an object mentally, the longer the comparison takes. The speed at which you can complete the tasks provides a general measure of your spatial ability. The answers are (1) A and (2) B.

Paper folding tasks are classic measures of spatial visualization ability.

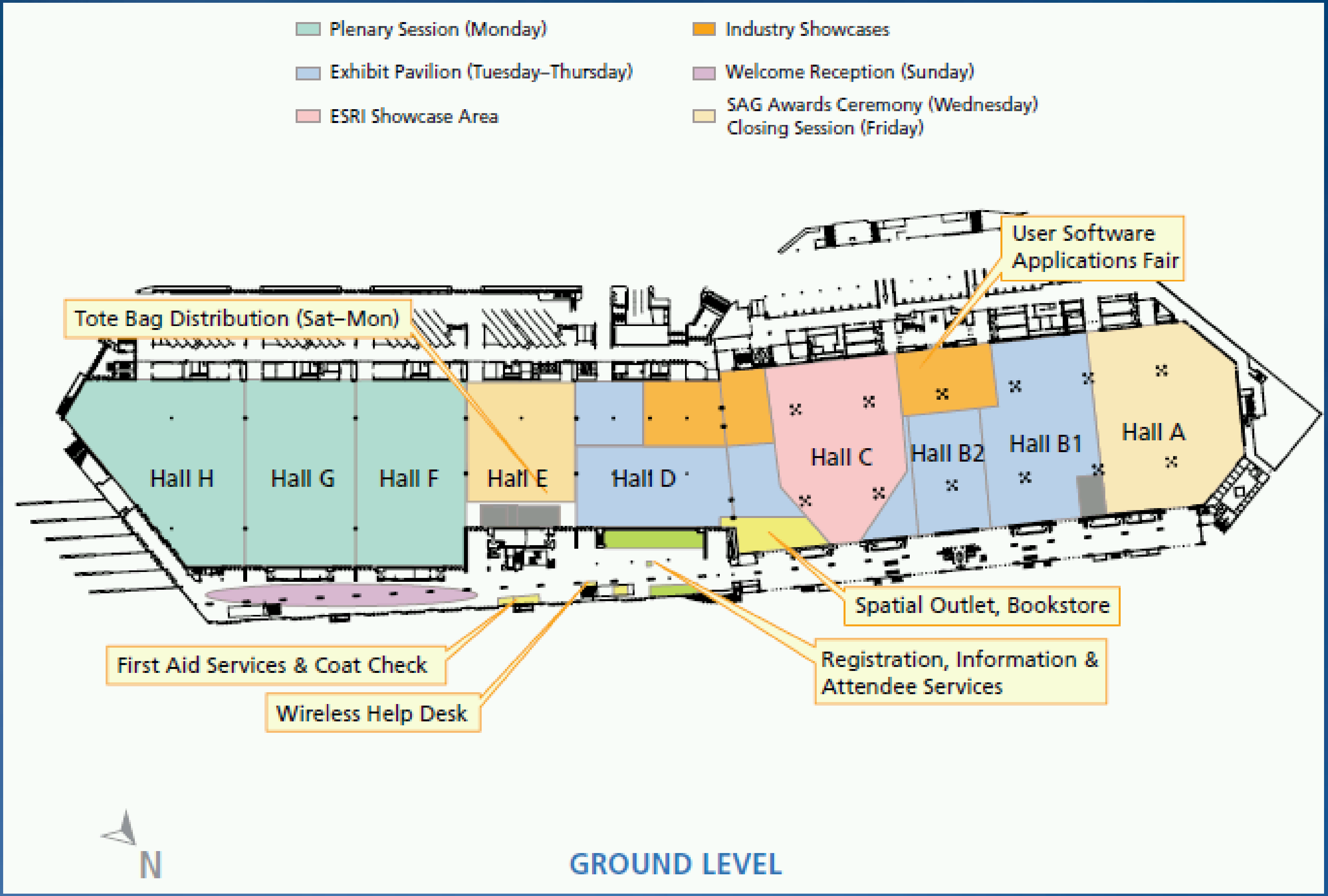




Tests 312 and 315 in: J. Eliot & I. M. Smith (1983). An international directory of spatial tests. Windsor, UK: NFER-NELSON.

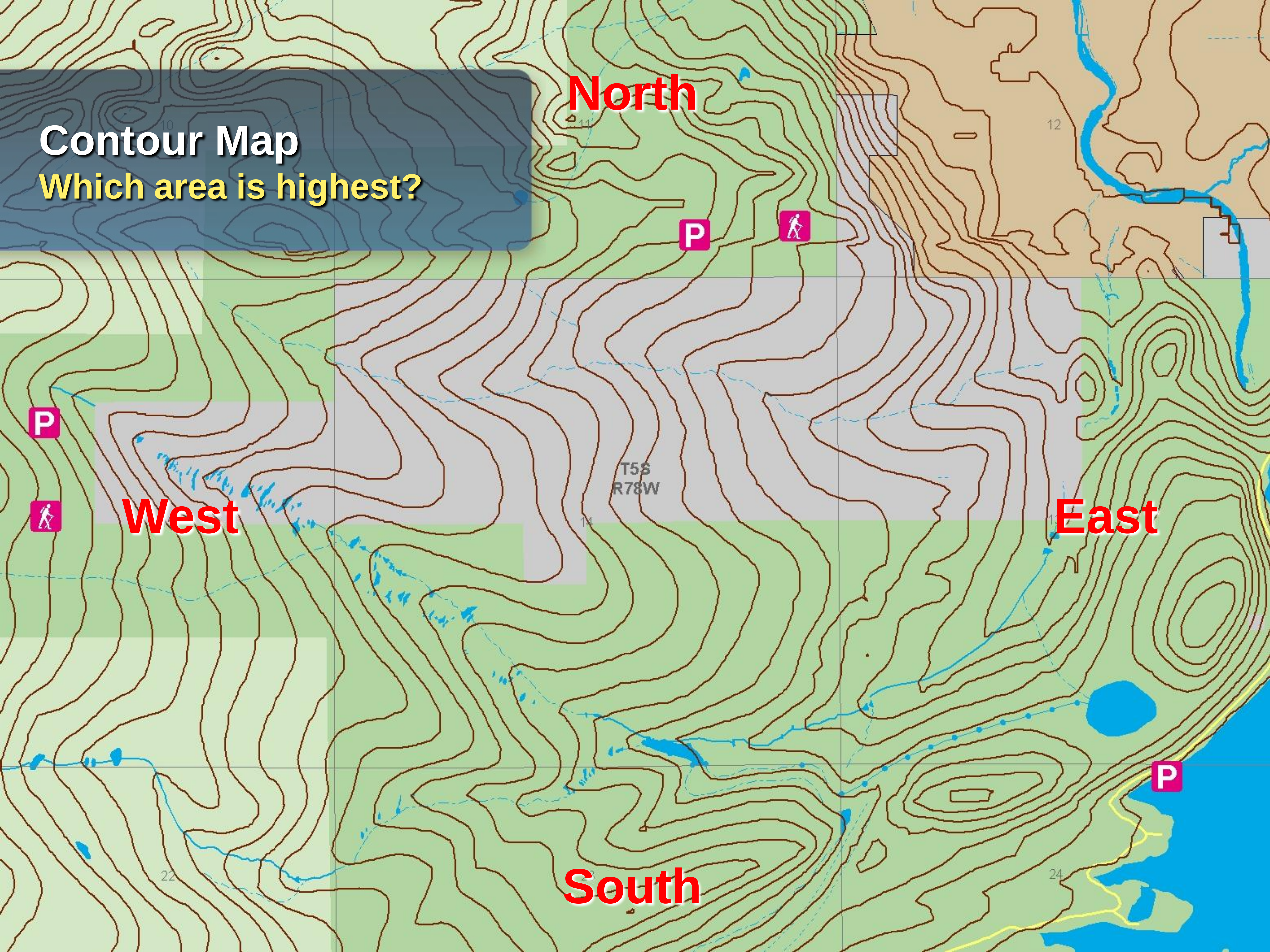
Egocentric space…

San Diego Convention Center (You are …Here?)



Contour Map

Which area is highest?

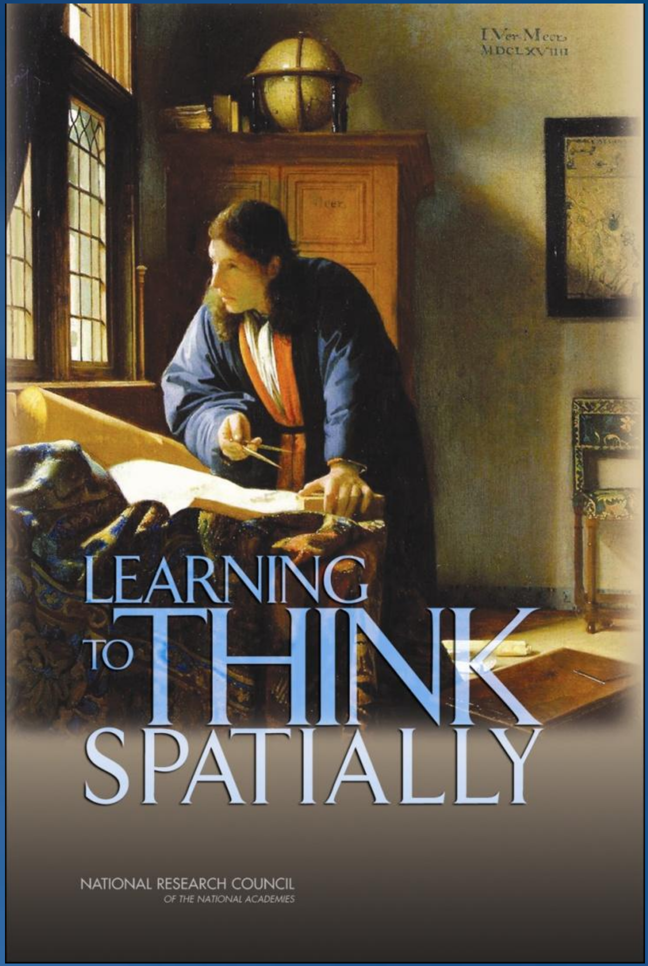


US National Research Council (2006)

Learning to Think Spatially: GIS as a Support System in K-12 Education

Not just primary and secondary

- **an essential tool for every person**
- **Needs to be taught across subjects**
- **Problem solving integrator/facilitator**
- **Needed by the workforce**
- **GIS can be significant**
- **Need research on the topic**



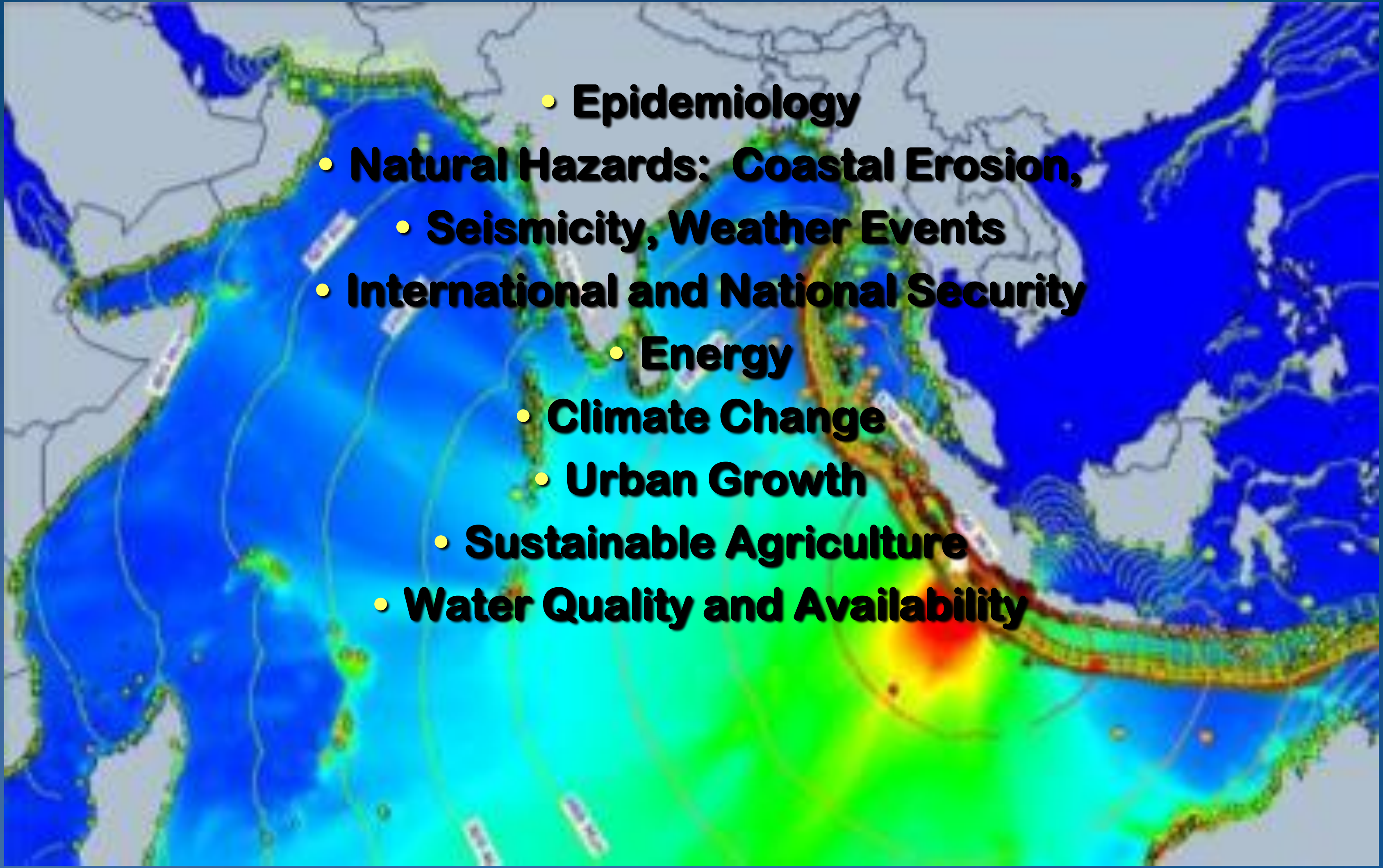
www.nap.edu/catalog/11019.html

NRC view

- “the committee views the process of spatial thinking as a universal mode of thinking, one that is accessible to everyone to different degrees in different contexts.
- Spatial thinking can be learned, *and* it can and should be taught at all levels in the education system. “

- ESRI supports this idea.

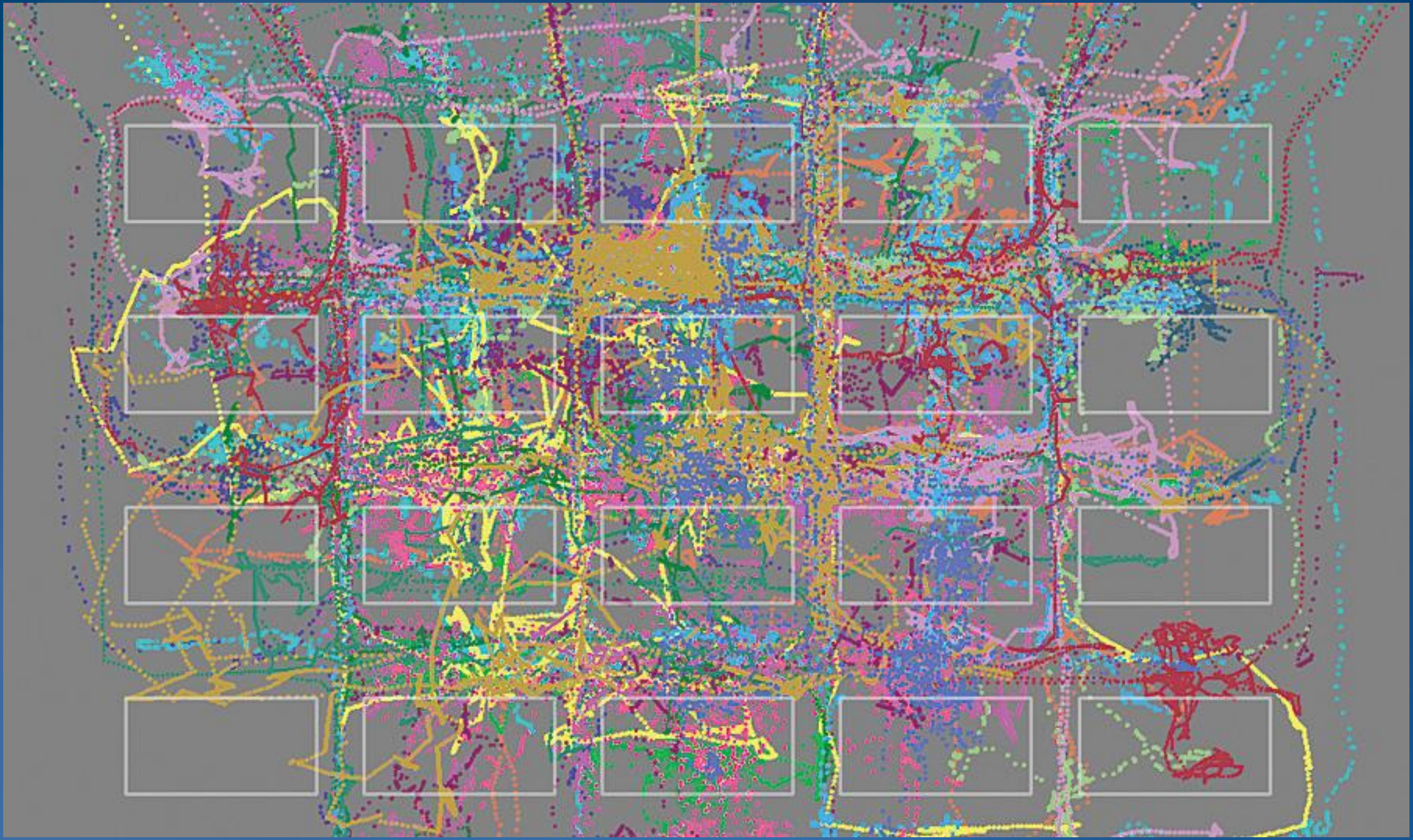
Why Spatial Thinking in education?



- Epidemiology
- Natural Hazards: Coastal Erosion,
- Seismicity, Weather Events
- International and National Security
- Energy
- Climate Change
- Urban Growth
- Sustainable Agriculture
- Water Quality and Availability

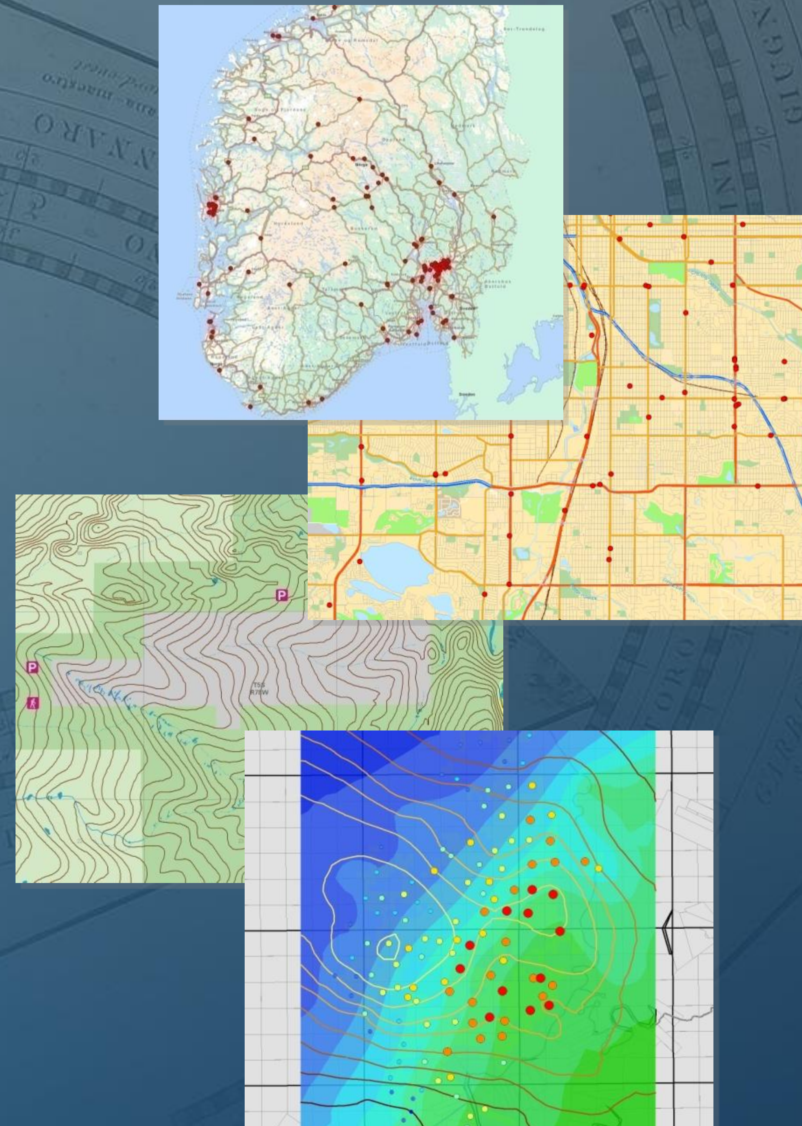
Dance GIS (The Ohio State University)

Dance GIS 2

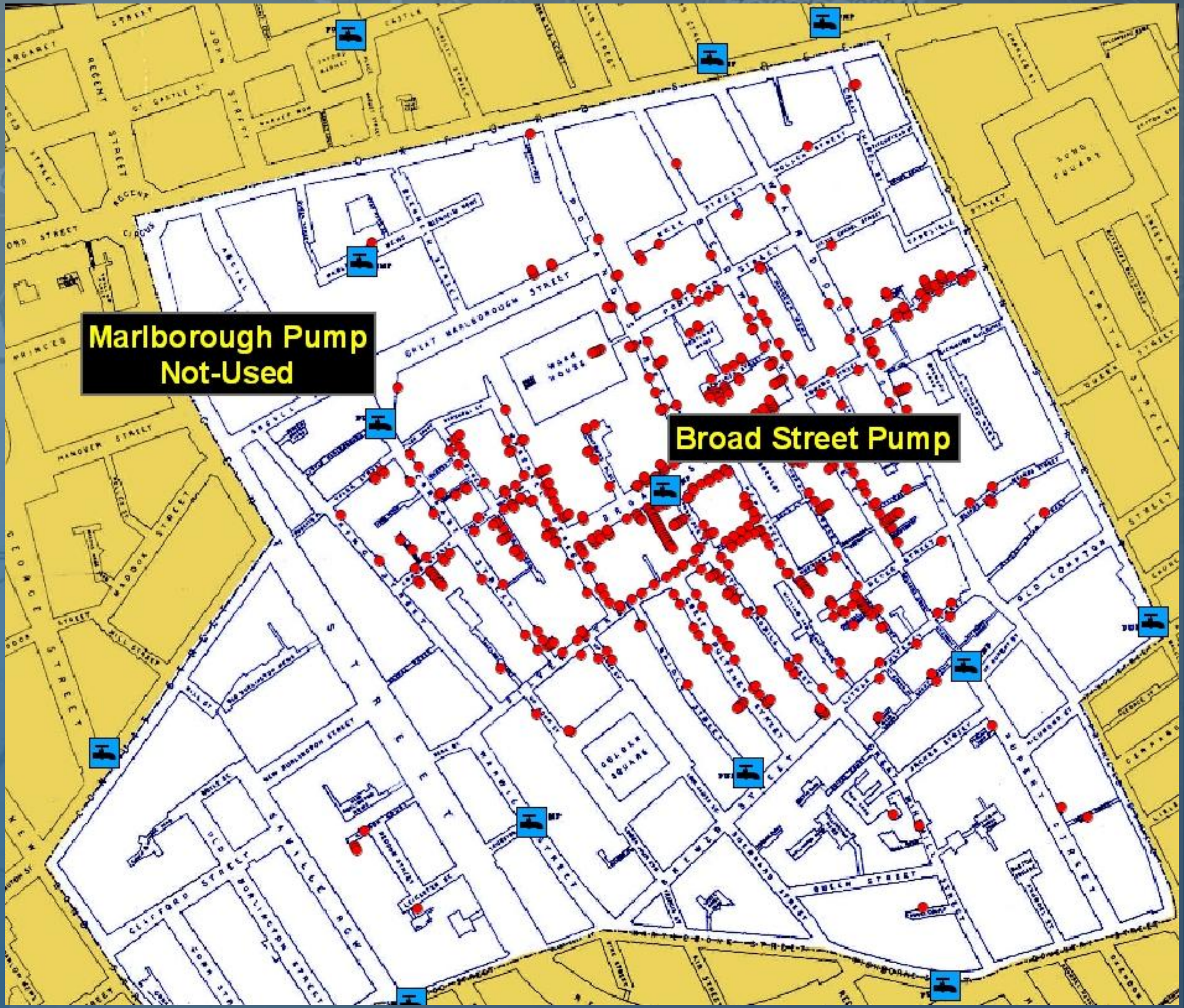


Ways to Think Spatially

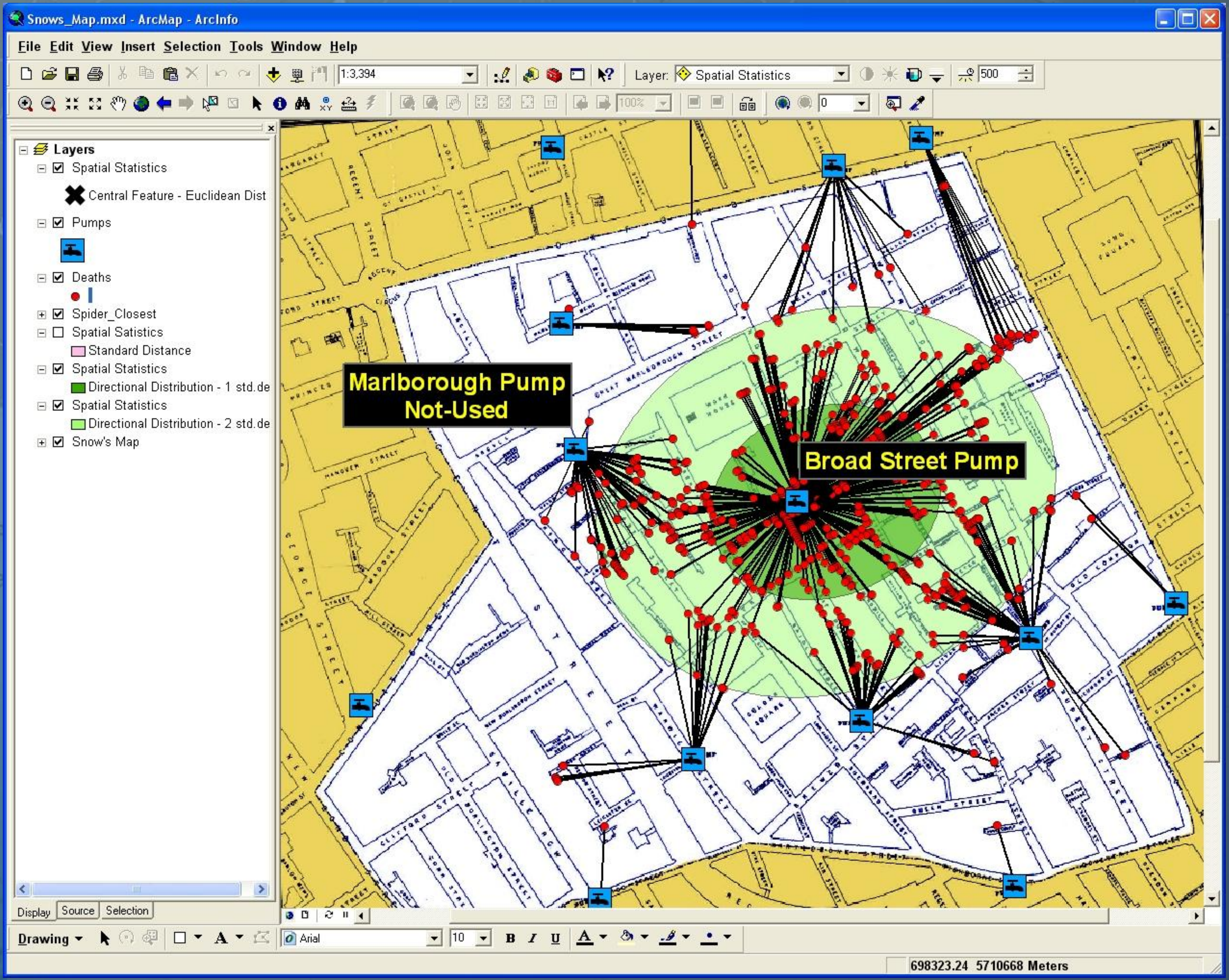
- Pattern Recognition
- Proximity and Spatial Distances
- Space and Time
- Overlays (spatial coincidence)
- Workflows & Modeling
- 3D (multi-dimensions)
- Connectivity and Interaction
- Uncertainty and Sensitivity
- Scale



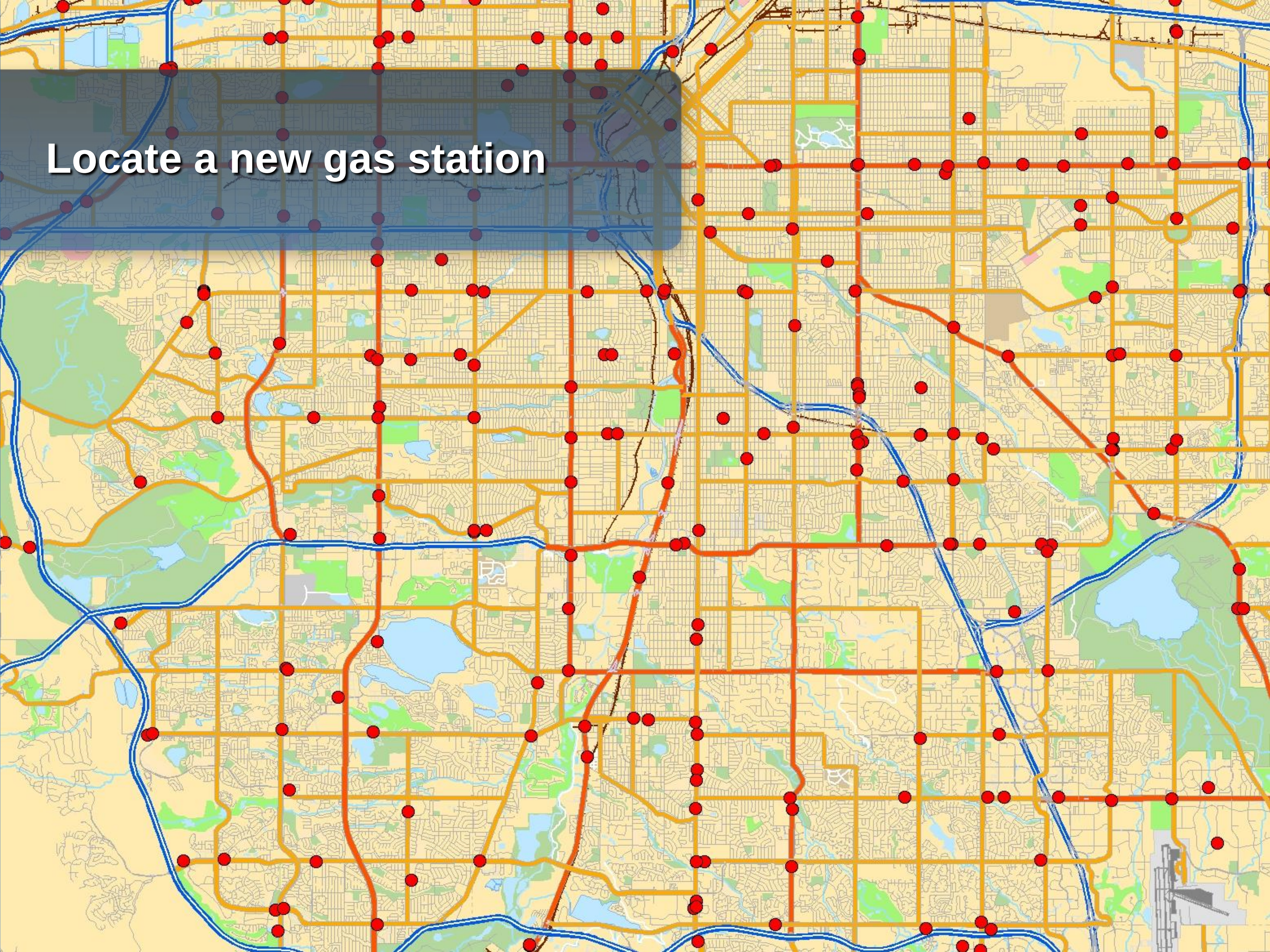
1854 London – Cholera
Dr. John Snow

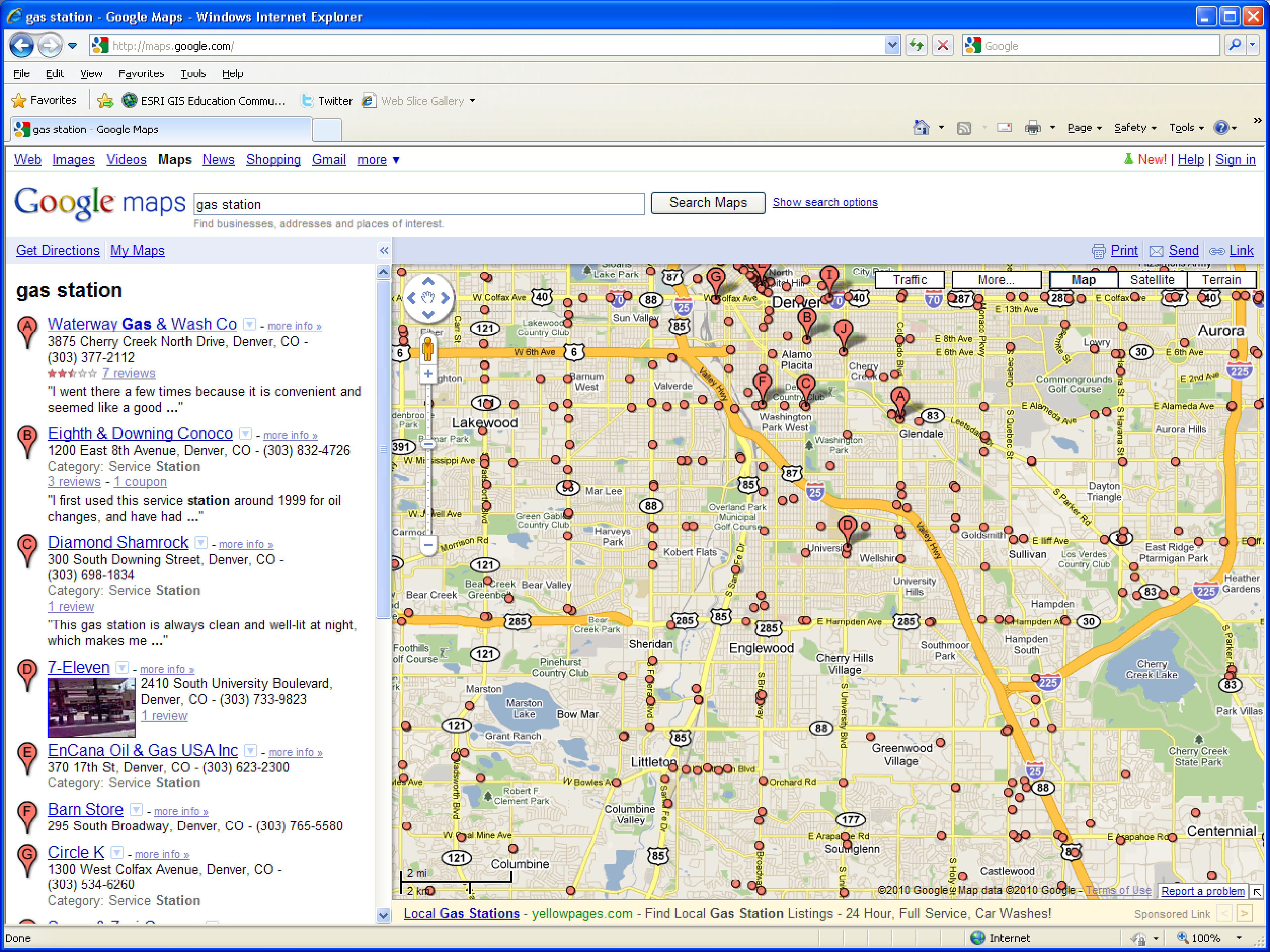


An obvious GIS analysis



Locate a new gas station




gas station - Google Maps - Windows Internet Explorer
http://maps.google.com/
File Edit View Favorites Tools Help
Favorites
ESRI GIS Education Commu...
Twitter
Web Slice Gallery
gas station - Google Maps
Page Safety Tools
Web Images Videos Maps News Shopping Gmail more
New! | Help | Sign in
Google maps
gas station
Search Maps
Show search options
Find businesses, addresses and places of interest.
Get Directions My Maps
Print Send Link
gas station
Waterway Gas & Wash Co - more info »
3875 Cherry Creek North Drive, Denver, CO - (303) 377-2112
7 reviews
"I went there a few times because it is convenient and seemed like a good ..."
Eighth & Downing Conoco - more info »
1200 East 8th Avenue, Denver, CO - (303) 832-4726
Category: Service Station
3 reviews - 1 coupon
"I first used this service station around 1999 for oil changes, and have had ..."
Diamond Shamrock - more info »
300 South Downing Street, Denver, CO - (303) 698-1834
Category: Service Station
1 review
"This gas station is always clean and well-lit at night, which makes me ..."
7-Eleven - more info »
2410 South University Boulevard, Denver, CO - (303) 733-9823
1 review
EnCana Oil & Gas USA Inc - more info »
370 17th St, Denver, CO - (303) 623-2300
Category: Service Station
Barn Store - more info »
295 South Broadway, Denver, CO - (303) 765-5580
Circle K - more info »
1300 West Colfax Avenue, Denver, CO - (303) 534-6260
Category: Service Station
Traffic
More...
Map
Satellite
Terrain
Denver
Aurora
Lakewood
Glendale
Englewood
Sheridan
Littleton
Centennial
Columbine
Cherry Hills Village
Greenwood Village
Cherry Creek Lake
Cherry Creek State Park
Marston Lake
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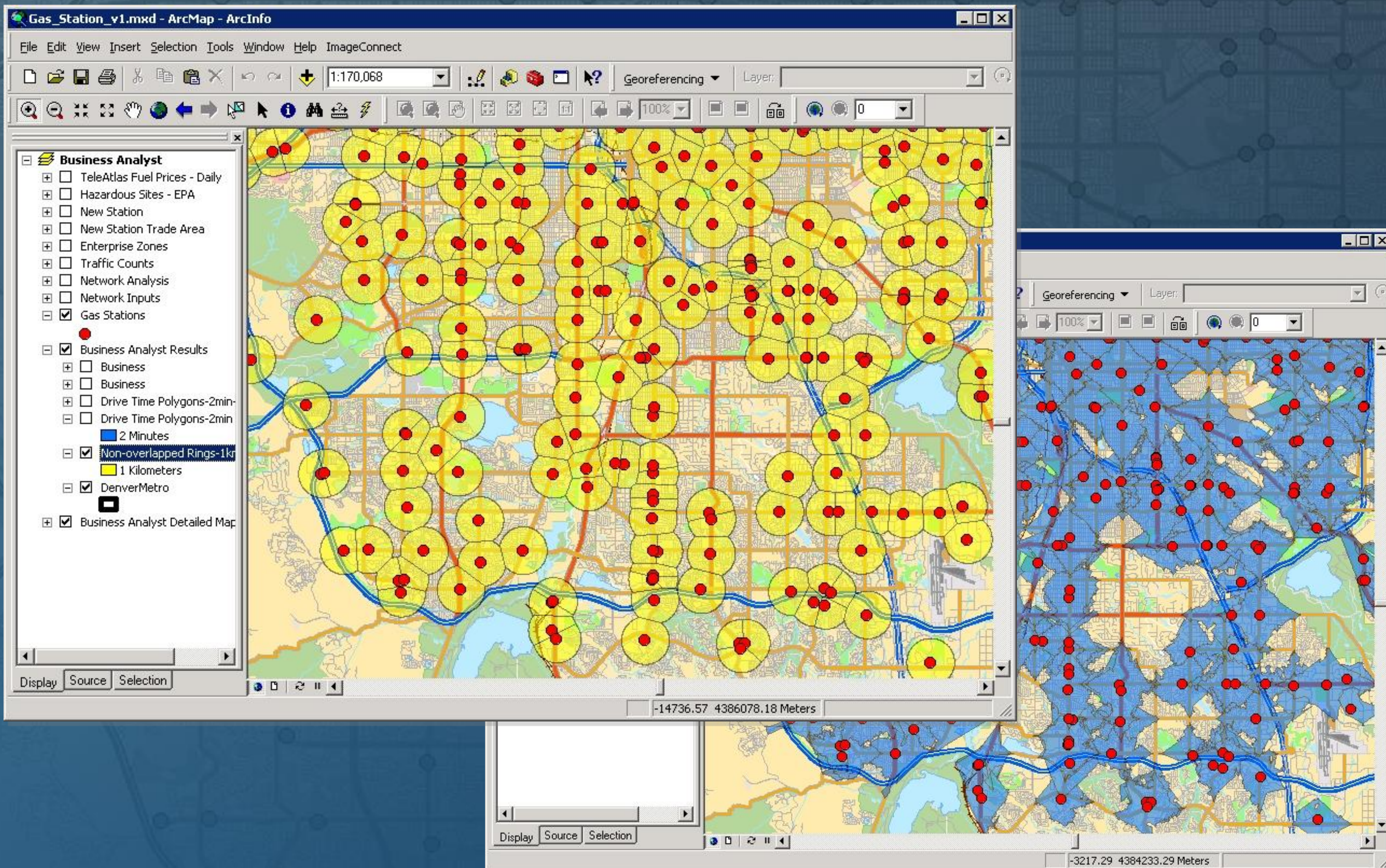
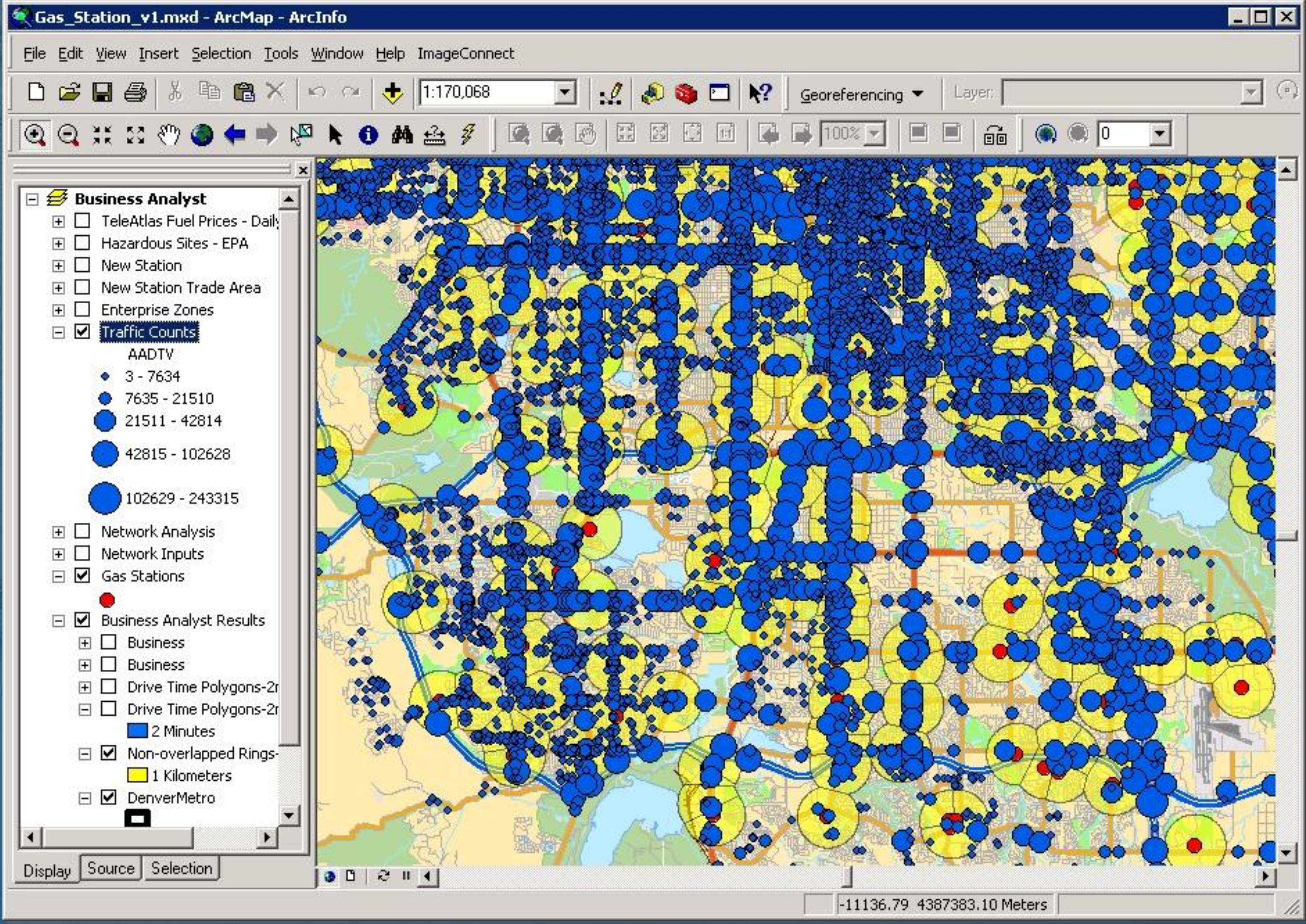
Report a problem
Local Gas Stations - yellowpages.com - Find Local Gas Station Listings - 24 Hour, Full Service, Car Washes!
Sponsored Link
Done
Internet
100%

GIS Analysis: Calculate Service Areas



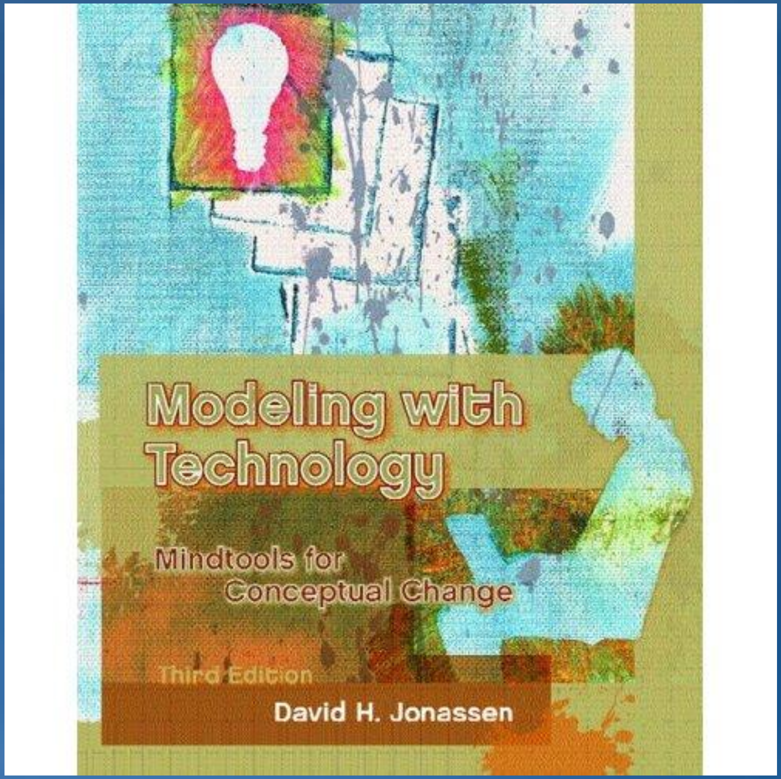
Overlay Traffic Counts



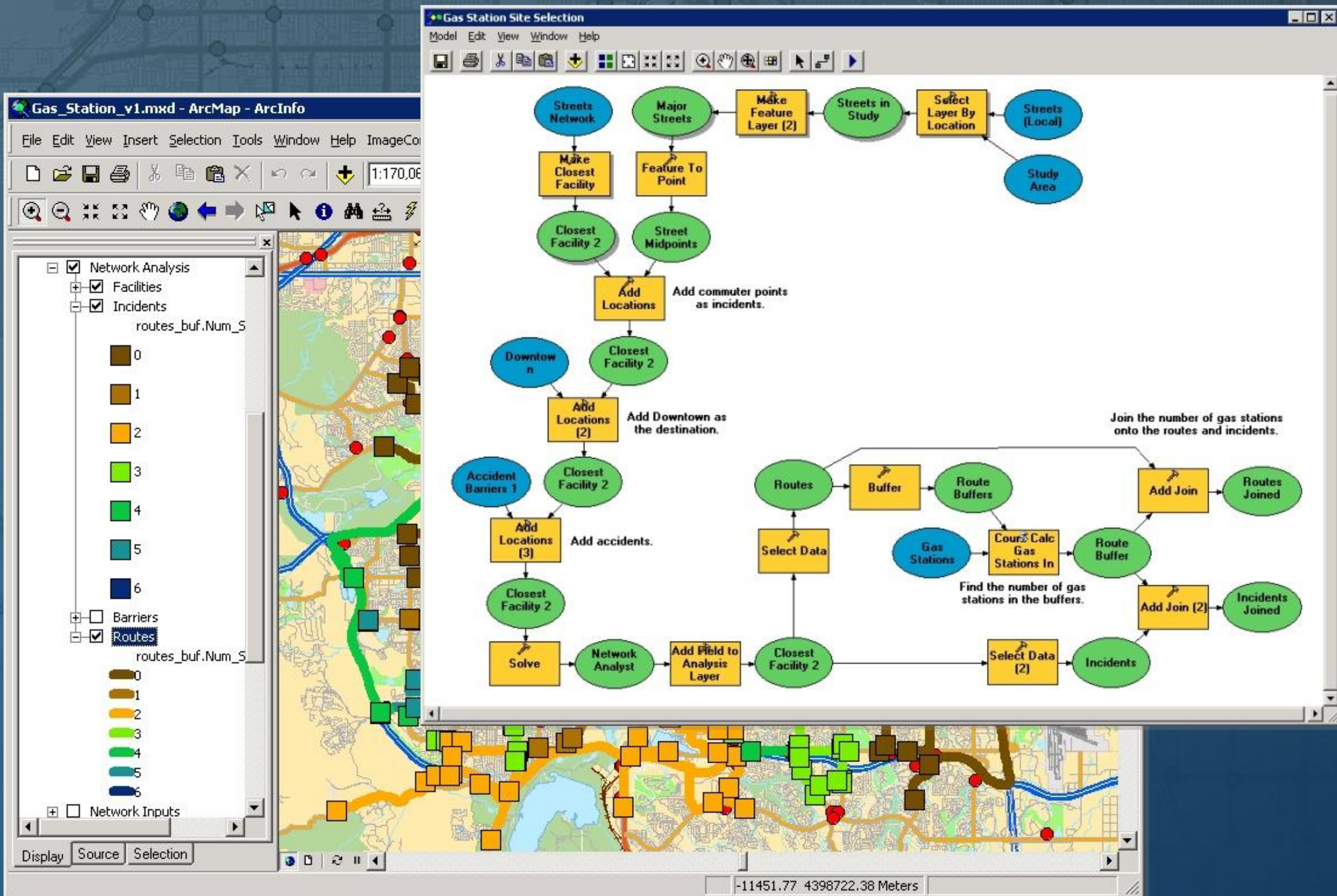
Model the Problem…
- components, interactions, dependencies, outcomes

Modeling with Technology (3rd Ed., 2005)

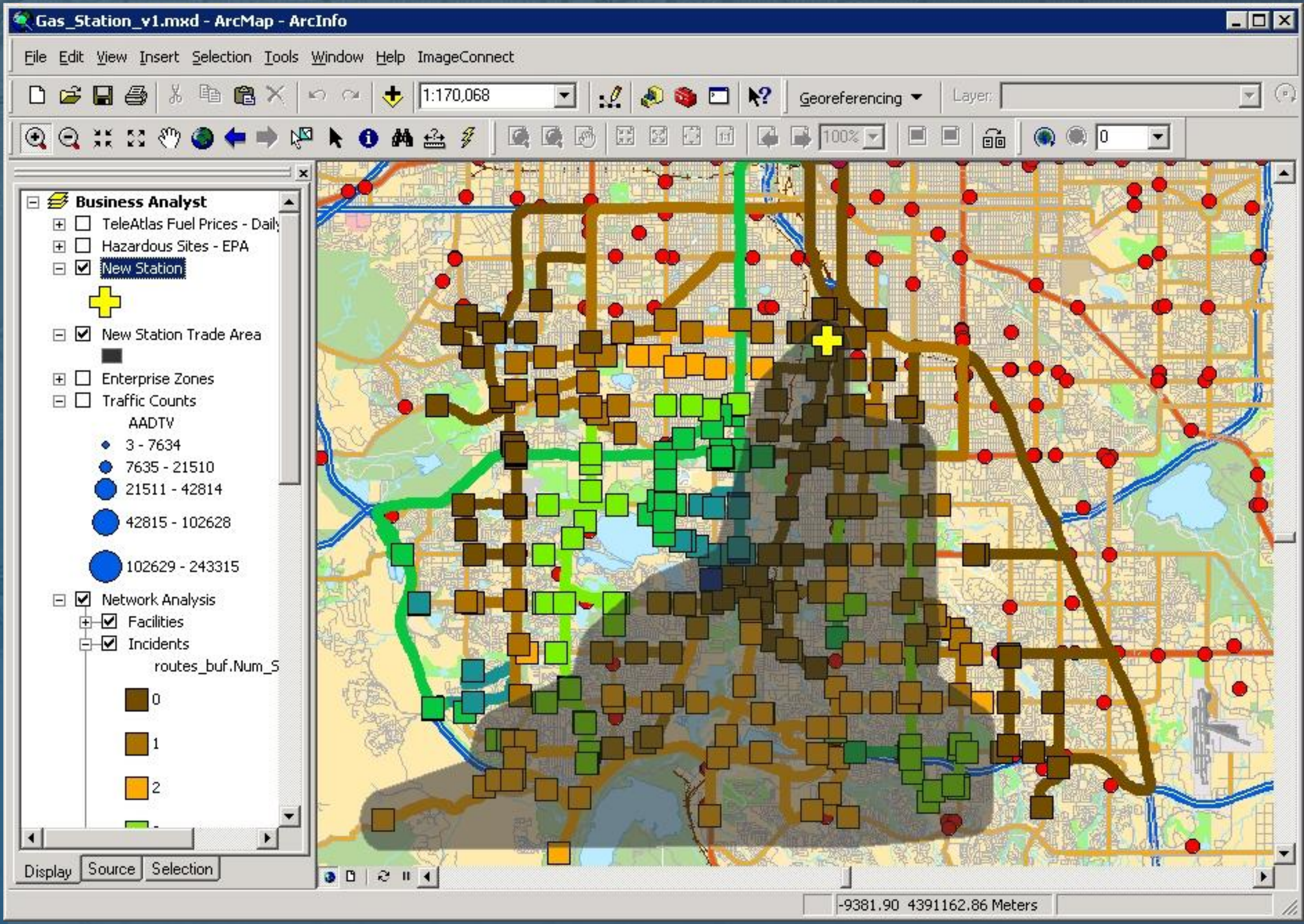
- Constructivist Education, after David Jonassen (and others)
- Use technology to Model what you are studying, to aid in comprehension
  - Spreadsheets
  - Visualization software
  - Databases
  - Concept Mapping
  - Expert Systems
  - GIS



Modeling Your Methodology

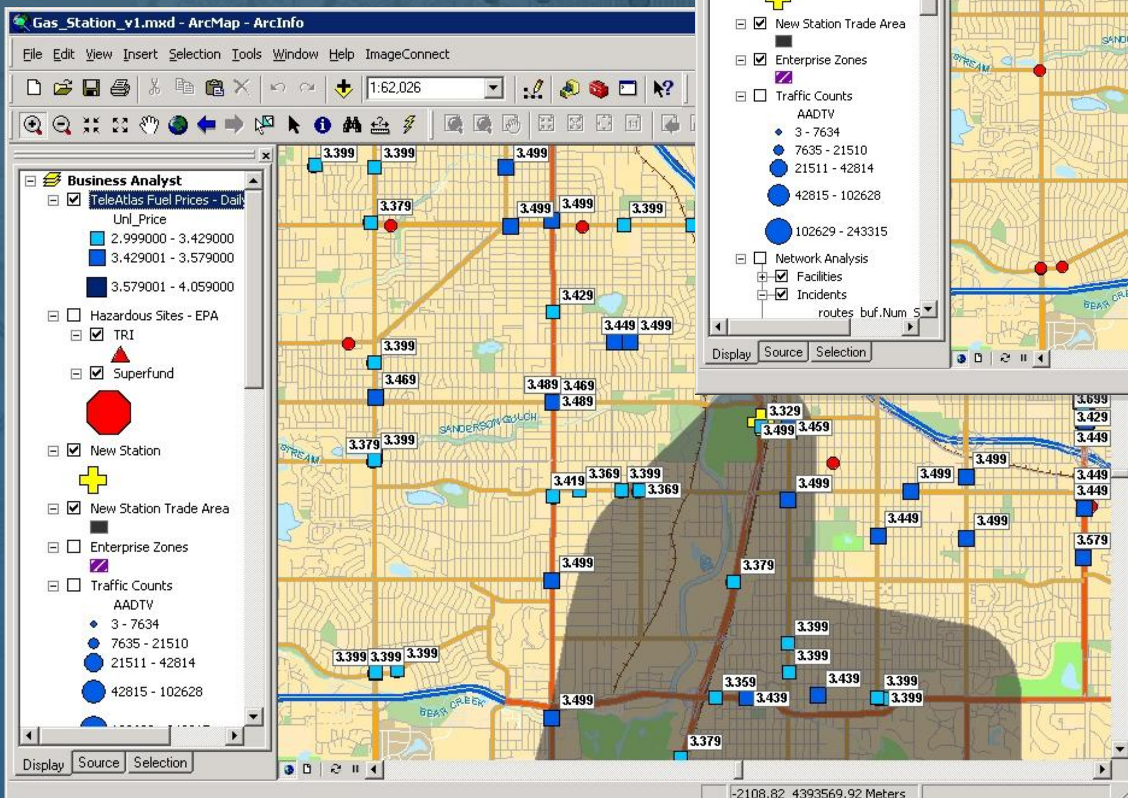


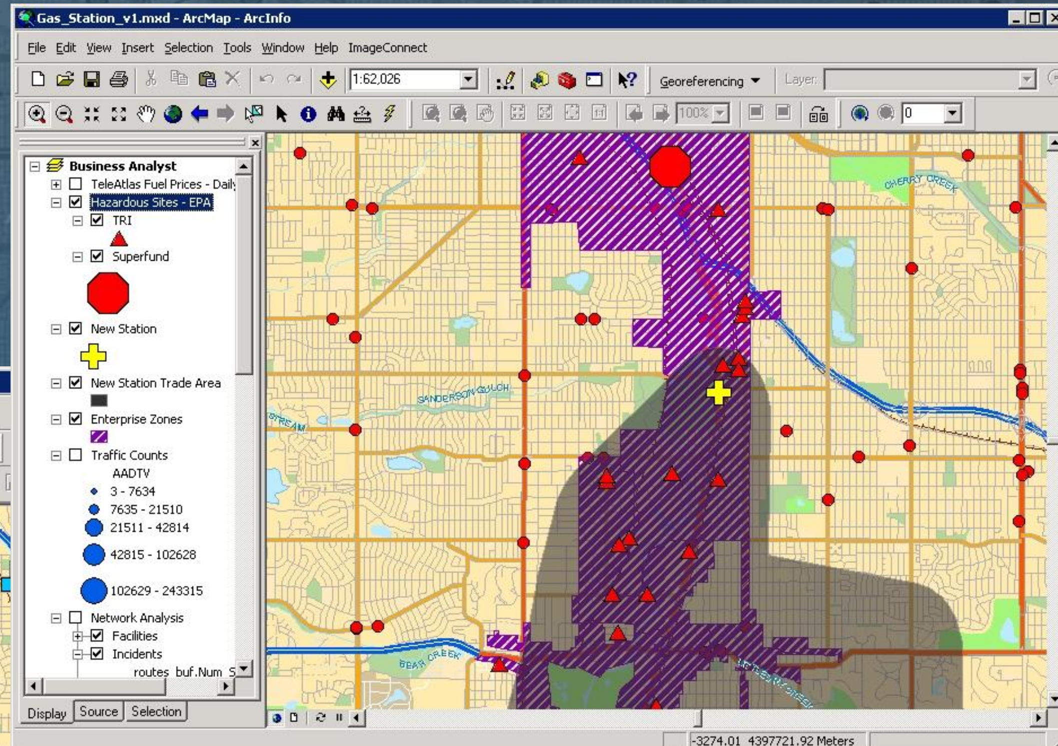
Modeling Your Methodology: possible outcomes



Then add Economic & Environmental Overlays

Gasoline Prices





Superfund & Toxic Sites Enterprise Zones

spatial@ucsb
perspectives for teaching and research

Established 2007 to integrate a campus-wide community of spatial thinkers at UCSB

National Center for Geographic Information & Analysis
NCGIA
Buffalo
Santa Barbara
Maine

The SAGE Center
For the Study of the Mind

CSISS
Center for Spatially Integrated Social Science
Spatial Resources for the Social Sciences

Cognitive Science Program
UCSB

Hegarty Spatial Thinking Lab

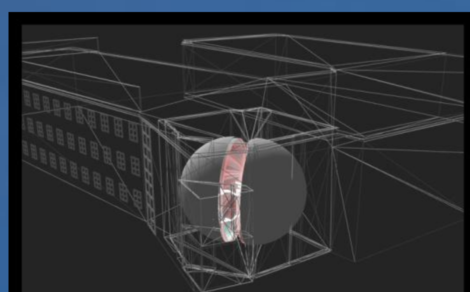
CENTER FOR THE ANALYSIS OF SACRED SPACE

Alexandria Digital Library

SPOT at UCSB

UNIVERSITY OF CALIFORNIA, SANTA BARBARA
CNS–UCSB
Center for Nanotechnology in Society

UCSB
UCSB Four Eyes Lab
Imaging, Interaction, and Innovative Interfaces



Mike Goodchild, director of spatial@ucsb
"spatial@ucsb aims to change what people think of spatial thinking – from something that only experts need to know about, to something that everyone should use."

National Center for Ecological Analysis and Synthesis

$$\frac{\partial}{\partial t}(\nabla^2\phi) = \frac{\partial\psi}{\partial z}\frac{\partial}{\partial x}(\nabla^2\psi) - \frac{\partial\psi}{\partial x}\frac{\partial}{\partial z}(\nabla^2\psi) + \nu\nabla^2(\nabla^2\psi) + g\alpha\frac{dT}{dx}$$

UCSB is Spatial

Desktop to Laptop to Cloud

- A story of increasing computational ubiquity

- Progression started with mainframes
- GIS taught since 1970, on timeshared minicomputers
- History of restricted access to highly-specialized hardware and software…becoming less and less so

- 1990s: desktop GIS became popular
  - Still expensive, difficult to maintain and customize
  - But at least it was possible
  - Special GIS support technicians hired

Challenges with Desktop Computing

- Funding and continued maintenance of computer lab
  - Hardware, Software, Infrastructure
- Hardware becomes obsolete (3 yr amortization)
- Maintaining software licenses
  - Licenses tied to CPU or MAC address
  - Hardware keys (dongles)
  - Keeping up with latest version
  - Different functionality on Windows, Mac, etc.
  - Compatibility with other key software
- Multiple configurations
  - Through continued use, machine content evolves and diverges
  - Unauthorized installations, viruses, etc.

Desktop to Laptop to Cloud

- Increased degree of computing ubiquity
- Checkout of school laptops
  - Different maintenance problems
  - *Nobody ever washed a rental car…*
- Student-owned laptops
  - Very interesting in principle
  - In practice, also diverse machines mean configuration and maintenance complexity
  - Cost to students: prohibitive for many families
    - Although many of the same students own $300 iPods
- 1 laptop per student = no need for a computer lab
- Computer Supported Education can happen anywhere, anytime
- Say goodbye to “computer class” (= ubiquity)

Challenges in Teaching on Laptops

- All teachers need to become computer literate
- Difficulty moving from teaching the tool, to using the tool to teach the domain subject
  - GIS to teach Geography, Environmental Science, History
- Management of software licenses
  - Floating license managers now available
  - Check-in/Check-out licenses via web
  - Control who has what license and for how long
- No computer labs means more server-based issues
- Processing power: are *Netbooks* enough?
  - CPU, Main memory, Graphics memory

Future: Minimal laptops connected to the Cloud?

Desktop to Laptop to Cloud

- Cloud Computing: the latest buzzword

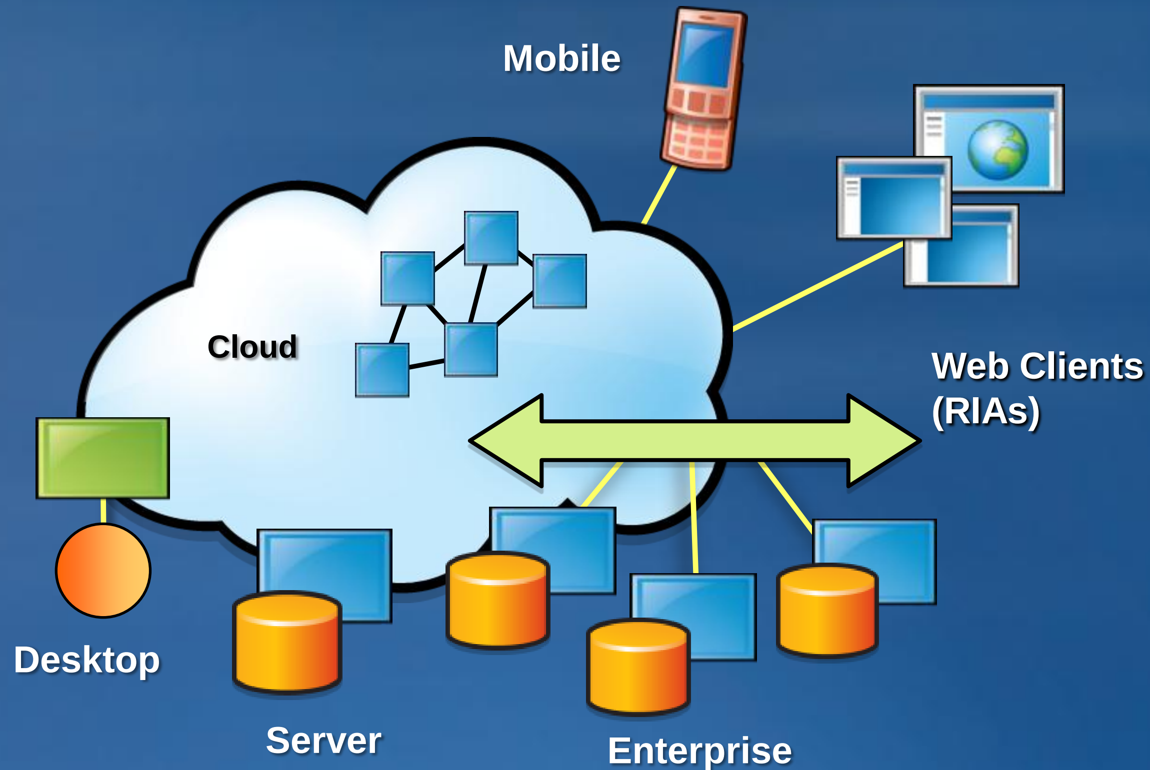
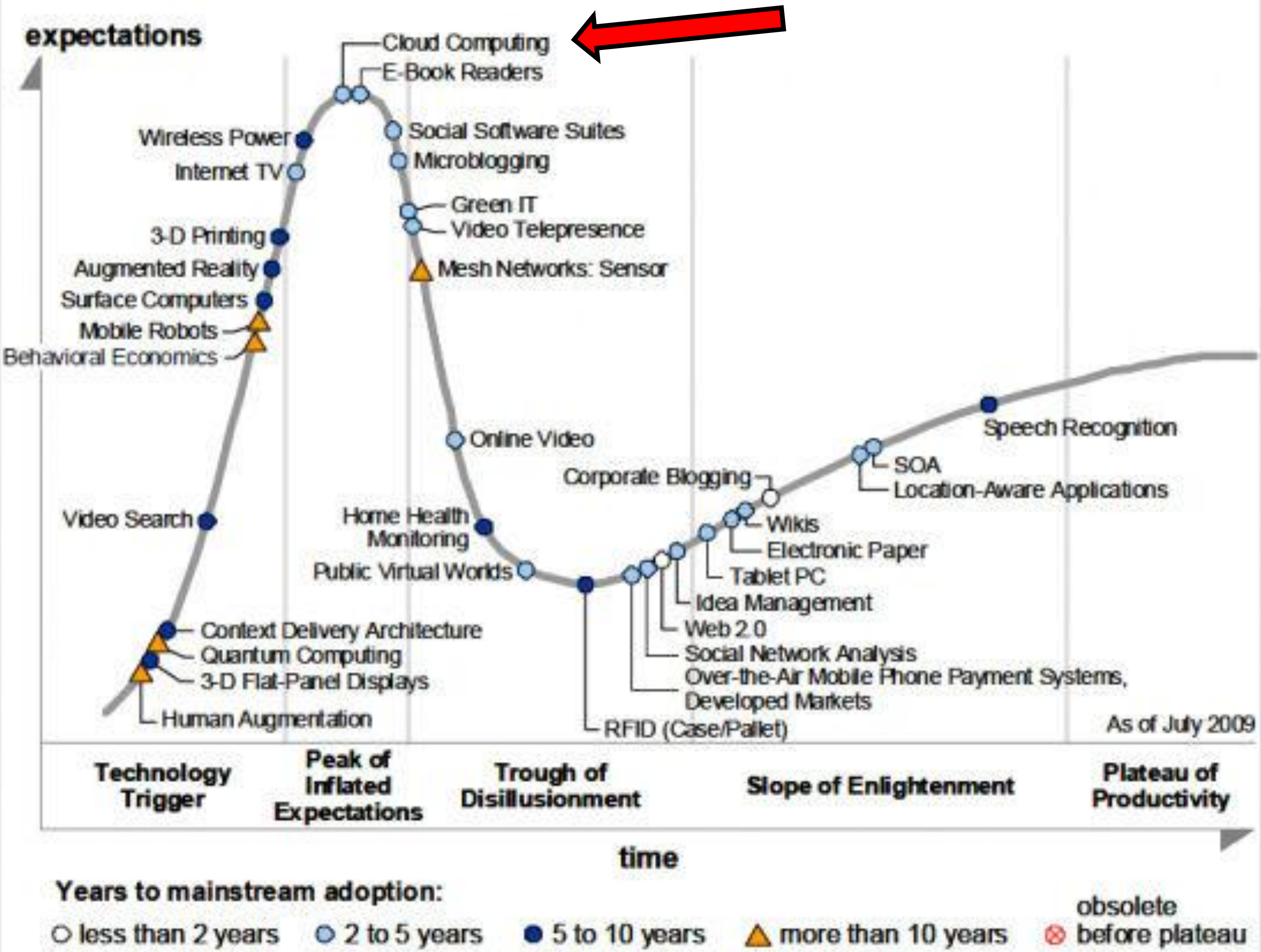


Figure 1. Hype Cycle for Emerging Technologies, 2009



Source: Gartner (July 2009)

Cloud Computing Service Models

Software as a Service (SaaS)

End-user applications, delivered as a service, rather than on-premise software

Platform as a Service (PaaS)

Application platform or middleware as a service on which developers can build and deploy custom applications

Infrastructure as a Service (IaaS)

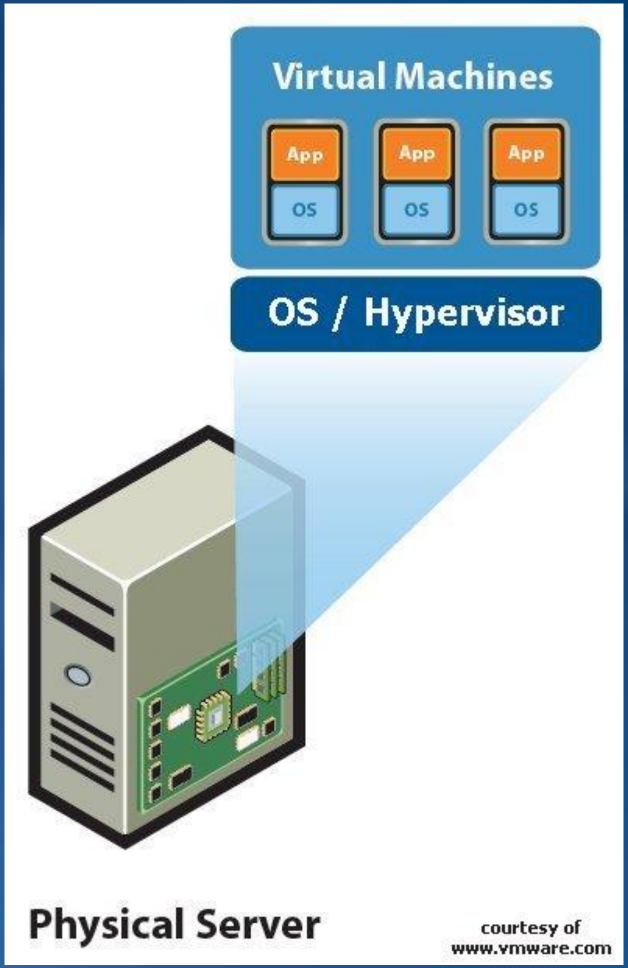
Compute, storage, or other IT infrastructure as a service, rather than as dedicated capability.

Changes to the Computing Model

Models	Traditional	Cloud
Procurement	Buy assets and build technical architecture	Buy service(s)
Business Model	Pay for fixed assets, overhead, administration	Rent assets; pay based on use
Access	LAN, WAN, client	Ubiquitous Network
Technical	Static and single tenant	Elastic and multitenant

Multitenency = Virtualization

- Server virtualization allows the conversion of one server into many virtual machines
- Main components
  - Physical Computer (Host)
  - Host Operating System + Virtualization Component (Hypervisor)
  - Virtual Machines
  - Management Suite + Tools




ISRV931-25_012610 - VMware Player
File
VM
Help
My Computer
Stop All Services
Recycle Bin
Windows Explorer
Internet Explorer
ArcGIS Server Manager
ArcGIS Servic...
ArcMap
ArcCatalog
ESRI Training—GIS learning solutions for the classroom, online, and on the go
www.esri.com/training
ESRI Press—Publisher of award-winning GIS books
www.esri.com/esripress
Live Training Seminars—Free training streamed live to your desktop
www.esri.com/lts
ISRV
Student
Windows 2003 Service Pack 2
ArcGIS Desktop 9.3.1770
Business Analyst Desktop (none)
ArcGIS Engine Runtime (none)
ArcGIS Server NET 9.3
ArcGIS Server Java (none)
Start
JavaScript API Sampl...
2:55 PM
vmware
ISRV931-25...
VM-94
Effat MOU.doc
BPC_Cloud_...
Recycle Bin
RequestFor...
Guidelines.doc
start
Swisscom Hospi...
Swisscom Hospit...
ESRI Secure Ac...
Microsoft Power...
VM-94
ISRV931-25_01...
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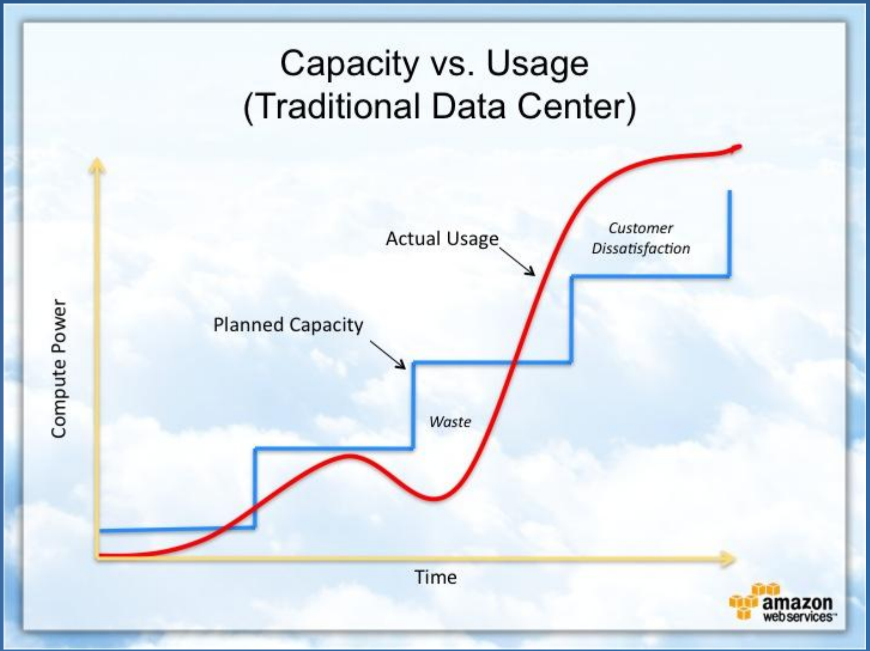
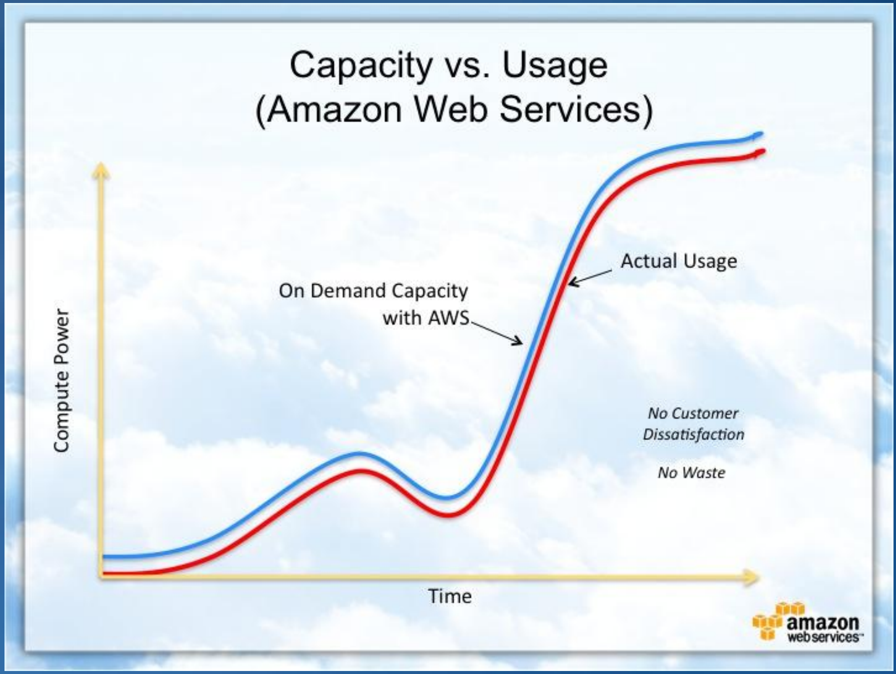
In favor of cloud computing

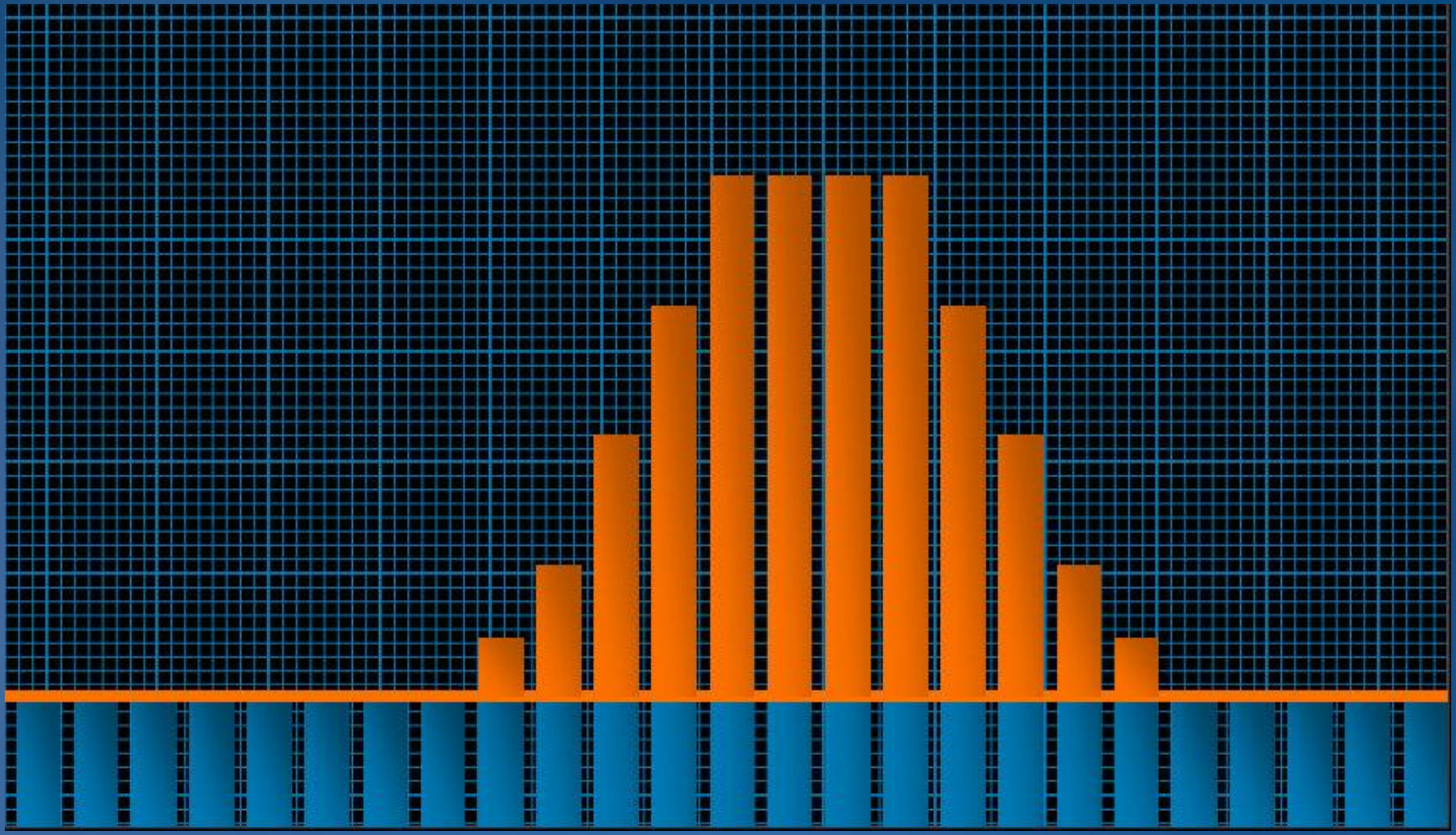
- Reduce costs and improve cash flow.
- Minimize your financial and business risks.





Graphics courtesy: aws.amazon.com/economics

Hybrid: "Own the Base, Rent the Spike"



Quote by Jens Lapinski

Courtesy: Joe Weinman, AT&T

This Month's Activity as of March 21, 2010

The billing cycle for this report is March 1 - March 31, 2010 . The AWS service usage charges on this page currently show activity through approximately 03/21/2010 16:59 GMT.

Viewing: Charges due: your AWS Account

Expand All Services | Collapse All Services — Printer Friendly Version

	Rate	Usage	Totals
Amazon Elastic Compute Cloud View/Edit Service			
US-East (Northern Virginia) Region			
Amazon EC2 running Windows			
	\$0.48 per Large Windows Instance (m1.large) instance-hour (or partial hour)	468 Hrs	224.64
Amazon EC2 Bandwidth			
	\$0.00 per GB Internet Data Transfer - all data transfer into Amazon EC2	0.001 GB	0.00
	\$0.150 per GB Internet Data Transfer - first 10 TB / month data transfer out of Amazon EC2	0.000277 GB	0.01
	\$0.010 per GB Regional Data Transfer - in/out /between AZs or when using public or Elastic IPs or Elastic Load Balancing	0.000015 GB	0.01
Amazon EC2 EBS			
	\$0.10 per GB-month of provisioned storage	131.895 GB-Mo	13.19
	\$0.10 per 1 million I/O requests	1,653,834 IOs	0.17
	\$0.15 per GB-Month of snapshot data stored	2.045 GB-Mo	0.31
		Download Usage Report »	**238.33**
Amazon Simple Storage Service View/Edit Service			
		Download Usage Report »	**0.03**
Amazon Virtual Private Cloud View/Edit Service			
		Download Usage Report »	**0.00**
Taxes Estimated Taxes (Due April 1, 2010)			**0.00**
Charges due (your AWS Account)*			**\$238.36**

Administrative Challenges (Cloud)

- Budgets often distinguish hardware from services
  - My ex-university: annual hw maintenance budget (SGI Onyx)
  - Cloud services are essentially rented hardware
  - Software fees do not disappear
- Controlling usage: school work versus play
  - School pays for x-hours of computer time; student pays the rest
- Difficulty judging peak and valley usage
  - Summer school
  - Big final projects (remembering timeshare days)
- Computing staff change management

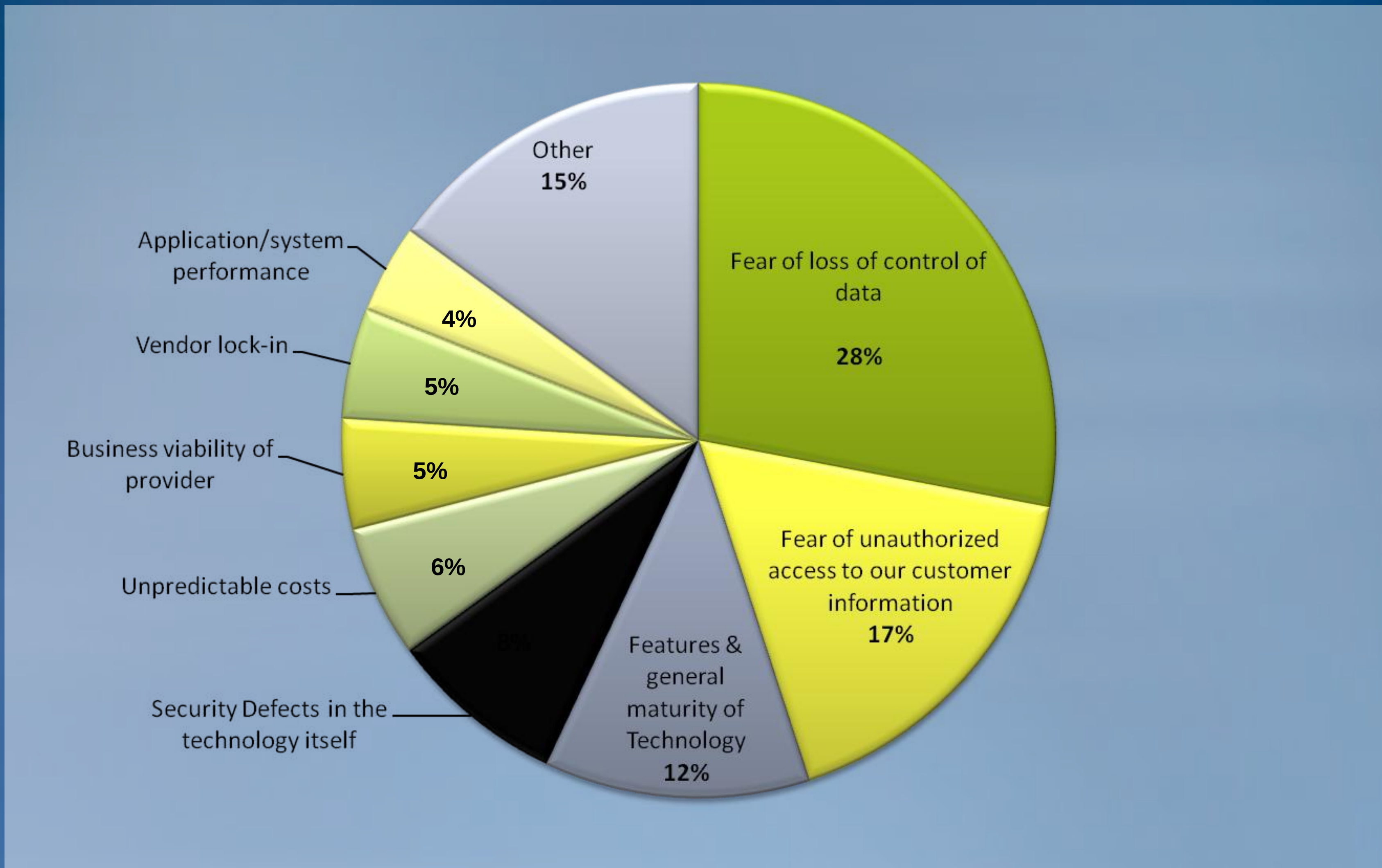
Administrative Opportunities (Cloud)

- Transparent server hardware maintenance
- Client hardware can be minimal
- Centralized software maintenance

- Combined with student laptop use, allows fixed school computer labs to …. disappear.

- Opportunities to capture distance learning students
  - Or to lose students to better distance learning programs elsewhere

What is the primary reason your organization will not use public cloud services?



Information Week analytics, January 2010

Trusting the Cloud

- November 23, 1999
  Microsoft® Passport "wallet" service is now live at 24 leading merchant sites. In addition to these live sites, there are now over 100 e-commerce sites committed to supporting Passport, a 90% increase since the service was launched in October. …
- Microsoft Passport can help streamline the online purchasing process for consumers by giving them one electronic wallet for use across multiple Web sites, making it faster and easier to purchase their gifts online.

http://www.microsoft.com/presspass/features/1999/10-11passport.mspx

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Concluding: Implication for Education

- In theory:
  - Software (databases, CAD, GIS, Modeling, Graphic Design) resides in the cloud, cost shared among whole school district or university
  - Students have diverse, owned, laptops (just part of being a student)
  - Laptops access school software via ordinary web browser+cloud
  - Minimal system requirements
  - Student has access to Learning Technology platform, in class, in the library, in the cafeteria, at home, on vacation,…
  - Technology ceases being a special academic subject, and becomes a natural part of the school day
  - Less time spent teaching Technology
  - More time teaching Problem-Solving, Critical Thinking using technology
  - Students play learning games rather than watch TV at home!
  - Many become scientists, entrepreneurs, and go off and save the world.

Implications 2

- In practice:
  - 100 reasons why this might not happen
  - "technology engages students" is not enough
  - Teaching to standardized tests is not enough
  - Teachers must be retrained, education changed

  - Number 1 Challenge for Teaching and Administration: Having the Courage to make it happen.

  - We must improve learning, not merely make it fun and adjust the performance measuring stick .

Conclusions

- Critical Thinking, not only visualization (GIS case)
- Emphasis on Constructivist Education
- Ubiquity of Computing
- Cloud Computing as future possibility
- Possibility of lessening emphasis in the Technology per se, in favor of technology to improve learning

- You are the people who can make a difference, because you understand both sides: technology and education!

Thank you for your attention

- Michael Gould mgould@esri.com
- http://edcommunity.esri.com