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Title: Toward Enterprise GIS Design for DOE

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Abstract

An increasing number of institutions are challenged with implementing robust geographic information system (GIS) capabilities for a large number of individuals through information sharing and interconnected networks. In the past, numerous technological roadblocks hampered successful implementation of enterprise GIS (EGIS). With the advent of high-speed networks, increasingly fast computers, intelligent spatial data serving technologies, improved data architecture, and advances in GIS software, the newest challenge involves integration of the various technological and institutional components. This integration can be viewed as an inevitable stage in the evolution of GIS. Successful EGIS design depends on three elements: 1) distinct stakeholder roles, 2) a complete geospatial data cycle, and 3) proven data warehouse concepts.

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Toward Enterprise GIS Design for DOE

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Overview

I. Foundational Concepts

What is Enterprise GIS? Elements of Success…

II. Enterprise GIS Design

Five-Step Approach, a Prototype, Metrics of Success…

III. Perspective

The path forward…

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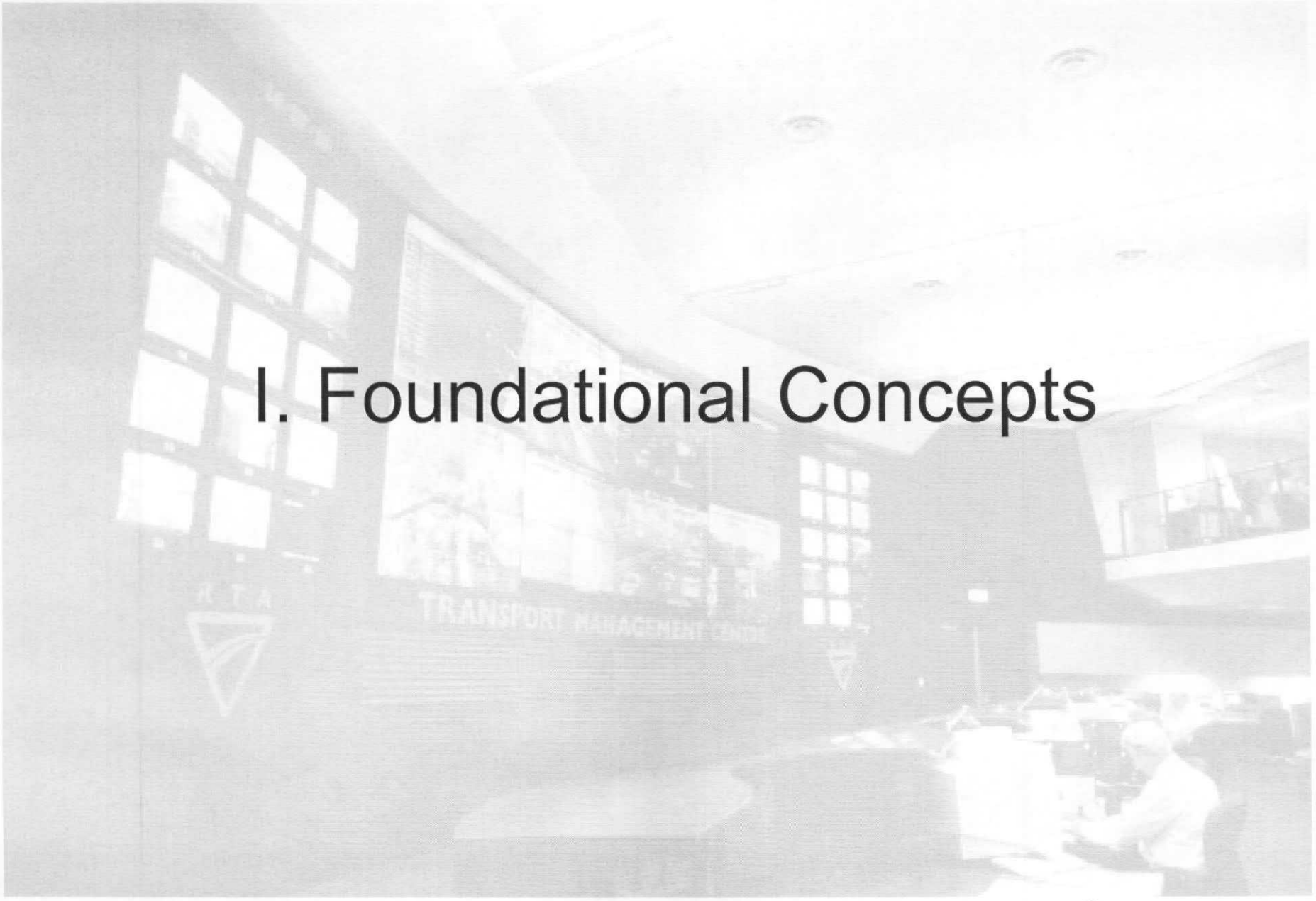

I. Foundational Concepts

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What is Enterprise GIS?

access to shared geospatial information and analysis resources for large number of concurrent users located in different parts of an institution

components:

- shared hardware
- shared software
- shared geospatial data

(Keating et al. 2002, 2002b, 2003, Witkowski et al. 2002, 2003, 2004)

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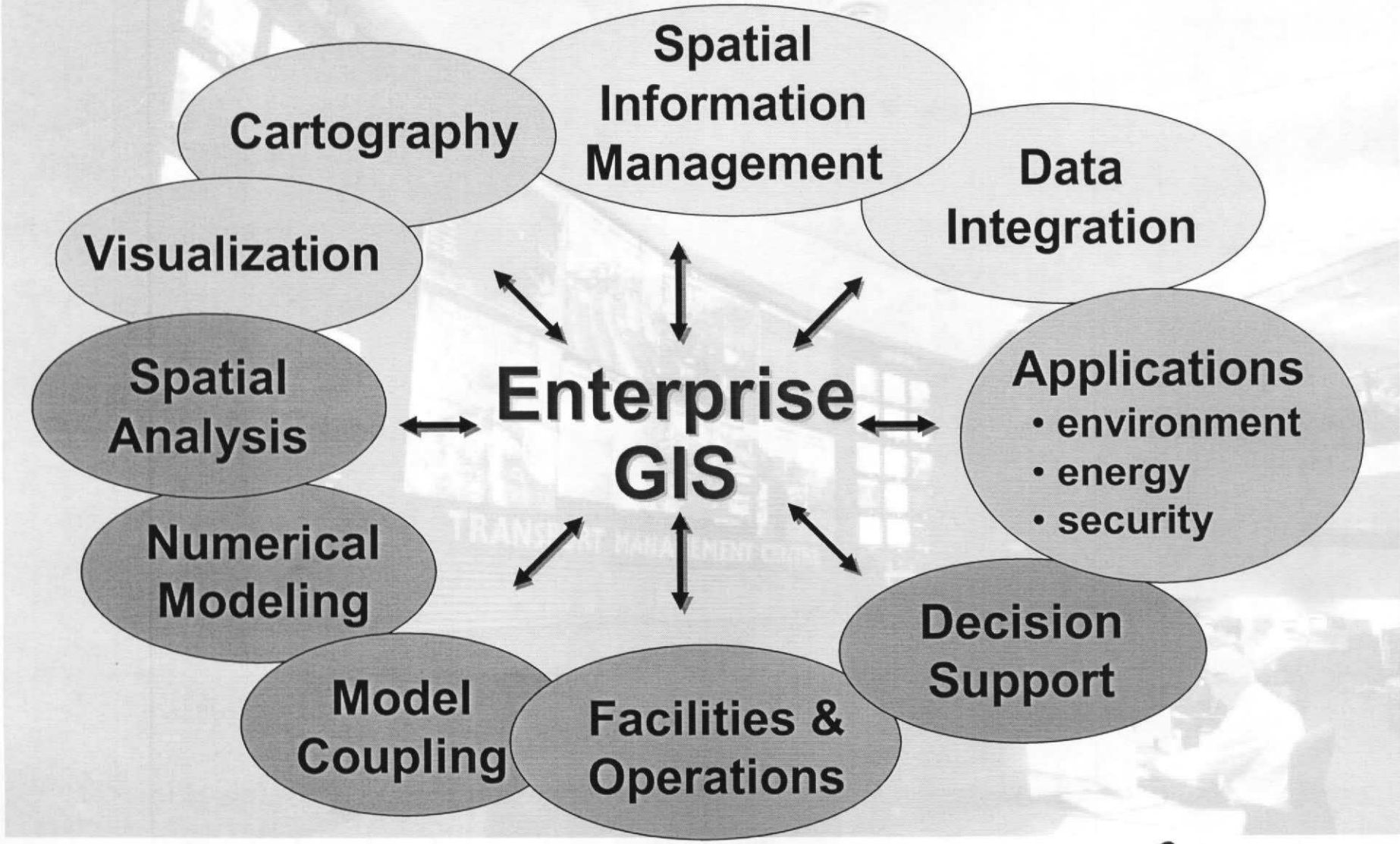
What is Enterprise GIS?



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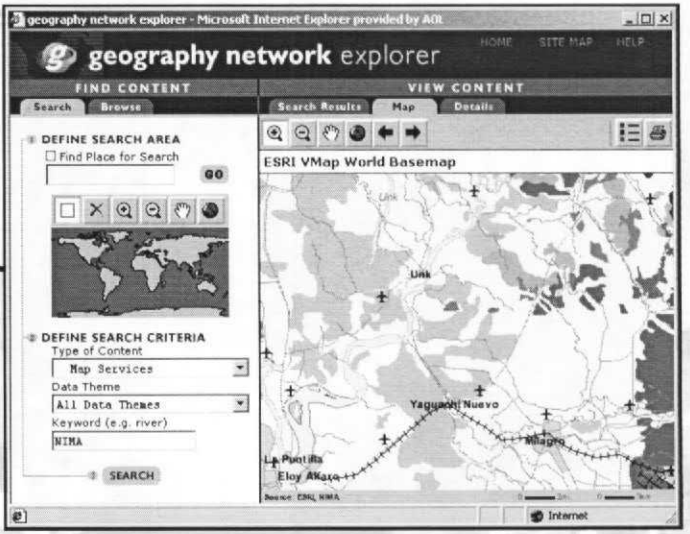
Integration and Access with Enterprise GIS

Clients

Web Server

IMS Server

SDE



Spatial Data Warehouse

Numerical Model Warehouse

Servers

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Key Design Concepts

- stakeholder roles
- complete geospatial data cycle
- data warehouse architecture

Current: Data-Centric View

Future: GIServices View

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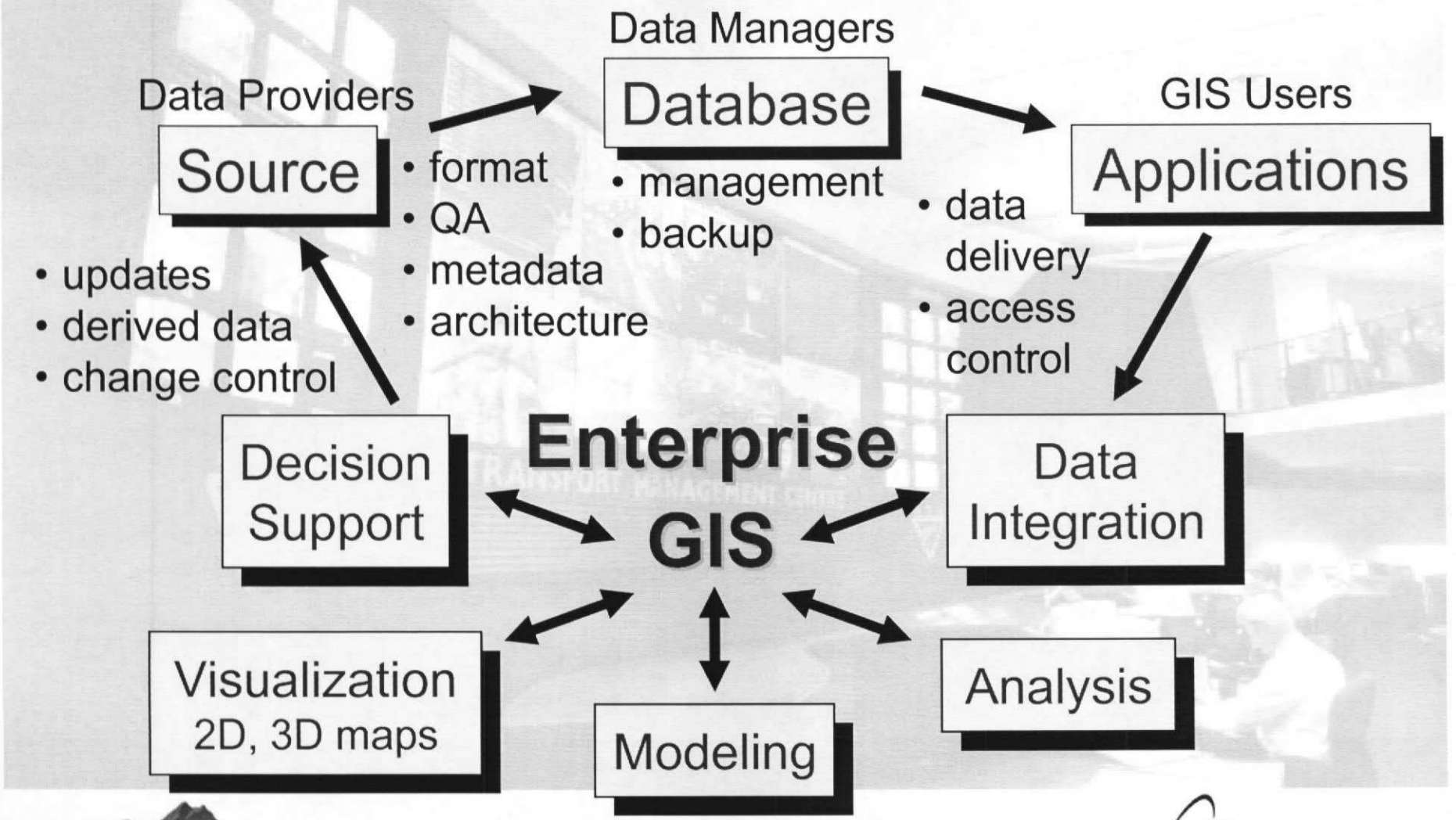
Stakeholder Roles

- **Data providers** need consistent standards and effective tools to prepare, organize, and document data
- **Data managers** need consistent workflow procedures to ensure efficient and standardized means to manage and deliver data
- **GIS users** need consistent mechanisms to locate and access well-documented and reliable data
- **Customers** need timely and reliable service, based on sound technical and business design

Geospatial Data Cycle

Goal: complete, integrated work and data flows



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Data Warehouse Architecture

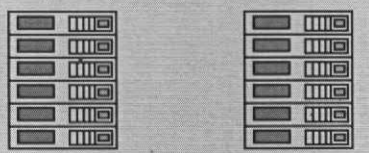
Staging

- Receive Source Data
- Review Source Data
- Apply Standard Procedures
- Incorporate Metadata
- Review Data Product
- Categorize Data
- Transfer Data to Warehouse

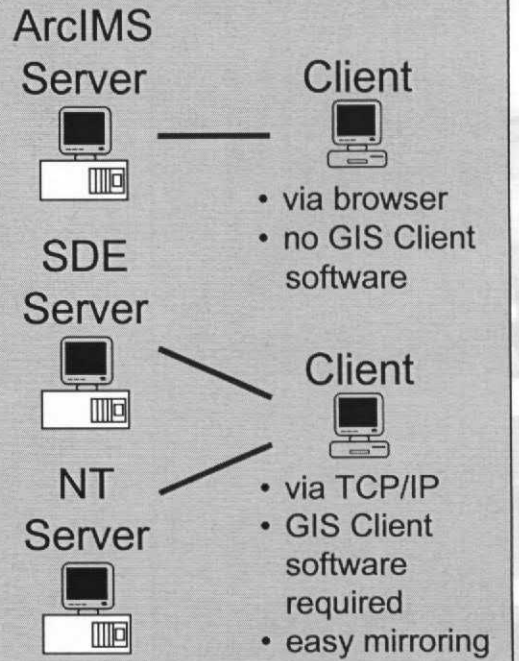
Storage

- Thematic Categorization
- Modular Design
- Integrated Logical Architecture
- Controlled Access

Open Limited-Access



Delivery



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Elements of Success

- attain management support
- develop plan
- be customer focused
- ensure in-house "ownership" for process
- build a "team of two" of technical expertise and management support

– Jack Dangermond, President ESRI (February 2002)

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II. Enterprise GIS Design

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Five-Step Methodology

1) design specification

2) resource evaluation

3) logical system design

4) physical system design

5) implementation plan

(Witkowski et al. 2003, 2004)

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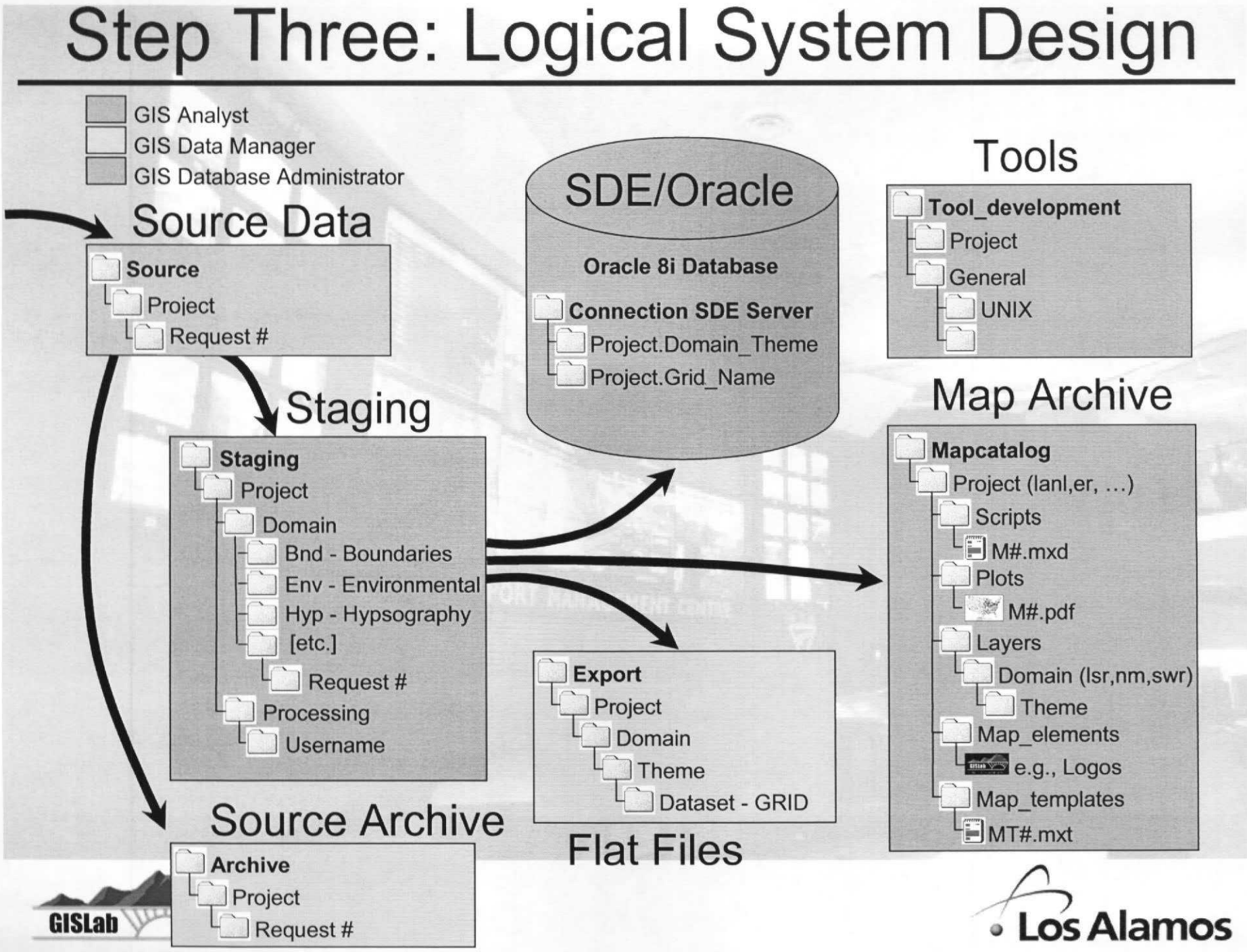
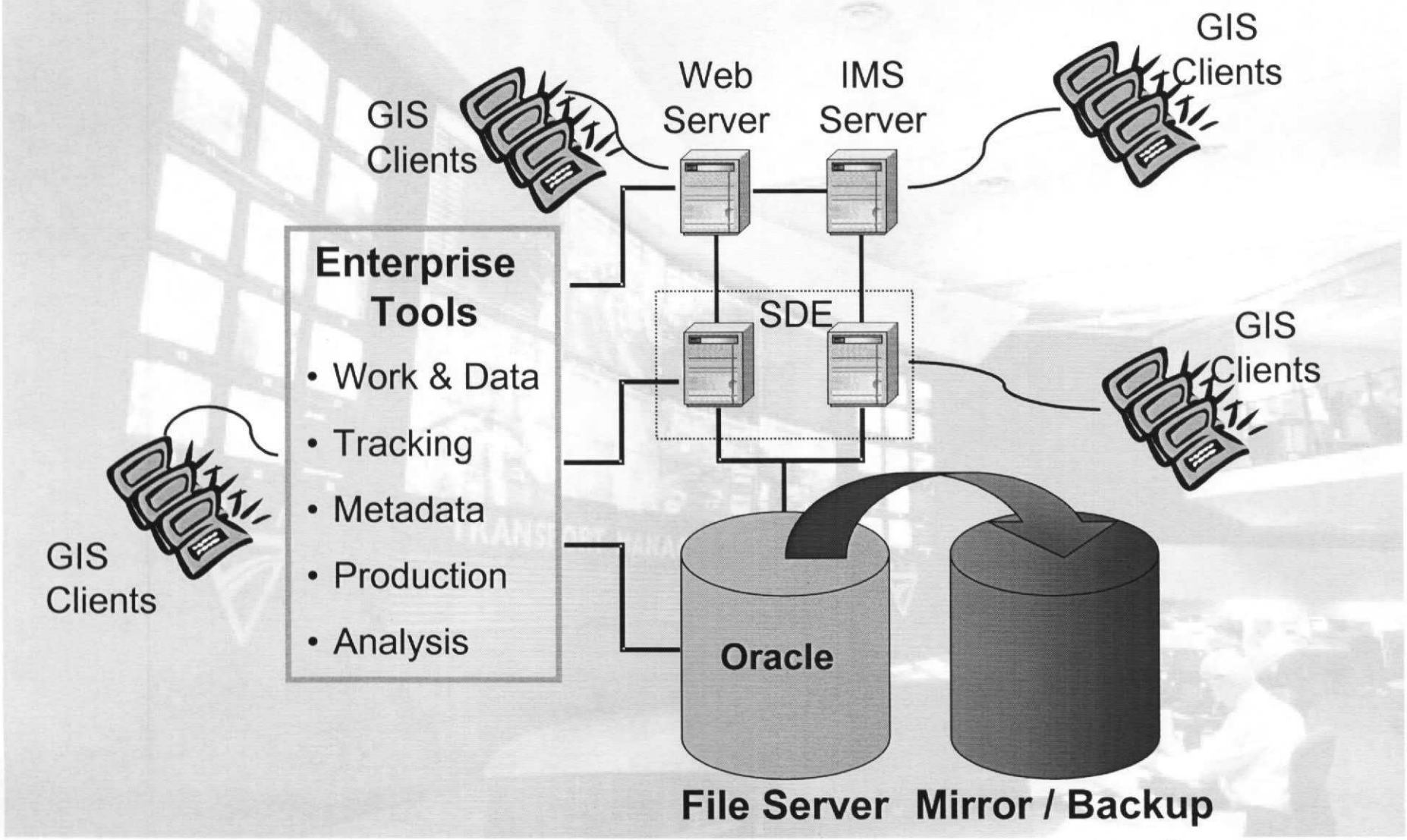
Step Three: Logical System Design



Step Four: Physical System Design



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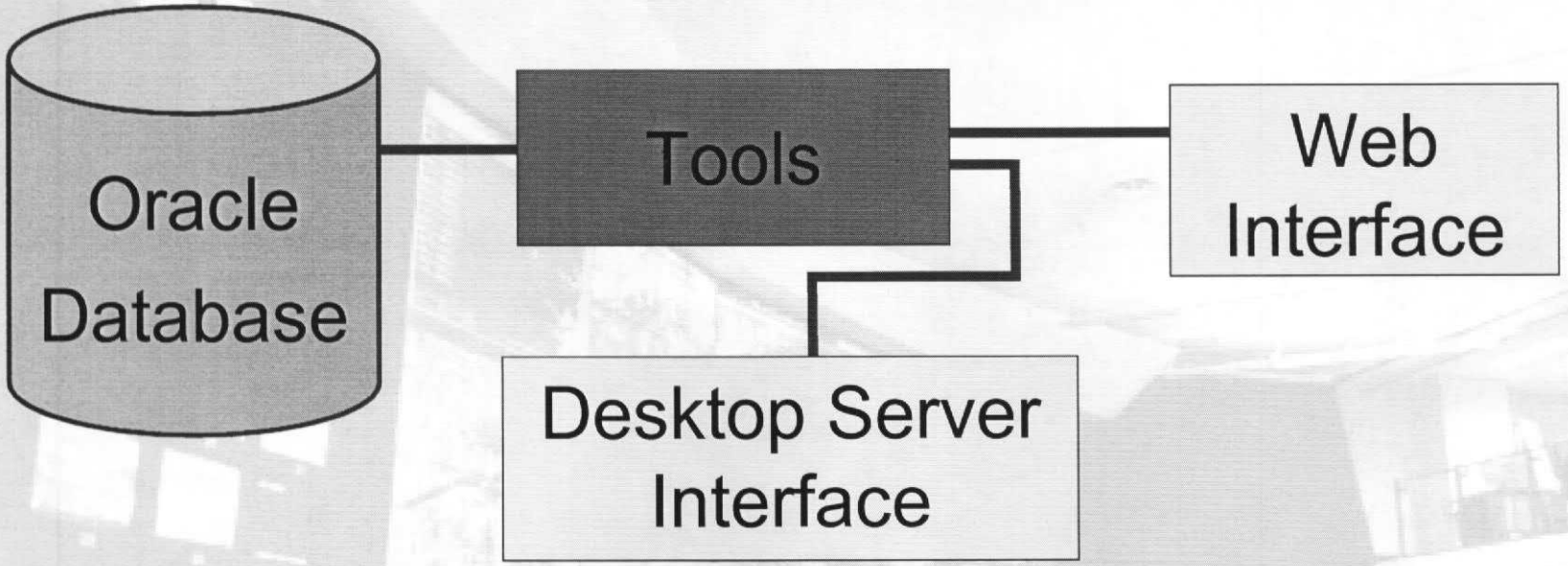
Enterprise GIS Database and Tools



- out-of-the-box solutions where available
- custom tools required to fill gaps
- feedback to industry

(Linger et al. 2002)

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Step Five: Implementation

- **Funding:** direct, fee-for-service, overhead, facility fees
- **Roles and Responsibilities:** clear, "team of two"
- **Institutional Champion:** vision, understanding, authority, respect
- **Research and Development**: sound business
- **Training**: for system managers and users
- **Communication and Outreach**: bridge technical and management; inform about GIS and its potential
- **Peer Review**: internal & external; data, policies, standards, processes
- **Measures of Success**: specific, relevant

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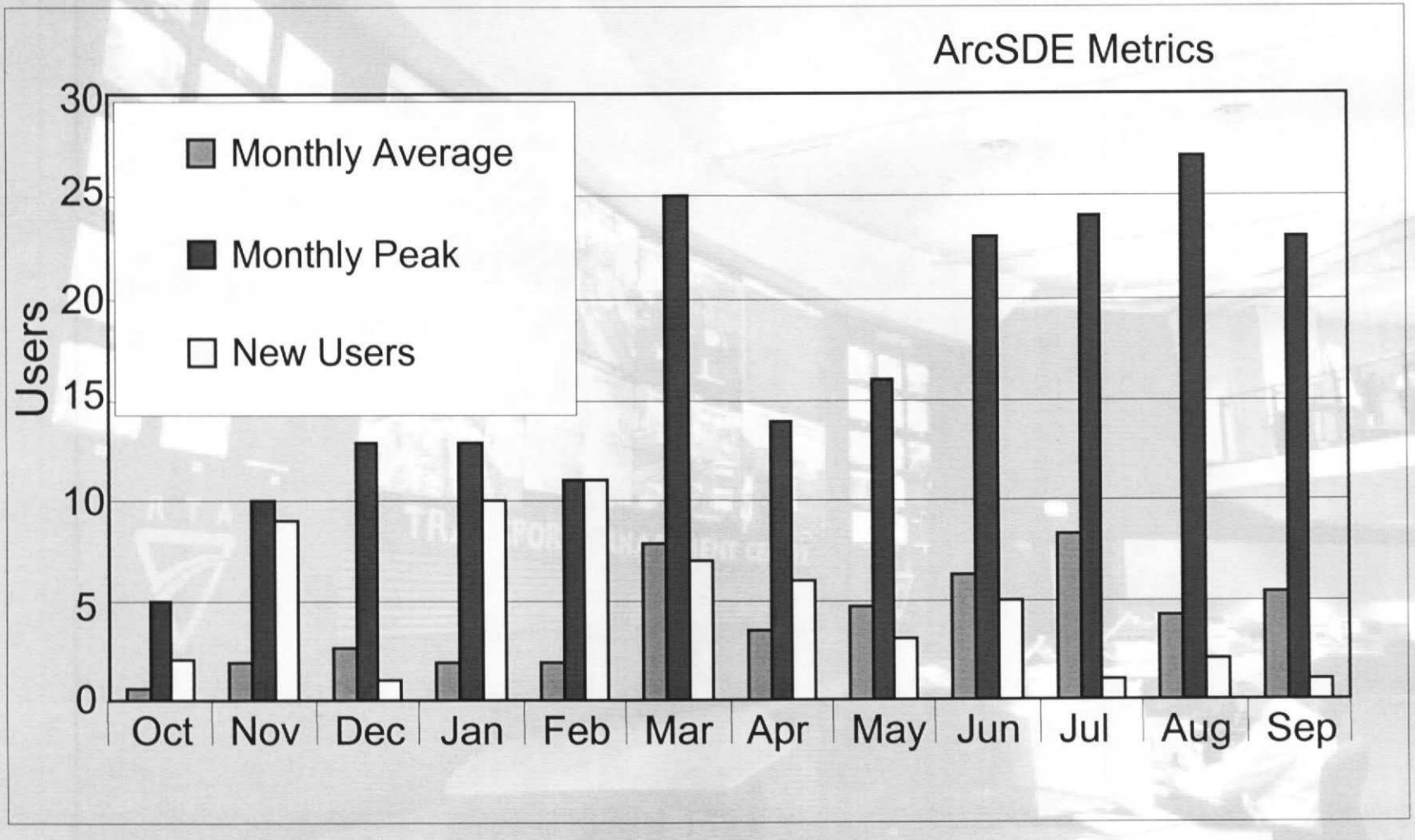
Metrics for Success 1

System Usage



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Metrics for Success 2

Element	Criteria	CGRP-GIS Results
Implementation of Physical System	Hardware installed	3.3 Tb file server, web server, and map server
	Software installed	ArcSDE 8.2, ArcIMS 4, ArcGIS 8.3, Oracle 8i
	Custom software developed	Request System Rapid Mapping Tool Batch Processing Tool
System Performance	Server down time	< 1 Day/yr
	Data transfer rate	11 Mbps (Max)
Utility of Spatial Data Warehouse	Number of data layers loaded and size	1419 SDE & 2304 Folders Total > 85 Gb Served
	Completeness of data and metadata	100% Complete Data w/ FGDC Compliant Metadata
	Number of users	> 50/yr
Website effectiveness	Number of website visits	> 2000/yr

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Metrics for Success 3

Element	Criteria	CGRP-GIS Results
Workflow standardization	Policies implemented	Data Access, Contracts
	Standards adopted	Metadata
	Procedures implemented	Change Control, Data Processing, Workflow, Cartography, Metadata Preparation, Website Design and Maintenance
Productivity of GIS Services	Number of work requests completed	639/yr
	Number of maps completed	2179/yr
Funding stability	Annual budget	~ $2 million/yr

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Metrics for Success 4

Element	Criteria	CGRP-GIS Results
Institutional Benefits	Enhanced awareness of GIS	5 Training Seminars, 3 invited speakers, bi-weekly tech steering committee meetings, quarterly user group meetings
	Increased internal data sharing	7 LANL divisions use system
	Enhanced data usage by external stakeholders	> 10 Data Usage Agreements Signed and in place.
	Increased productivity	Estimated 35% Decrease in time spent searching for data
	Elimination of redundancy	Not Quantified
	Cost saving to institution	Not Quantified

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III. Perspective

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Thoughts About Enterprise GIS Design

No "turn key" or "one-size-fits-all" solution

- Technology, management, and unique institutional needs constraint design
- Enabling technologies (fast computers, high-capacity storage devices, high-speed networks) relatively mature
- GIS software powerful and rapidly evolving
- Integration of technical and management components still in early stage of maturation

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Challenges

Competition for limited resources leads to many isolated, independent, project-centric GIS groups with limited motivation for data sharing and collaboration.

- Keating et al. (2002)

- Bridge Organizational Divides
- Promote Data Sharing
- Overcome Resistance to Change
- Find Institutional Champion
- Build "Team of Two"
- Develop Institutional Plan

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Solutions

- **Centralized vs. Decentralized Design:** mixed model strikes balance
- **Education:** awareness, common purpose, "buy in"
- **Funding:** coordination to minimize stove-piping
- **Cross-Organizational Teams:** goals that transcend individuals and boundaries
- **Formalized Data Exchange:** carefully planned processes and procedures
- **Roles and Responsibilities:** formalized, coordinated
- **Promote Good Institutional Behavior:** collegiality, trust, coordination, mutual respect

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Enterprise GIS: a Natural Stage in the Evolution of GIS

*new **"collective geographic awareness"**, whereby GIS specialists and non-specialists can access wealth of map-based data, models, and analysis capabilities, with broad benefit (day-to-day operations, customer support, research, decision making...)*

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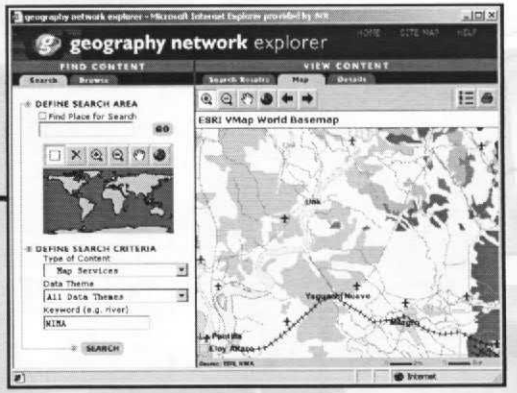
IMS Server



SDE

Clients

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Numerical Model Warehouse

Servers

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References

Keating, G., Rasmussen, S., and Raven, M. 2002. Consensus building tools for GIS design. LANL Report LA-13894-MS.

Keating, G., Rich, P.M., Witkowski, M.S., Batts, C.M., Deming, J.H., Jones, M.A., Linger, S.P., Mynard, C.R., Riggs, T.L., and Walther, D. 2002. Challenges for EGIS in post-wildfire hazard mitigation and emergency management. LANL Report LA-13930.

Keating, G., Rich, P.M., and Witkowski, M.S. 2003. Challenges for Enterprise GIS. URISA Journal. In Press.

Linger, S.P., Batts, C.M., Rich, P.M., Riggs, T.L., Walther, D.E., and Witkowski, M.S. 2002. GISLab Enterprise GIS Tools. LANL Report LA-UR-02-4008.

Mynard, C.R., G.N. Keating, P.M. Rich, and D. Bleakly. 2002. GIS emergency support for the May 2000 Cerro Grande Wildfire. LANL Report LA-14007-MS.

Witkowski, M.S., Rich, P.M., Keating, G.N., Linger, S.P., and Riggs, T.L. 2002. Spatial Data Warehouse Design for Enterprise GIS. In Proceedings of Second International Conference on Geographic Information Science, Boulder, CO.

Witkowski, M.S., P.M. Rich, and G.N. Keating. 2003. A Prototype for Enterprise GIS, LANL Report LA-14027.

Witkowski, M.S., P.M. Rich, and G.N. Keating. 2004. Enterprise GIS Design. In Manuscript.

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