Managing Hazardous and Toxic Waste Information:

GIS Application

CORPS OF ENGINEERS

CERL

WES

THAMA

August 9-11, 1989
Denver, Colorado

MANAGING HAZARDOUS AND TOXIC WASTE INFORMATION: GIS APPLICATIONS

United States Army Toxic and Hazardous Materials Agency (USA-THAMA), United States Army Construction Engineering Research Laboratory (USACERL), and United States Army Waterways Experiment Station (USAWES) sponsored a symposium entitled "Managing Hazardous and Toxic Waste Information: Geographic Information Systems (GIS) Applications" on August 9, 10, and 11 in Denver, Colorado. The purpose of that meeting was for sharing ideas, systems and progress on the various GIS programs within the Corps of Engineers and the Army, with applications to the study and management of hazardous and toxic waste issues. The symposium provided a unique opportunity to develop synergy between the Corps of Engineers Laboratories, specifically in the area of GIS Research and Development and GIS implementation efforts. Discussions about these efforts proved very beneficial to all parties concerned.

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INTRODUCTORY MATERIAL

A. AGENDA

B. LIST OF REGISTERED ATTENDEES

C. MEETING NOTES BY MIKE YOEMAN

MANAGING HAZARDOUS AND TOXIC WASTE INFORMATION: GIS APPLICATIONS
Denver, Colorado
August 8-11, 1989
MEETING AGENDA

Tuesday, August 8	
6:00 p.m.-9:00 p.m.	**Registration** *Judy Zindars*
7:00 p.m.-10:00 p.m.	**Icebreaker** *THAMA*
Wednesday, August 9	
8:30-8:45	**Opening Remarks** *Mark Bovelsky, William Goran, Sandy Stephens*
8:45-9:15	**Keynote Address**
	"GIS in the Corps: Process and Directions" *Bill Klesch*
9:15-10:00	**THAMA**
	"THAMA Overview: Installation Restoration Data Management Information System (IRDMIS)" *Mark Bovelsky*
	"Geotechnical Applications Using Interactive Surface Modeling" *Ira May*
10:00-10:15	**Break**
10:15-11:00	**CERL**
	"GIS Capabilities and Activities at CERL" *William Goran*
	"GRASS: Development and Support" *Jim Westervelt*
11:00-12:00	**WES**
	"Geotechnical Applications of GIS" *Albert Williamson*
	"GIS/Image Processing Synopsis" *Jack Stoll*
	"CADD and GIS" *Sandy Stephens*
12:00-1:00	**Lunch**
1:00-1:45	**CRREL**
	"Demonstration of PRISM and STELLA Software for use in the Corps of Engineers" *Ike McKim*
1:45-2:30	**ETL**
	"GIS Work at ETL" *Bruce Opitz*
2:30-2:45	**Break**
2:45-3:30	**DMA**
	"DMA: CD-ROM Products" *Mark Shellberg*
3:30-3:45	**Wrap-up** *Mark Bovelsky*
3:45-6:00	**Corps Demonstrations**
Thursday, August 10	
8:30-8:45	**Opening Remarks** *Sandy Stephens*
8:45-10:15	**Vendors' and Agencies' Presentations**
	DBA *Dave Johnson*
	Dynamic Graphics *Bill Hoaker*
	Autometrics "MOSS and Autometrics" *Bruce Morse*
	Purdue University "Evaluating Ground Water Pollution Potential using GIS" *Kurt Buehler and Douglas Hickey*
10:15-10:30	**Break**

10:30-12:00	**Vendors' and Agencies' Presentations**
	Intergraph *Gary Lambert*
	ESRI *Jack McCarthy*
	Concurrent Computer Corporation *Daryl McDaniel*
12:00-1:30	**Lunch**
1:30-3:00	**Working Groups**
3:00-3:15	**Wrap-up** *Sandy Stephens*
3:15-3:30	**Break**
3:30-5:00	**Vendors' and Agencies' Demonstrations**

Friday, August 11

8:15-8:30	**Opening Remarks** *William Goran*
8:30-9:00	**Bringing it all Together: Data Interface** *Sandy Stephens*
9:00-10:30	**Round Table Discussion**
10:30-10:45	**Break**
10:45-12:00	**Round Table (cont.)**
12:00	**Adjourn**

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MANAGING HAZARDOUS AND TOXIC WASTE
INFORMATION: GEOGRAPHIC INFORMATION SYSTEM (GIS) APPLICATIONS
August 8 -11, 1989
Meeting Notes prepared by Mike Yoemans

I. Introduction: Meeting was co-sponsored by USATHAMA and WES. Approximately 65 personnel attended the meeting. Primary focus was on coordinating/sharing GIS Lab activities with emphasis on finding ways to better serve the field. The meeting covered a variety of topics to include presentations by each laboratory (THAMA, CERL, WES, CREEL, and ETL). It also included a number of vendor presentations and break-out sessions, dealing with four (4) key GIS problem areas.

II. Key Note Speaker: Dr. Bill Klesch opened the conference by discussing the HQUSACE reorganization, which puts environmental functions into a single organization as a part of the Chief's initiative to create a greatly expanded environmental mission. He also discussed the results of a Corps-wide GIS study he led. The study was completed in Oct 88 by 32 personnel from throughout the Corps. Personnel were divided into eight (8) sub-groups. Focus was on GIS applications. The Chief has approved the study findings, briefly described below:

A. Report recommended the creation of a technology transfer program and emphasized need for software sharing.

B. Headquarters needs to promote GIS. There will be a GIS coordinator at headquarters, located in the Civil Works Policy and Planning Division. A GIS steering committee will be established with counterparts at districts. District representatives will be given increased visibility.

C. Sub-group recommendations:

1. User Needs. GIS should promote professionalism -- technology must work and provide a high level of credibility. GIS must be practical and flexible. GIS costs must be accurately tracked and users must be trained on proper procedures for conducting cost/benefit analysis. Users and developers of GIS are cautioned to remember that data collection is the most expensive aspect of system operations, and its a long road to system benefits. A formal GIS education program should be created. GIS must be easily accessible to all who need them.

2. Scoping. There are many issues related to scoping: How much data is enough? Can we afford GIS for this project? How much time do we have? To deal with these and other scoping concerns, the sub-group recommended:

(a) Project managers should gather as much detailed information as early on in the project as possible. Data should be structured in a manner that takes into account future uses.

(b) Standard ways of collecting data should be developed.

(c) Share existing data to maximum extent.

3. Hardware capability. Sub-group recognized the need for standard hardware, but not in the immediate future. Organizations need to get their feet wet first. As of the study completion date, there were 48 existing systems with approximately half in the FOA and the half at the Labs. Requirements need to be defined. We need to define those applications that are routinely used. The lead district concept should be applied to facilitate GIS development. A GIS training program needs to be established.

4. Data quality. Data must be accurate! Need to develop multi-purpose data bases. To do this data will have to be structured independent of the applications that use it. Procedures need to be developed for tracking errors (Error Budgets). Data accuracy requirements need to be defined. Policies need to be established making data quality essential to all aspects of GIS to include the R & D community.

5. Technology transfer. We must create opportunities for sharing technology. Top management needs to be educated. We need to find ways to promote GIS.

6. Cost. This is a tough issue. $59 million spent to date. 9 districts are operational as of Oct 88. 26 districts were not operational. The study estimated that is would require $210 k per district to get started. There are currently 35 - 50 packages to be evaluated. The most important point about cost is to remember that data collection is the most expensive aspect of GIS.

7. Software Sharing. Mehtods and procedures need to be developed for sharing software and for encouraging open architecture vendor solutions.

8. Inter-agency coordination. GIS data and application requirements and capabilities must be coordinated with Federal, state, and local colleges. Everyone is doing their own thing. Benchmarks have to be developed for evaluating data base structures and hardware configurations. We need to manage between GIS, CADD, and remote sensing.

D. Bill Klesch closed his remarks by talking about how the Corps is going to deal with the toxic waste program. He indicated that the Chief thinks environmental engineering is our future. There will be a coalition between the engineering and environmental community. We are beginning to see how hazardous waste relates to civil works projects. Final word: Focus on GIS applications!! Use this information to influence vendor GIS products!!

III. Lab presentations. Mark Bovelsky opened this portion of the conference by talking about the fragmentation of the GIS program and the need to pull it all together. This was followed by a presentation from each of the Labs.

A. CERL. William Goran gave a good presentation on the Geographic

Resource Analysis Support System (GRASS), which has extensive land management capabilities. The software is public domain, and it is available at a cost of $1K per package. This presentation had lots of information showing hardware configurations and existing software programs (estimated at 180 programs). This looks like a very good system -- one that should interest all FOA. Other material distributed at the conference included a GRASS Newsletter and a GIS fact sheet. Personnel interested in obtaining copies of this material or more information on GRASS should contact CERL directly.

B. WES. Sandy Stephens lead off with the standard CADD briefing. He was followed by Al Williamson who gave a presentation on geotechnical applications. He indicated that there are 36 different applications with about 40 users. He briefly described the Computerized Environmental Resource Data System (CERDS). It was used to analyze data for 1,000 river miles. Data came primarily from existing maps. Al's talk focused on developing GIS applications to solve specific problems. He stressed that GIS applications should not become software or hardware dependent. Jack Stoll was the final WES speaker. He talked about Image Processing. He indicated that WES was actively supporting NASA's GIS upgrade. He also mentioned a specialized GIS hardware, which makes extensive use of the TCP/IP communications protocol. He emphasized the need to ensure image processing capabilities be included as a critical feature for future GIS.

C. ETL. Bruce Opitz gave an enlightening talk on ETL's efforts to develop systems to support the soldier. He pointed out that it is quite a different problem to develop systems that must operate under battlefield conditions by soldiers who may not have graduated from high school. Bruce indicated that ETL will be purchasing large numbers of systems. They are looking to acquire off-the-self systems. Human engineering factors will play a heavy role in system selection.

D. DMA. Mark Shellberg presented Defense Mapping Agency's initiatives to apply CD-ROM products to convert existing paper maps. They have an extensive information modernization program estimated at $2.6 billion. There is much the Corps can learn about CD-ROM technology from DMA. Moreover, there is an extensive amount of data sharing that can and should occur between the Corps and DMA. Mark said if you want information from DMA on data holdings, lessons learned, etc., you must go through ETL (Mark Bovelsky).

E. CRREL. Ike McKim talked about two systems: PRISM and STELLA. They feature image conversion and image processing. They seek to overcome the vector versus raster problem by allowing all data to be viewed as vector. STELLA is an object oriented program. It the first good example of object oriented programming I've seen! The system is capable of building extremely complicated models.

IV. Vendor Presentations. Six (6) vendors made presentations as follows:

A. DBA. Specialize in GRASS customization, data base generation, digital data input services, image processing, and image manipulation. They are establishing a Digital Cartographic Research Laboratory to look high technology for GEO-TECH.

B. Dynamic Graphics. A software development firm featuring large software library, interactive systems for surface modeling, and 3D modeling. Graphics were exceptionally good!

C. Autometrics. Provides on-call support for the Map Overlay Standard System (MOSS). This system was originally built in 1976. It is public domain software used extensively by the Omaha District. It is an analytical tool. It was largely redesigned in spring of 1989.

D. Intergraph. Gave standard CADD presentation with focus on data and software integration capabilities and third party porting products.

E. ESRI. Featured their integration tools. Good slides showing GIS integration requirements for both data and application.

F. Current Computer Corporation. They feature real-time systems. They sell hardware, but they provide a "GIS Bundled GRASS Based system, which is operational at Little Rock District.

V. Working Group presentations. Based on area of interest, attendees were divided into four working groups as follows:

A. Raster versus Vector. Group suggests:

1. Desire for concurrent processing of raster and vector data without having to convert back and forth.

2. More sharing of data. Open system architecture and standard interchange data model.

3. Procedures for acquiring existing data. Central Corps site for distributing data. Data acquisition policy.

4. Library of Corps GIS applications. Suggestion was made to use NTIS (?) and catalog of GIS software produced by USGS.

B. Single discipline task group. Recommend broad needs for GIS development:

1. Development of a GIS infrastructure.

2. Need to create GIS center similar to CADD center.

3. Technology transfer forums.

4. GIS standards -- Attribute schema and symbology and

weighting criteria.

5. Software development requirements need to be defined.

6. GIS R&D support for modeling/analysis.

7. GIS Training program and steering committee.

C. Planning and Marketing.

1. Establish GIS Center
   a. News Letter
   b. E-Mail

2. GIS Planning Guidelines

3. Educate Management/Need copy of cost/benefit analysis

4. Corps-wide GIS inventory of applications and platforms

5. Army Steering Committee to develop guidelines

6. Standards for sharing data

7. User Groups

8. Incorporate GIS planning into IMP sequence

9. IM architecture should include GIS

10. Include IRM Committee in GIS to extent possible

11. Definition:Terms

12. Policy on GIS: Should exist at planning and be funded through technical and indirect

D. Remote Sensing: How to get data that already exists. Lower costs. Lots of land, but no information on it, and no handbook on how to collect data. Responsibility should be placed in Real Estate section. Get ACE here in future! Newly created Environmental Division.

1. Need participation in R&D to insure money is spent in right way

2. Water quality factor.

SPEAKERS PRESENTATION MATERIALS

A. NOTES FROM KEYNOTE ADDRESS

B. THAMA

C. CERL

D. WES

E. CRREL

F. ETL

G. DMA

NOTES OF KEYNOTE ADDRESS

The GIS Ad Hoc Committee: Corps of Engineers/Environmental Advisory Board, at it's 1987 March Meeting on ENVIRONMENTAL DATA recommended that the Chief of Engineers select a specialist to focus on environmental data and GIS, addressing eight areas --

1. Scoping
2. Sensitivity to user needs
3. Inter-model hardware consistency
4. Software capability
5. Data quality
6. Technology transfer
7. Cost
8. Inter-agency coordination.

September 1987 - Klesch appointed Chairman
November 1987 - Group of 32 selected and convened
Range of experience and familiarity with GIS among this 32 person
Focus on Application of GIS to Corps.
32 assigned to 8 subgroups.
Ad Hoc report completed 10/88 and forwarded to Chief of Engineers.

1. Chief has accepted and report will be printed.

RECOMMENDATIONS:

1. GIS Coordination at HQ OCE to reside in Policy and Planning Division.
2. Establish Steering Committee of Division Chiefs
3. GIS Coordinators at Districts/Divisions - but needs visibility to cut across Division activities.

SENSITIVITY TO USER NEEDS --

- Professional Credibility - tools actively support mission
- Practicality
- Flexible - lots of different professionals
- Accurate cost information
- Education & Accessibility - need training opportunities.

SCOPING - How much data is enough.

- Detail required tied to investigation
- Gather most detailed information needed as soon as possible.
- Development of standardized materials for data collection.

HARDWARE AND SOFTWARE CONSISTENCY

- Lots of discussion - compelling argument for standarization - but recommended that standardization be postponed - why - diversity of current use.
- Recommend - offices should develop multi-year plan for GIS implementation and use.
- Recommend - use expertise in place at certain districts, especially on regional basis, to respond to specialized or regional Corps needs.
- Recommend - training program.

DATA QUALITY -

Data is greatest cost - data quality is critical

- Anticipate future needs in developing data rather than short term.
- Procedure to tract error propagation.
- More involvement with Federal inter-agency committee

TECHNOLOGY TRANSFER --

- Need for effective communication
- Technology awareness within the Corps Senior Leadership - Match aware of this technology area.
- Timely and accurate information and systems acquisition
- Need program of GIS training to reach at least one at each site

COST --

- In 1988 -- 48 systems in place -- Cost = 5.6M
- Required to add other districts -- Cost = 5.7M (26 districts without capabilities)

INTERAGENCY - COORDINATION --

- Use of GIS grown dramatically in last four years
- Data exchange and system capabilities problems abound
- Need -- benchmarks for scale, quality.
- Draw together - Remote Sensing and GIS

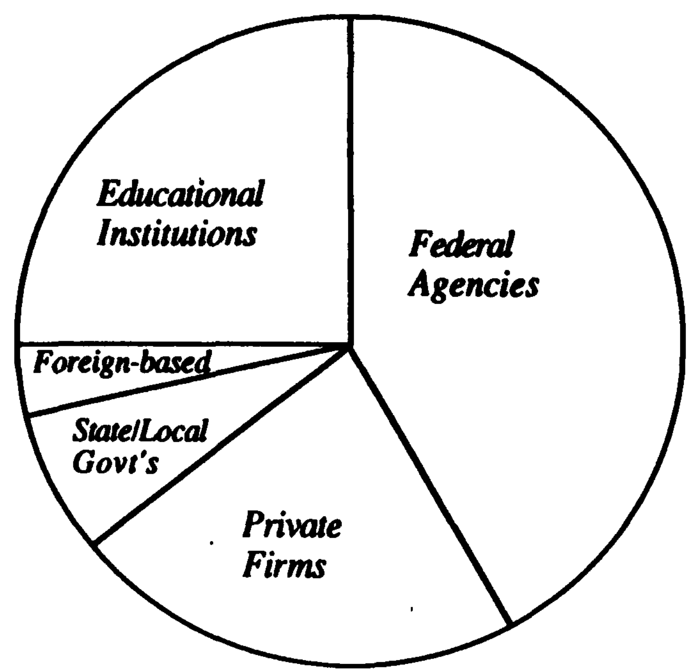
Regarding Hazardous and toxic waste data management, the COE's Chief's emphasis is on water resource issues and environment. Corps as an environmental agency to seek solutions for the engineering and environmental community. GIS offers great applications for hazardous and toxic waste management as a tool for COE.

THAMA

CERL

THE GRASS USER COMMUNITY

Federal Agencies
State & Local Governments
Educational Institutions
Private Firms
Foreign-based Organizations



FEDERAL ORGANIZATIONS USING GRASS

U.S. Army Installations
Corps of Engineers Districts, Divisions & Labs
Soil Conservation Service
National Park Service
U.S. Geological Survey
U.S. Navy
Department of Energy
National Aeronautic & Space Administration
National Oceanographic & Atmospheric Admin.
Defense Mapping Agency
U.S. Forest Service
U.S. Air Force
Agricultural Research Service

ARMY INSTALLATIONS USING GRASS

- ***Current:***

Fort Hood, TX
Fort Lewis, WA
Fort Carson, CO
Yakima Firing Center, WA
Hohenfels Trn'g Area, FRG
Camp Ripley, MN
Headquarters NGB, MD

- ***Planned:***

*Fort Belvoir, VA
Fort Polk, LA
Fort Bliss, TX
Fort McClellan, AL
Fort Chaffee, AR
Fort Knox, KY
Fort Sill, OK
Fort Leonard Wood, MO
Orchard Trn'g Range, ID

CORPS SITES USING GRASS

- *Current:*

  Fort Worth
  Little Rock
  Rock Island
  St. Paul
  CERL
  ETL
  WES

- *Planned:*

  * Chicago
  Mobile
  * New Orleans
  Omaha
  Portland
  St. Louis
  Tulsa
  Vicksburg
  Walla Walla
  New England Division
  Southwest Division
  CRREL

GRASS DEVELOPMENT

- Government-developed, Public Domain
- Multi-Agency Participation
- Portable, Multi-Host
- Open Design Philosophy

HARDWARE PLATFORMS RUNNING GRASS

APOLLO
AT&T 3B2
AT&T 6386
COMPAQ 386
DELL 386
HP 9000
IBM-RT
VAX

INTERGRAPH INTERPRO
MASSCOMP
OPUS PC-TEKTRONIX
PC CLIPPER
TEKTRONIX WORKSTATIONS
SILICON GRAPHICS IRIS
SUN (3's, 4's & 386i)
APPLE MACINTOSH II

INSTITUTIONAL STRUCTURES GUIDING GROWTH

- GRASS Inter-Agency Steering Committee
- Annual GRASS User Group Meeting
- GRASS Distribution & Support Centers
  - ITD/SRSC
  - DBA Systems
  - Central Washington University
  - USACERL
  - Soil Conservation Service
  - National Park Service
- GRASS Training Courses
- GRASS Software Documentation
- Quarterly GRASS Newsletter

DOCUMENTATION SUPPORTING GRASS/GIS IMPLEMENTATION

GRASS USER'S REFERENCE MANUAL
GRASS PROGRAMMER'S MANUAL
GRASSCLIPPINGS NEWSLETTER

GRASS IMPLEMENTATION GUIDE
GRASS APPLICATIONS GUIDE
GRASS USER'S GUIDE - APPLICATION EXAMPLES
GRASS PROBLEM-SOVING MANUAL
METHODOLOGY FOR PERFORMING A RETURN
ON INVESTMENT STUDY FOR GRASS

THE LAND ANALYSIS GROUP

STAFF AND ORGANIZATION

Subgroups

- Software Design
- Cartography and Data Development
- Analysis and Applications
- Technology Transfer

Technical Disciplines

- Archaeology
- Computer Science
- Forestry
- Geography
- Landscape Architecture
- Mathematics
- Soil Science
- Urban Planning

THE LAND ANALYSIS GROUP

HARDWARE

Communications & Documentation Pyramid 90x

GIS Equipment:

Sun 4/280	Masscomp 5450
Sun 4/110	Masscomp 5500
Sun 3/60 (6)	Masscomp 500
Sun 386i (2)	Interpro 240
Sun 150 (2)	Compaq 386/25
	Compaq 386/16
	Apple Mac IIx

Digitizers: Altek, Calcomp (2), Geographics (2), Kurta

Output Devices:

Calcomp 1043 (plotter)	Tektronix (ink jet)
Imagen (laser printer)	Shinko (thermal)

All machines linked via NFS over ethernet.

THE LAND ANALYSIS GROUP

SOFTWARE

GRASS	GIS and Image Processing
MAPGEN	Cartographic Output
Intergraph	Digital Terrain Model and CADD
ETIS	Soils Information System Economic Impact Forecast System Environmental Legislative System Bulletin Boards (GISTALK, CRIBB)
TAE	Transportable Application Executive
X	Window/Graphics Interface

VICAR, ERDAS	Image Processing
S	Statistical Package
CRIS	Cultural Resource Mgmt
Dbase, Empress, RIM, Oracle	DBMS
AutoCAD	CADD

THE LAND ANALYSIS GROUP

GRASS/GIS RELATED SERVICES

- Introductory Information on GRASS and GRASS Applications
- Distribution of Software and Documentation
- Hardware Configuration and/or Acquisition Information
- On-site Installation of Software and Hardware
- Telephone Support for Software
- Data Acquisitions Assistance
- Data Conversions between various Formats and Media
- Data Digitizing
- Applications and Data Analysis Assistance and Services
- New Drivers for Hardcopy Devices, Digitizers, and Display Devices
- Hardware System Management Support
- Networking Consultation and Guidance

GRASS ANALYTICAL FUNCTIONS

- ***Analytical Tools:***

  Boolean Overlays
  Weighted Overlays
  Inference "Rule-Based"
  Grid Cell Math Calculations
  Image Classification
  Distance Zones
  Neighborhood Filters
  Mask Creation
  Coincidence Tabulation
  Raster/Vector Conversions
  Area Calculations
  Reclassification

- ***Analytical Models:***

  Trajectory Analysis
  Watershed Dynamics
  Noise Contours
  Erosion Prediction
  Site Evaluation
  Damage Assessment
  Corridor Selection
  Site Allocation
  Site Prediction

GRASS MAPPING FUNCTIONS

- Vector Digitizing, Edit & Display
- Raster 2-D and 3-D Display
- Site Display & Analysis
- Labeling & Legends
- Raster Hardcopy Devices:
  - Ink Jet
  - Thermal
  - Impact
  - Electrostatic
- Input of Data from:
  - DMA DTED
  - USGS DEM
  - USGS DLG
  - SPOT
  - Landsat MSS & TM
  - Commercial Formats
  - Hardcopy Maps

U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

WES

DENVER GIS PRESENTATION
(WEDNESDAY AUGUST 9)

August 4, 1989 12:22pm

Subject: Managing Hazardous and Toxic Wastes - GIS Applications

SLIDE 1

INTRODUCTION

SLIDE 2

PROBLEM - MULTI-PLATFORMS

SLIDE 3

COMMON DATA BASE

SLIDE 4

CONTRACT COMPONENTS

SLIDE 5

APPLICATION SOFTWARE

SLIDE 6

CADD AUTHORITY

SLIDE 7

CADD FACTS

SLIDE 8

MAX RETURN / MIN TIME

SLIDE 9

CADD CENTER

SLIDE 10

OBJECTIVES

IMPLEMENTATION
COORDINATION
INTEGRATION
TRAINING

SLIDE 11

IMPLEMENTION

IDENTIFY H/W & S/W FOR APPLICATIONS
H/W & S/W ADVANTAGES/DISADVANTAGES
PROMOTE ENHANCEMENTS/MODIFICATIONS
IDENTIFY STD H/W FOR DATA EXCHANGE/SUPPORT

SLIDE 12

COORDINATION

IDENTIFY AREAS OF EXPERTISE
PROMOTE SHARING OF LESSONS LEARNED
SOLICIT SUPPORT FROM MANAGEMENT
ENHANCE EXCHANGE OF DATA

SLIDE 13

INTEGRATION

SLIDE 14

INTEGRATION BLOCK

SLIDE 15

INTEGRATION

AUTOMATE THE DESIGN PROCESS
ESTABLISH STD FORMATE FOR GRAPHICS/DB/OBJECTS
STANDARDIZE DATA CONVERSION
(SURVEYS, MAPPING, & ANALYSIS)
DEVELOP INTERFACES TO OTHER PROGRAMS

SLIDE 16

TRAINING

ENHANCE EXISTING TRAINING
DEVELOP ADVANCED/SPECIALIZED APPLICATIONS

SLIDE 17

CADD CTR DIAGRAM

SLIDE 18

RELATIONSHIP OF CADD/GIS

DIFFERENCES
- OBJECT-ORIENTED
- SPATIAL ANALYSIS

SIMILARITIES
- GRAPHIC DISPLAY
- DATA BASE ATTRIBUTES
- DATA ANALYSIS

SLIDE 19

CADD/GIS USES

REAL ESTATE (LEASES/OWNERSHIPS)
TERRAIN MODELS
COORDINATE DATA/ANALYSIS
HYDROGRAPHIC BASIN ANALYSIS
LAND USE MODELING/ANALYSIS
EROSION & INFILTRATION ANALYSIS
URBAN PLANNING & ASSESSMENT
UTILITY LAYOUTS & PLANNING

SLIDE 20

KINGS BAY TITLE

SLIDE 21

KINGS ROCK CONTOURS

SLIDE 22

KINGS AFTER SURVEY

SLIDE 23

KINGS AFTER SURVEY

SLIDE 24

FORT BENING

SLIDE 25

FORT BENING FLOW VECTORS

SLIDE 26

FORT BENING PLAN VIEW

SLIDE 27

FORT BENING EXPANDED VIEW

SLIDE 28

TINKER NAVY HANGER

SLIDE 29

TINKER MASTER PLAN

SLIDE 30

TINKER MP/SURVEY

SLIDE 31

TINKER FLOOR PLAN

SLIDE 32

TINKER STRUCTURAL MODEL

SLIDE 33

TINKER 3D MODEL

SLIDE 34

TINKER 3D MODEL

SLIDE 35

CADD CTR SUPPORT (Conclusions)

APPLY ADVANTAGES OF CADD TO GIS
DIGITAL MAPPING CAPABILITIES
INTEGRATE EXISTING DATA BASES
ENHANCE OUTPUT DISPLAY OF DATA

COMPUTER-AIDED DESIGN and DRAFTING (CADD) CENTER

MISSION

To enable the Corps of Engineers to achieve the best use of CADD within the shortest time frame.

PURPOSE

The CADD Center is the Corps vehicle for sharing information and development work and minimizing duplication of effort while retaining local automonies and decentralized organizational structures.

MODE OF OPERATION

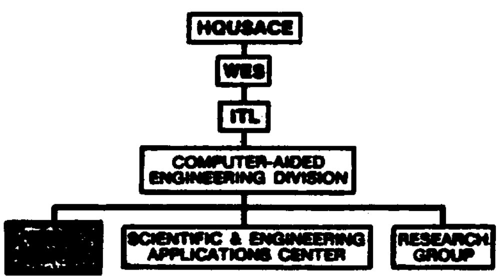
The Center is an end-user driven, technology transfer oriented organization. Single-Discipline Task Groups (SDTG) are formed under headquarters guidance to get field office grass roots input into CADD activities. A Field Technical Advisory Group (FTAG) provides the guidance to the Center.

OBJECTIVE

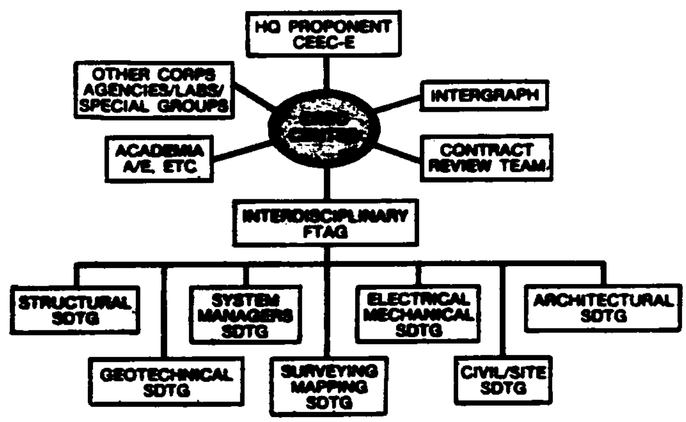
To integrate and implement CADD by:

- Furnishing technical advice
- Conducting training
- Evaluating products
- Providing advisory teams
- Initiating studies
- Promoting communications
- Distributing products

ORGANIZATIONAL CHART



FUNCTIONAL CHART



FTAG - FIELD TECHNICAL ADVISORY GROUP
SDTG - SINGLE DISCIPLINE TASK GROUP

CADD Center
Points of Contact

Information Technology Laboratory	**CEWES-IM-Z**
Chief, Dr. N. Radhakrishnan	(601) 634-2527
Computer-Aided Engineering Division	**CEWES-IM-D**
Chief, Dr. Ed Middleton	(601) 634-4020
CADD Center	**CEWES-IM-DA**
Chief, Mr. Sandy Stephens	(601) 634-2945
Mr. John Hood	(601) 634-3138
Mr. Richard Bradley	(601) 634-2286
CPT Mike Conrad	(601) 634-2947

"GUIDED BY THE FIELD"

US Army Corps of Engineers
CADD Center
Information Technology Laboratory
Waterways Experiment Station
PO Box 631
Vicksburg, Mississippi 39181-0631

Office Symbol: CEWES-IM-DA
Ontyme: CEWE.S-IM-DA
(601) 634-4109
1-800-LAB-6WES

OBJECTIVES

- IMPLEMENTATION
- COORDINATION
- INTEGRATION
- TRAINING

STEPH063

IMPLEMENTATION

- IDENTIFY H/W & S/W FOR APPLICATIONS
- H/W & S/W ADVANTAGES/DISADVANTAGES
- PROMOTE ENHANCEMENTS/MODIFICATIONS
- IDENTIFY STD H/W FOR DATA EXCHANGE/SUPPORT

STEPH084

COORDINATION

- IDENTIFY AREAS OF EXPERTISE
- PROMOTE SHARING OF LESSONS LEARNED
- SOLICIT SUPPORT FROM MANAGEMENT
- ENHANCE EXCHANGE OF DATA

STEPH073

INTEGRATION

- AUTOMATE THE DESIGN PROCESS
- ESTABLISH STD FORMATE FOR GRAPHICS/DB/OBJECTS
- STANDARDIZE DATA CONVERSION
  - SURVEYS, MAPPING, & ANALYSIS
- DEVELOP INTERFACES TO OTHER PROGRAMS

STEPH085

TRAINING

- ENHANCE EXISTING TRAINING
- DEVELOP ADVANCED/SPECIALIZED APPLICATIONS

STEPH066

[redacted]

CADD/GIS
(HAZARDOUS & TOXIC USES)

- O REAL ESTATE (LEASES/OWNERSHIPS)
- O TERRAIN MODELS
- O COORDINATE DATA/ANALYSIS
- O HYDROGRAPHIC BASIN ANALYSIS
- O LAND USE MODELING/ANALYSIS
- O EROSION & INFILTRATON ANALYSIS
- O URBAN PLANNING & ASSESSMENT
- O UTILITY LAYOUTS & PLANNING

STEPH072

CADD CENTER GIS SUPPORT

- APPLY ADVANTAGES OF CADD TO GIS
- DIGITAL MAPPING CAPABILITIES
- INTEGRATE EXISTING DATA BASES
- ENHANCE OUTPUT DISPLAY OF DATA

STEPH070

POTENTIAL GROUPS

- HYDRAULICS & HYDROLOGY
- REAL ESTATE
- OPERATIONS
- DEH

STEPH074

DENVER GIS PRESENTATION
(FRIDAY AUGUST 11)

August 4, 1989 12:22pm

SLIDE 1

INTRODUCTION

SLIDE 2

CONCEPTS TO CONSIDER

FUNCTIONALITY
COSTS

SLIDE 3

COMPATIBLE DATA

SLIDE 4

MULTIPLE PLATFORMS

SLIDE 5

HARDWARE/SOFTWARE SUPPORT

SLIDE 6

ADDITIONAL CONCEPTS TO CONSIDER

EXISTING H/W & S/W
    INPUT/OUTPUT DEVICES
ADP PROGRAMMING SUPPORT
H/W & S/W SUPPORT
MAINTENANCE
TRAINING PERSONNEL

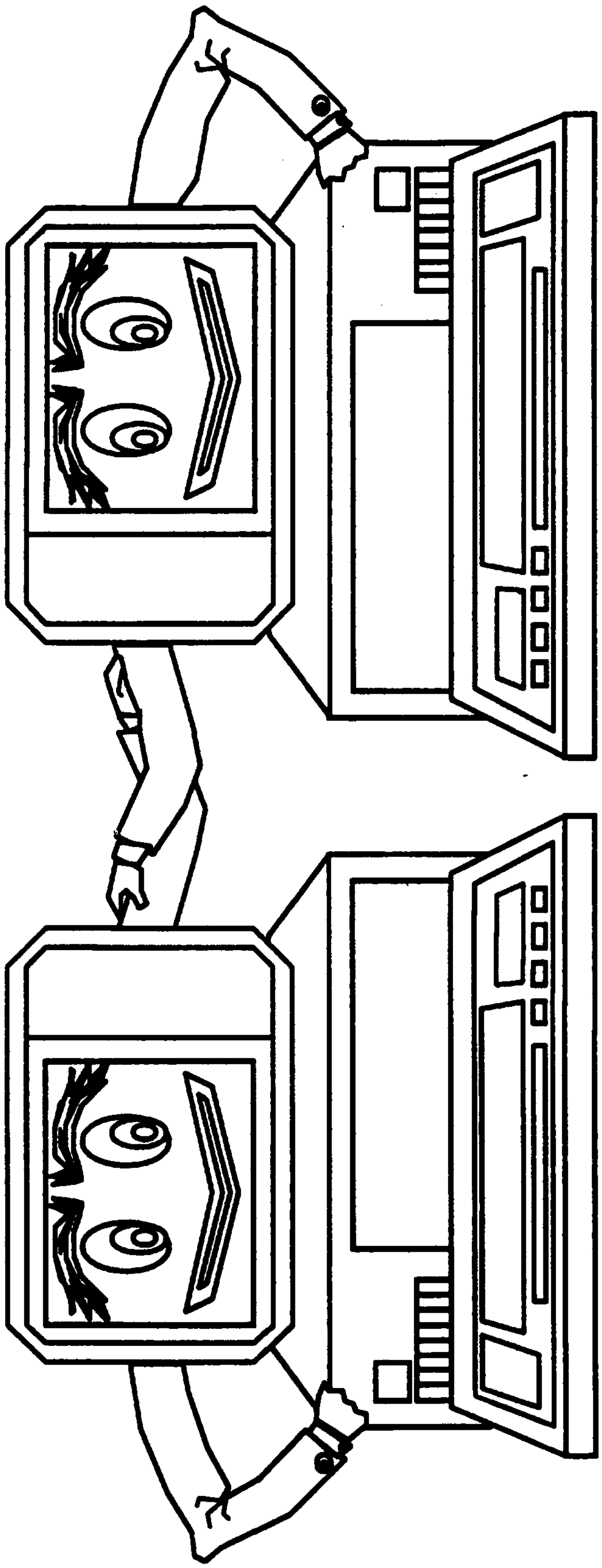
SLIDE 7

TYPES OF R&D PROJECTS

SINGLE APPLICATION
MULTIPLE APPLICATIONS
    HOW TO APPLY ANALYSIS
    FOA's TECHNICAL ABILITIES
    PERSONAL AVAILABLE
    EXISTING EQUIPMENT
    DATA INPUT REQUIREMENTS

SLIDE 8

TYPES OF R&D PROJECTS



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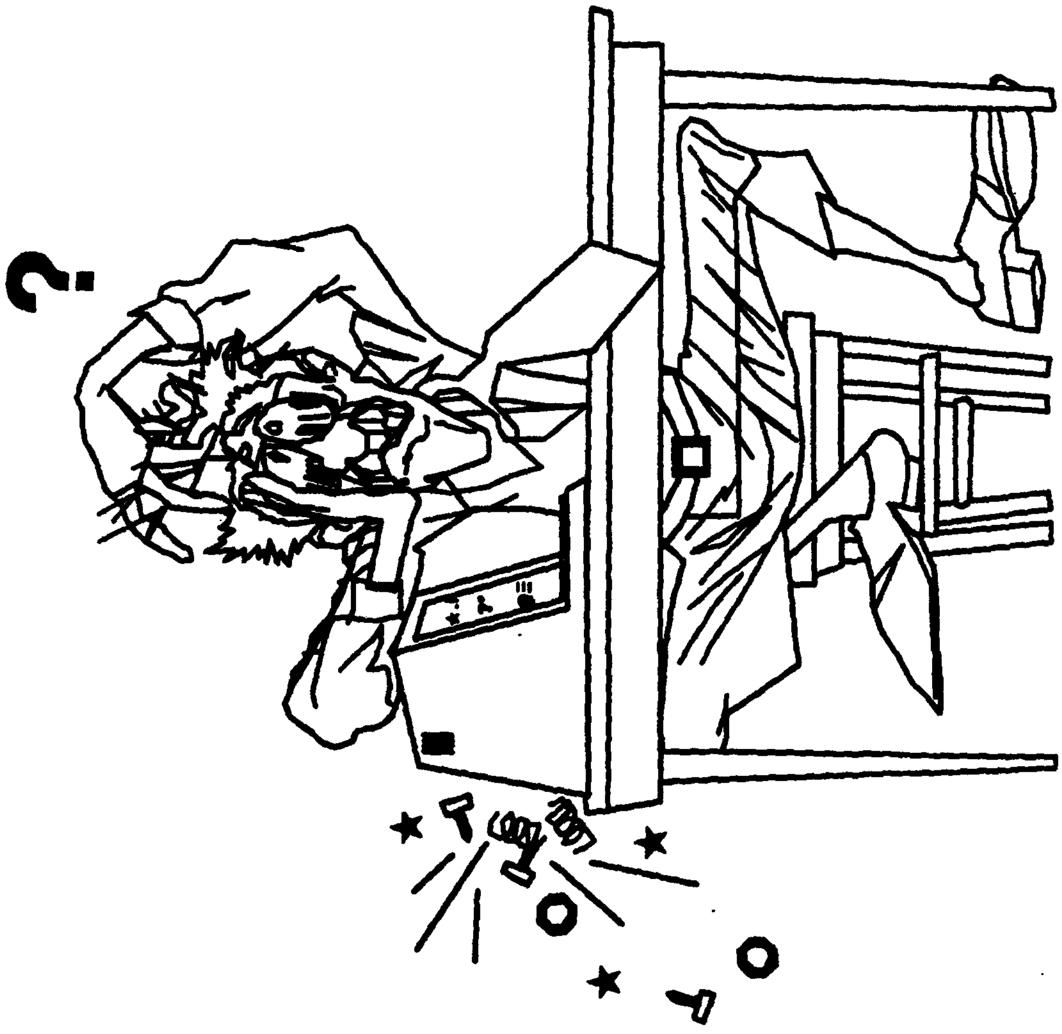
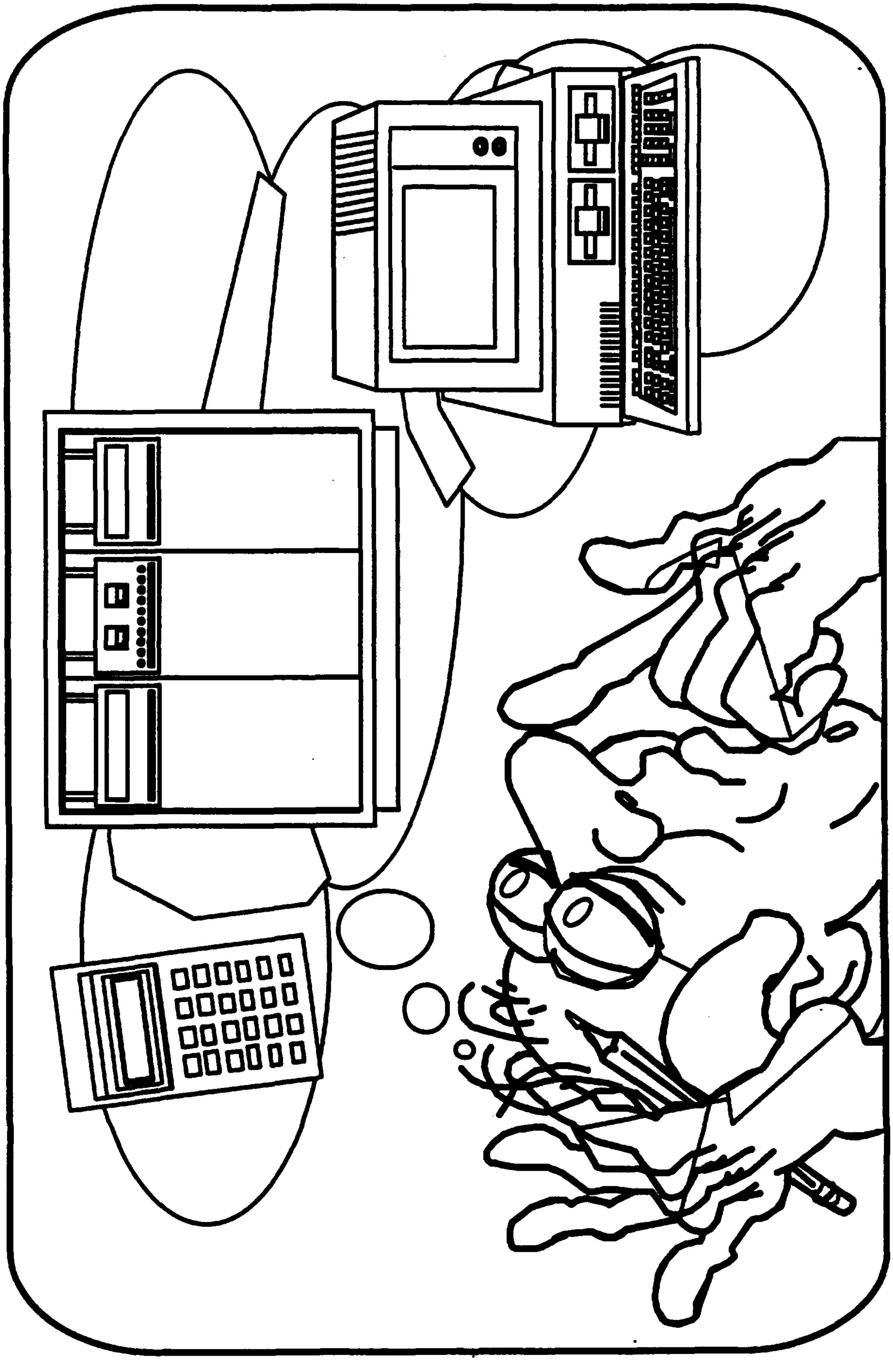




STEPH082

CONCEPTS TO CONSIDER

- FUNCTIONALITY
- COSTS

STEPH067

ADDITIONAL CONCEPTS TO CONSIDER

- O EXISTING H/W & S/W
  - O INPUT/OUTPUT DEVICES
- O ADP PROGRAMMING SUPPORT
- O H/W & S/W SUPPORT
- O MAINTENANCE
- O TRAINING PERSONNEL

STEPH068

TYPES OF R&D PROJECTS

- SINGLE APPLICATION
- MULTIPLE APPLICATIONS
  - HOW TO APPLY ANALYSIS
  - FOA'S TECHNICAL ABILITIES
  - PERSONNEL AVAILABLE
  - EXISTING EQUIPMENT
  - DATA INPUT REQUIREMENTS

STEPH080

LABORATORY PERSPECTIVE/OBJECTIVES

- O BASIC RESEARCH
- O APPLIED RESEARCH
- O BALANCE
  - O PRESENT REQUIREMENTS
  - O 3-5 YEAR OBJECTIVES

STEPH075

Demonstration of Prism and Stella Software for the Corps of Engineers Toxic and Hazardous Waste Management Program

by

Alan Cassell, Perry LaPotin, Harlan McKim
Cold Regions Research and Engineering Laboratory
72 Lyme Road
Hanover, NH 03755-1290

Brief Description of presentation

given at

Meeting on

Managing Hazardous and Toxic Waste Information: GIS Applications
Denver, CO

August 8-11, 1989

The movement of toxic and hazardous materials through soil systems is a function of the pattern of water movement through the soil matrix and the physical/chemical interactions between the soil particles and the hazardous material itself. Given the spatially variable nature of soil systems, the dynamic transport characteristics of the waste material also vary spatially. The formulation and use of models to predict the spatially variable behavior of waste movement in such complex systems has been difficult and largely unavailable to operating agencies.

STELLA is an object oriented programming environment that operates on the Macintosh computer. STELLA is specifically designed to simulate dynamic systems and is well adapted to model intractive networks. STELLA is a commercially available software package in which the user creates structural diagrams on the screen that describes the dynamic system of interest. Thus models based on interacting differential equations with constant and variable coefficients are rapidly and easily created and tested. This demonstration shows a STELLA model that simulates the movement of a toxic and hazardous material through a spatially variable two dimensional soil system. The output from the STELLA model serves as input to additional software that provides high quality animation of the simulated movement of waste over time through the network. The total effort required to produce this complex model and sophisticated output was less than two days.

Figure 1 shows the structural diagram of the simplified spatial model. The rectangular structures accumulate the waste over time that flows into and out of each rectangle through the pipelines. The circular structures attached to each pipeline (controllers) contain the logic that regulates the flow-rate in each pipeline. In the model, each rectangle can be thought of as representing a pixel (or some unit of land area). Since each rectangle is attached (through the connecting pipelines) to adjacent rectangles, the condition in any one rectangle at any time is interactively reflected in adjacent rectangles (or areas). Thus a truly interactive two-dimensional system has been created.

The simulation is started by initiating water flow through the pipelines into the network from the left side of the network. High concentrations of waste was assumed to exist in rectangle 32 at time zero (i.e. a simulated waste site). Additionally, at times of 40 and

110 units into the simulation run, a slug input of waste was assumed to enter the system through controller IN 3.

Figures 2 and 3 show the dynamic simulations relationship of the relative waste concentrations in each rectangle (or for each area) versus elapsed time. Figure 2 shows the propagation of the waste through the system along the longitudinal axis, whereas Figure 3 depicts movement along the transverse axis. The model clearly shows the dynamic nature of both longitudinal and transverse dispersion as the waste moves through the system. While this unverified model is based on simple washout dynamics in two dimension, with additional research it will be possible to develop and verify such models that can operate in 3 dimensions while at the same time incorporating appropriate algorithms that describe unsaturated and saturated flow conditions and soil/contaminant interaction reactions.

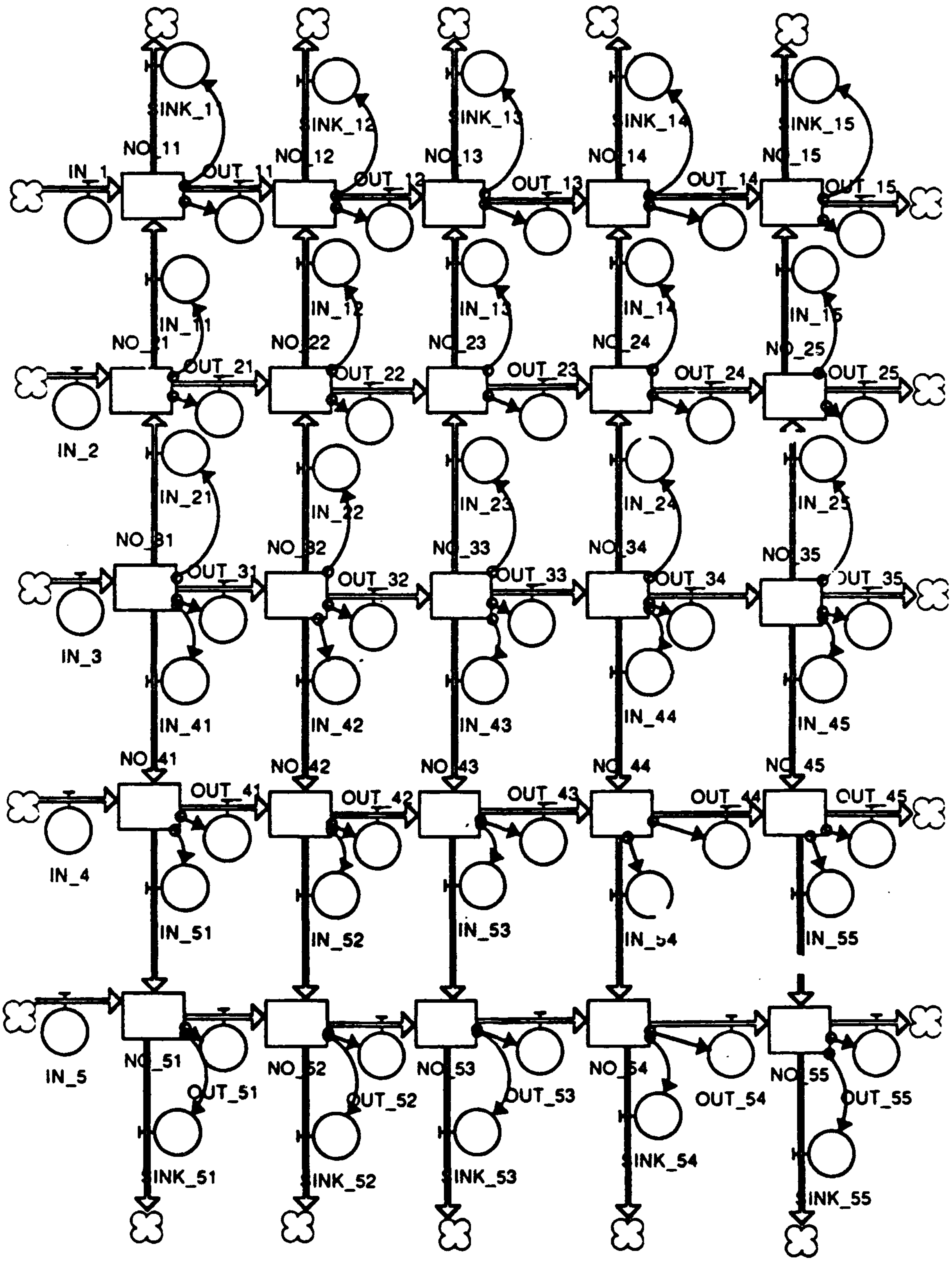


Figure 1. Simplified Dynamic Spatial Model

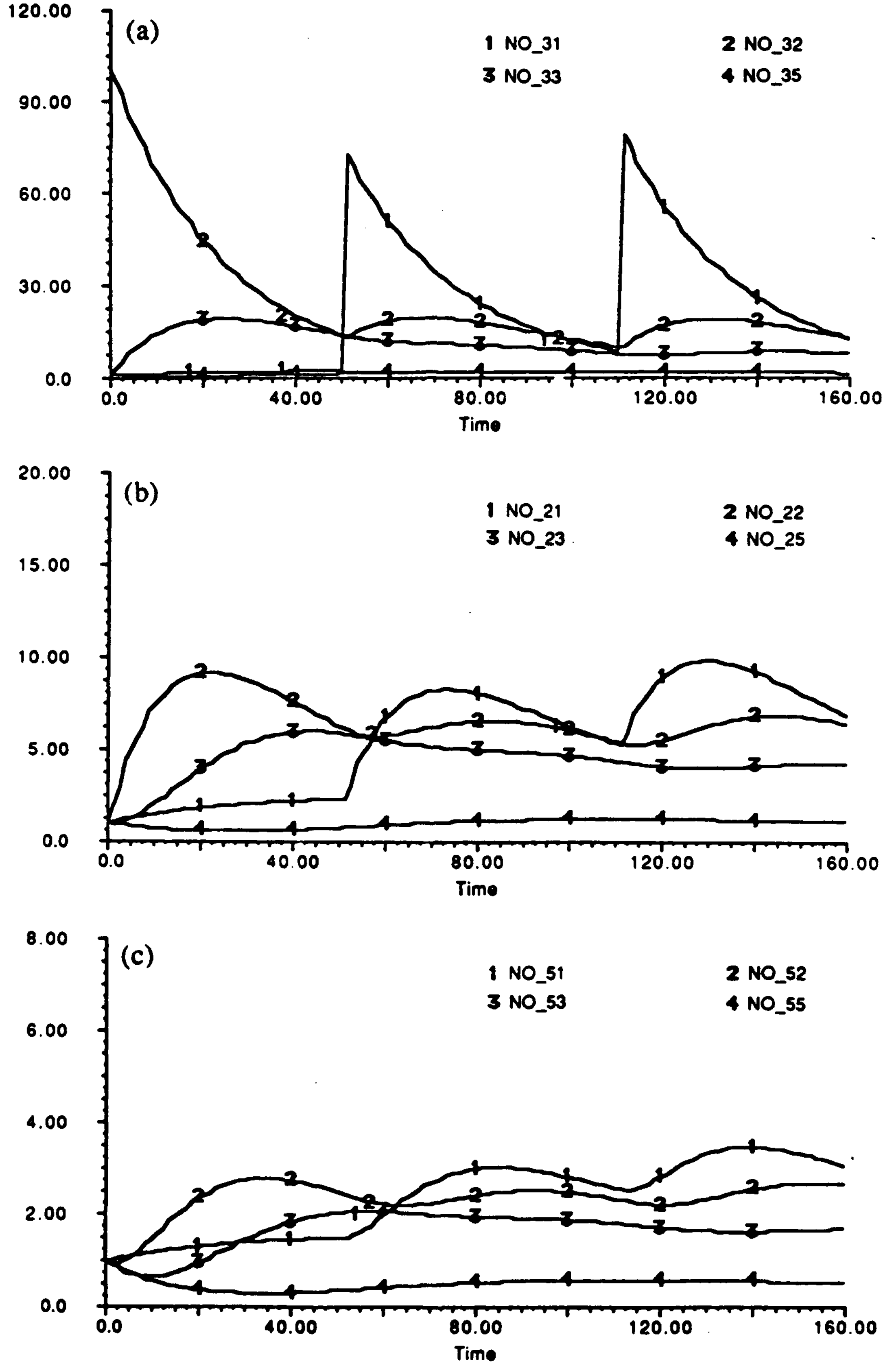


Figure 2. Longitudinal Waste Propagation

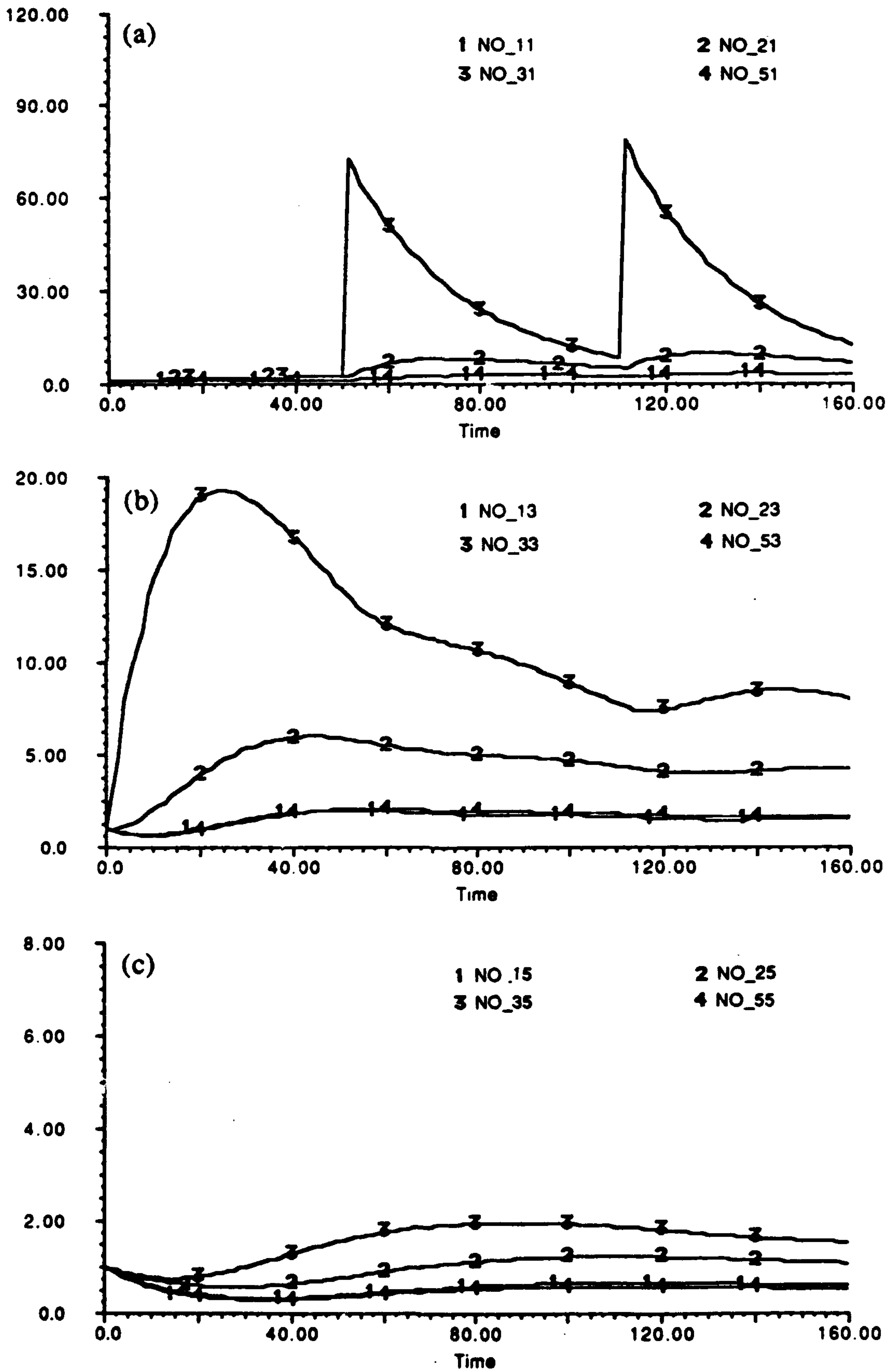


Figure 3. Transverse Waste Propagation

U.S. ARMY ENGINEER TOPOGRAPHIC LABORATORIES

ETL ACTIVITIES IN GIS

- GIS EVALUATION
- DTSS
- ALBE

ARMY GIS EVALUATION

STUDY PERFORMANCE CONSIDERATIONS OF OFF-THE-SHELF GIS'S

SYSTEMS LOANED TO ETL FOR R&D EVALUATION ON COST-REIMBURSABLE BASIS

CONCENTRATE ON ENGINEERING WORKSTATIONS & DESKTOP MICROS

ADVANTAGES TO GOVERNMENT

- PROVIDES SUPPORT FOR NUMEROUS PROJECTS & APPLICATIONS

- ENHANCES GOVERNMENT KNOWLEDGE BASE

  → ENABLES GOVERNMENT TO MAINTAIN "SMART BUYER" STATURE

- INCURS MINIMAL COSTS

PROJECTS WITH GIS REQUIREMENTS AT ETL

Commander's Aid for Reasoning About Terrain (CARAT) 6.1

Expert System for Minefield Site Detection 6.1

Advanced Digital Radar Image Exploitation System (ADRIES) 6.1-6.2

*Army GIS Evaluation 6.2

*Soldier-to-GIS Interface Research 6.2

Brigade Integration of Digital Data 6.2

Computer Image Generation Facility 6.2

DTSS Softcopy Image Exploitation Research 6.2

Terrain Information Extraction System (TIES) 6.2

TAC Modernized Production Facility 6.2 - OMA

ALBE Terrain Demonstration System 6.3

Digital Topographic Support System (DTSS) 6.4

DMA Digital Data Demonstration System OMA

ARMY GIS EVALUATION PREREQUISITES

DEVELOPMENT OF PRELIMINARY (BASELINE) REQUIREMENTS

FORMULATION OF PERFORMANCE STANDARDS FOR REQ'S

DEVELOPMENT OF EVALUATION CRITERIA - BENCHMARKS

ACQUISITION OR SYNTHESIS OF GIS DATA BASES FOR TESTS

GIS PERFORMANCE STANDARDS

ACCURACY

MAP ACCURACY STANDARDS

DATA QUALITY REQUIREMENTS

FUNCTIONAL COMPLETENESS

CONSISTENCY OF RESULTS

TIME

SKILL DEVELOPMENT TIME

USER SPEED OF PERFORMANCE

MACHINE PROCESSING TIME

UTILITY

USER SATISFACTION

USEFULNESS OF PRODUCT GENERATED

EFFICIENCY OF SYSTEM OPERATION

GIS BENCHMARKS

USER INTERFACE

SKILL ACQUISITION TIME
REVERSABILITY OF OPERATIONS

DISPLAY & PRODUCT GENERATION

ACCURACY OF PLOT / SCALING
TIME TO ASSIGN & PLOT
CORRELATION BETWEEN DISPLAY & PLOT

DATA BASE CREATION / DATA ENTRY

TIME / STEPS TO SET UP
TIME TO DIGITIZE
ERROR DETECTION

SYSTEM/ DATA BASE MANAGEMENT

DATA BASE UPDATE PROCEDURES
QUERY CAPABILITY EASE & LIMITS
ATTRIBUTE LOADING & EDITING

ANALYSIS & MANIPULATION

TERRAIN MODELING SIMULATIONS

BOOLEAN OVERLAY ACCURACIES & TIME

EASE OF WRITING/ IMPLEMENTING MACROS

ACCURACY OF MEASUREMENTS

GENERATION OF BUFFER ZONES

ABILITY TO CONVEY RELATIONSHIPS BETWEEN FEATURES & ENTITIES

PROJECTION TRANSFORMATION ACCURACIES

UNIT CONVERSION ACCURACIES

GIS PROBLEM AREAS

USER INTERFACE

SKILL ACQUISITION TOO LENGTHY
OVER RELIANCE ON USER'S MEMORY
LIMITED SENSE OF LOCUS OF CONTROL
LACK OF FORGIVENESS IN OPERATIONS

SYSTEM/ DATA BASE MANAGEMENT

INTEGRITY OF DATA BASE NOT GUARDED
QUERY CAPABILITY LIMITED
ATTRIBUTE HANDLING INADEQUATE
LINKS BETWEEN GRAPHIC & ATTRIBUTES CUMBERSOME

DISPLAY & PRODUCT GENERATION

CARTOGRAPHIC CAPABILITIES CRUDE
LIMITED SUITE OF OUTPUT DEVICES

DATA BASE CREATION / DATA ENTRY

DATA BASE CREATION TOO TIME CONSUMING
EDITING PROCESS CUMBERSOME
DATA QUALITY CHECKS LIMITED

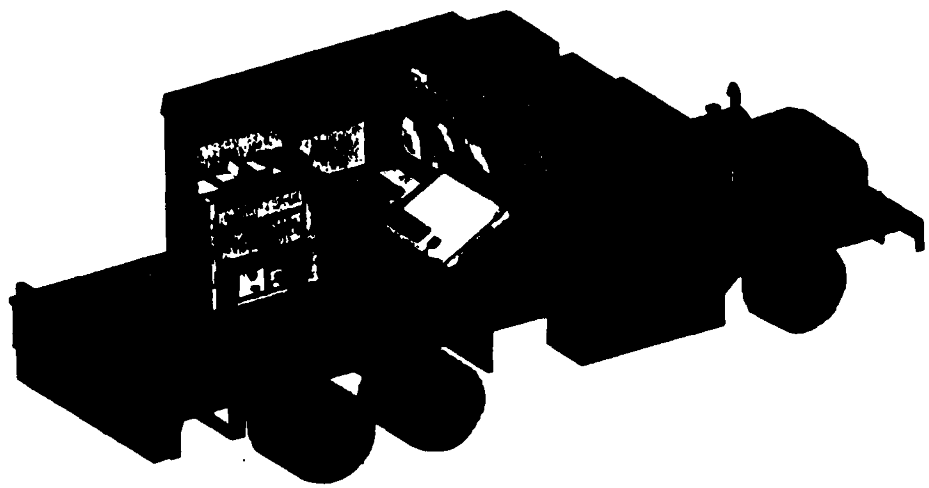
ANALYSIS & MANIPULATION

COMPLEX MODELS DIFFICULT TO IMPLEMENT
EXECUTION TIMES TOO LONG
INCONSISTENT RESULTS IN SPATIAL ANALYSIS FUNCTIONS

Digital Topographic Support System (DTSS)

DATA SOURCES

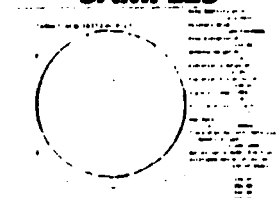
- DMA DATA
- CARTO PRODUCTS
- IMAGERY
- WEATHER
- CLIMATE
- SUPPORTING DATA



- GENERATES TERRAIN ANALYSIS PRODUCTS REGISTERED TO MAP DATA
  - Intervisibility Models
  - Mobility Models
  - Environmental Models
  - Special Purpose Models
- MAINTAINS TERRAIN DATA BASES
- UPDATES TERRAIN DATA BASES
- SUPPORTS BATTLEFIELD OPERATIONS AT EAC, CORPS, AND DIVISION

PRODUCT SAMPLES

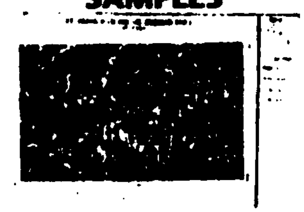
INTERVISIBILITY PRODUCT SAMPLES



TARGET ACQUISITION

MASKED AREA

MOBILITY PRODUCT SAMPLES



CROSS COUNTRY MOVEMENT

POTENTIAL HLZ

LORAL
Defense Systems–Akron

DIGITAL TOPOGRAPHIC SUPPORT SYSTEM

SOFTWARE

- MAN-MACHINE INTERFACE
  - Windows to software functions
  - Tailored for Terrain Analyst
  - Human Factored
- GEOGRAPHIC INFORMATION SYSTEM
  - ARC/INFO/TIN - ESRI
  - Data Manipulation
  - Data Base Creation, Revision, Update
  - Utilities - Input/Output, Display, Scale, etc.
- SYSTEM SUPERVISOR
  - Task Control
  - Resource Management
- APPLICATIONS SOFTWARE
  - Intervisibility
  - Mobility
- ENVIRONMENTAL MODELS
- SPECIAL PURPOSE PRODUCT BUILDER

DIGITAL TOPOGRAPHIC SUPPORT SYSTEM

SPECIAL PURPOSE PRODUCT BUILDER (SPPB)

1. AD HOC (SPECIAL) PRODUCT GENERATION
   - Airstrip Site Selection
   - Potential Bivouac Sites
   - Bridge Bypass Potential
   - Lines of Communication
   - River Crossing
   - Air Avenues of Approach
   - Others
2. SYMBOLIZATION/ATTRIBUTE MODELING/PROXIMITY ANALYSIS
3. COMBINATION PRODUCTS (STACKING)

FOREGROUND	BACKGROUND
Masked Area Plot	Cross Country Movement
Target Acquisition	Concealment
Flight Line Masking	Drop Zone
Path Loss/Line of Sight	Helicopter Landing Zone
SPPB	SPPB

SPPB 19May89

ALBE TECHNOLOGY DEMONSTRATIONS

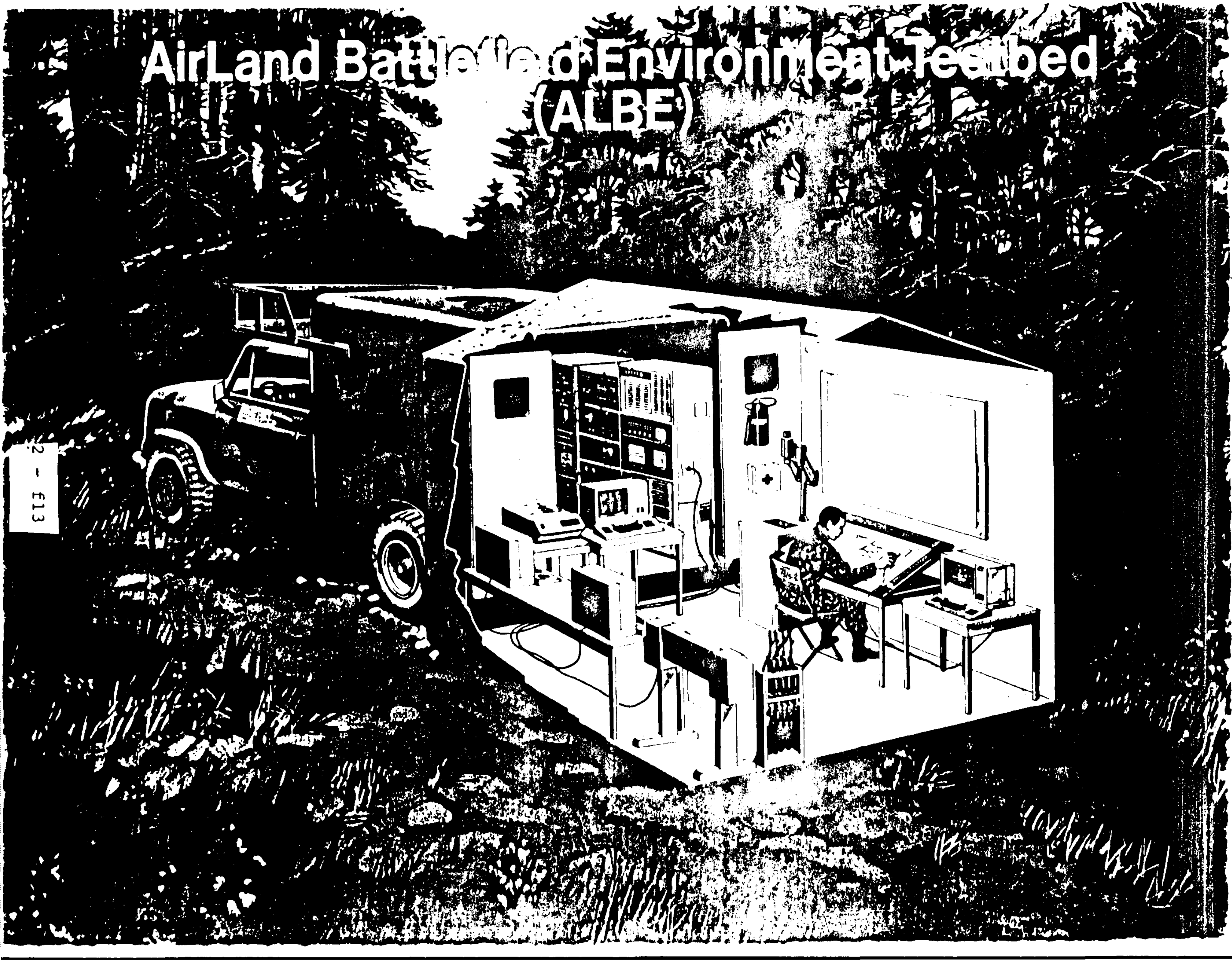
DESCRIPTION: Army Technology Demonstration Program
P.E. 0603734A, Project DT08

MANAGED BY: U.S. Army Corps of Engineers

EXECUTED BY: U.S. Army Engineer Topographic Laboratories

PARTICIPANTS: Atmospheric Sciences Laboratory (AMC/LABCOM)
Cold Regions Research and Engineering Laboratory
Engineer Topographic Laboratories
Waterways Experiment Station

ABRIEF01.DRW


AirLand Battlefield Environment Testbed
(ALBE)

ALBE GIS

GOALS	DESIGN DECISIONS
Provide required functions to TDA Programmers	Library of GIS subroutines callable from Fortran, C
Consistent user interaction and graphics standards across all ALBE components	Use of ALBE User Interface and Graphic (GKS) libraries throughout the GIS
Avoid tying up workstation during lengthy computations	Optional batch utilities for time-consuming GIS functions

AG

GOALS	DESIGN DECISIONS
Ability to query and retrieve data related to GIS objects from a DBMS	GIS "loosely coupled" to DBMS databases via a relation to associate GIS object IDs to DBMS record keys
Ability to create and operate user-defined GIS databases in self-contained mode (without a DBMS)	1) Optional storage of up to 63 GIS attributes per vector object in GIS data structures 2) Attribute dictionary to define and describe attributes

GOALS	DESIGN DECISION
Rapid response to most map query, manipulation, and display requests	Capacity to load and maintain large map data sets in internal data arrays
Ability to manipulate and display vector and cell data (incl. raster images) concurrently	Concurrent internal vector and cell data storage structures and logical overlay software
Ability to change level of display detail based on scale of display	Automatic map decluttering capability with user-selectable parameters

ALBE GIS INTERNAL DATA

CELL/RASTER

ONE ATTRIBUTE PER FILE

CELL OR RASTER (GRID) REPRESENTATION

DATA TYPES:
- DICHOTOMOUS
- DISCRETE CATEGORICAL
- DISCRETE ORDERED
- CONTINUOUS

STORED IN COORDINATES OF SPECIFIED MAP PROJECTION

VECTOR

OBJECT TYPES:
- LABEL POINT
- NODE
- ARC
- POLYGON
- COMPLEX OBJECT

INFORMATION CONTENT:
- SPATIAL
- TOPOLOGICAL
- GRAPHICAL
- DESCRIPTIVE

TACTAV.DRW 3APR89

ALBE GIS 2.0

* STATE-OF-THE-ART TECHNOLOGY
* HYBRID OF AMS, MOSS, MAPS, AND BATTELLE DIGCART FUNCTIONALITY
* CONCURRENT VECTOR AND CELL PROCESSING
* RELATIONAL DATABASE
* DYNAMIC DISPLAY OF SPATIAL DATA

DEFENSE MAPPING AGENCY

MARK SHELBERG
DEFENSE MAPPING AGENCY SYSTEMS CENTER
ST. LOUIS, MISSOURI

OPTICAL DISC INITIATIVE
PROJECT LEADER

(314) 263-4486

WHO IS THE DEFENSE MAPPING AGENCY

- Enhance national security and support our strategy of deterrence by producing and distributing to the Joint Chiefs of Staff, Unified and Specified Commands, Military Departments and other DoD users, timely and uniquely-tailored mapping, charting, and geodetic products, services, and training

- Insure our war-fighting forces have available to them effective mapping, charting, and geodetic support should our strategy of deterrence fail

- Provide nautical charts and marine navigational data to worldwide merchant marine and private vessel operators

- Employs nearly 9,000 people in more than 50 locations around the world

OPTICAL DISC GOALS

Assistant Secretary of Defense Latham's Guidance

- " ... develop a standard data specification in response to [Aircraft] Moving Map Display information requirements ..."
- " ... take the lead in establishing a DoD optical disc standard ..." for Mapping, Charting and Geodetic (MC&G) data
- " ... explore which additional MC&G information sets are appropriate for exchange via optical disc ..."

DIGITAL RASTER MAP DATA SPECIFICATION

ARC Digitized Raster Graphics (ADRG)

- 250 lines per inch (100 microns)
- 24 bits color (8 bits Red, Green, Blue)
- Data on Equal Arc-Second Raster Chart/Map (ARC) Projection System
- Status of Specification - Final Version: April 1989

OPTICAL DISC STANDARD

DMA'S Decision In Selecting CD-ROM Was Based On:

- Available standards
  Physical - ECMA and Yellow Book
  Logical - ISO 9660 (High Sierra)

- Non-proprietary technology

- Cost and availability of media and hardware

- Excellent mass distribution media

PROTOTYPE DEVELOPMENT

ADRG Production Prototype

- Contains:

    Disc#1 - JOG-As # NI 11-2,3,5,6 over China Lake

    Disc#2 - TLMs # 6446 I,II,III,IV over the Fort Hood area

    Disc#3 - TPC G-18B over China Lake

- Distribution Schedule

    Disc#1 - 31 October 1988

    Disc#2 - 15 November 1988

    Disc#3 - 14 April 1989

ADRG PRODUCTION PLANS

- FY 89 Production about 1800 map sheets
  (460 CD-ROMs)

- Post FY 89 Production about 1200 to 2000 sheets
  per year

- FY 89 Production areas:
  ONCs,TPCs and JOGs over the U.S.
  JOG-Gs and TLMs over Germany

- Planned FY 90 Production areas:
  Complete the ONCs and TPCs worldwide
  Limited JOGs and TLMs
  Maybe GNCs and JNCs

DIGITAL TERRAIN ELEVATION DATA (DTED) ON CD-ROM

- DTED consists of a uniform matrix of terrain elevation values spaced every 3 ARC seconds
- CD-ROM will contain DTED, Digital Mean Elevation Data (a more coarsely spaced elevation matrix) and a gazetter
- Two prototypes issued and evaluated
- Production implementation in process
- All DMA data on CD-ROM by middle of 1990

WORLD VECTOR SHORELINE

- Vector data base format
- Shoreline at 1:250,000
- Political boundaries from 1:1,000,000 chart source
- Prototype produced in May 1989

ADDITIONAL DIGITAL DATA ACTIVITIES

- Digital Feature Analysis Data (DFAD)
- Digital Chart of the World (1:1 million fully attributed vector data base
- Electronic Chart Update Manual
- Tactical Terrain Data

THE FUTURE

- DMA is committed to CD-ROMs for distribution of most if its digital product data
- CD-ROM is a good potential for other products eg. DMA catalogs and DMA product specifications
- DMA continues to track other media for use when appropriate such as WORM and erasable optical disks

CD-ROM IMPLEMENTATION STEPS

- Feasibility study
- System design
- Data requirements
- Product specification
- Data creation and preparation
- System simulation
- Premastering
- Mastering and replication
- Packaging, documentation, marketing and distribution

LESSONS LEARNED

- Use available standards
- If you are not an expert, get someone who is
- Know your users and their systems
- Develop a good data structure
- Use/Copy examples
- Generate prototypes, release data early on magnetic tape if possible
- The mastering/replication phase is the easiest except if your artwork is not on time or it is wrong

VENDORS & UNIVERSITY PRESENTATION MATERIALS

A. DBA

B. AUTOMETRICS

C. PURDUE UNIVERSITY

D. ESRI

DBA SYSTEMS, INC.

DBA GIS EXPERIENCE

GRASS GIS

AIRLAND BATTLE ENVIRONMENT/GIS

GEO-INTEL

GRASS GIS SUPPORT SERVICES

DBA GRASS WORKSTATION SUPPORT

- SUN 3, SUN 4, SUN386i
- TEKTRONIX 43xx
- TURNKEY SYSTEMS

SOFTWARE DISTRIBUTION

- INSTALLATION
- TRAINING

TECHNICAL SUPPORT

- GRASSNET CONNECTION
- TELEPHONE CONSULTATION
- CUSTOM ENHANCEMENTS

DATA BASE GENERATION

DATA INPUT - HARDCOPY TO RASTER

IMAGE SCANNING

DBA DESIGNS AND MANUFACTURES HIGH RESOLUTION IMAGE SCANNERS

- 20K CCD LINEAR ARRAY SENSORS
- RESOLUTION - 11 MICRONS AT 12 BITS/PIXEL
- ABILITY TO SCAN 20K X 20K IMAGE IN LESS THAN TWO MINUTES
- ACCOMODATES ROLL AND FLAT FILM - BARCODE SCANNER
- 9" X 9" FORMAT

DBA MANUFACTURES MEDIUM RESOLUTION IMAGE SCANNERS

- 5K SINGLE CCD CHIP LINEAR ARRAY
- 35 AND 70 MICRON RESOLUTION
- 7" X 17" AND 14" X 17" FORMATS

MAP SCANNING

DBA SCANS HARDCOPY MAPS AND IMAGERY AT VARIOUS SCALES AMD RESOLUTIONS

- 25 - 250 MICRONS
- COLOR COMPRESSION
- DATA WARPING

DATA BASE GENERATION

DATA INPUT - DIGITAL DATA PRODUCTS

DATA TRANSFORMATIONS

- DATA ENHANCEMENTS
- DATA INTEGRATION
- DATA COMPRESSION
- DATA FORMATTING

DATA CONVERSIONS

- RASTER TO VECTOR
- VECTOR TO RASTER

COORDINATE CONVERSIONS

HARDCOPY TO VECTOR COMPILATION

DATA BASE EXPLOITATION

IMAGE PROCESSING

- SENSOR MODELLING AND TRIANGULATION
- RECTIFICATION/ORTHORECTIFICATION
- AUTOMATED MOSAICKING
- RADIOMETRIC BALANCING

DATA BASE EXPLOITATION

IMAGE MANIPULATION
- DATA INCLUSION
- DATA EXCLUSION
- DATA EXTRACTION
  - TERRAIN DATA/MICRO RELIEF
  - HIGH RESOLUTION FEATURE DATA

DATA EDIT/ENHANCEMENT

APPLICATION SOFTWARE

DATA BASE MANAGEMENT

CAPABILITIES DEVELOPMENT OVERVIEW

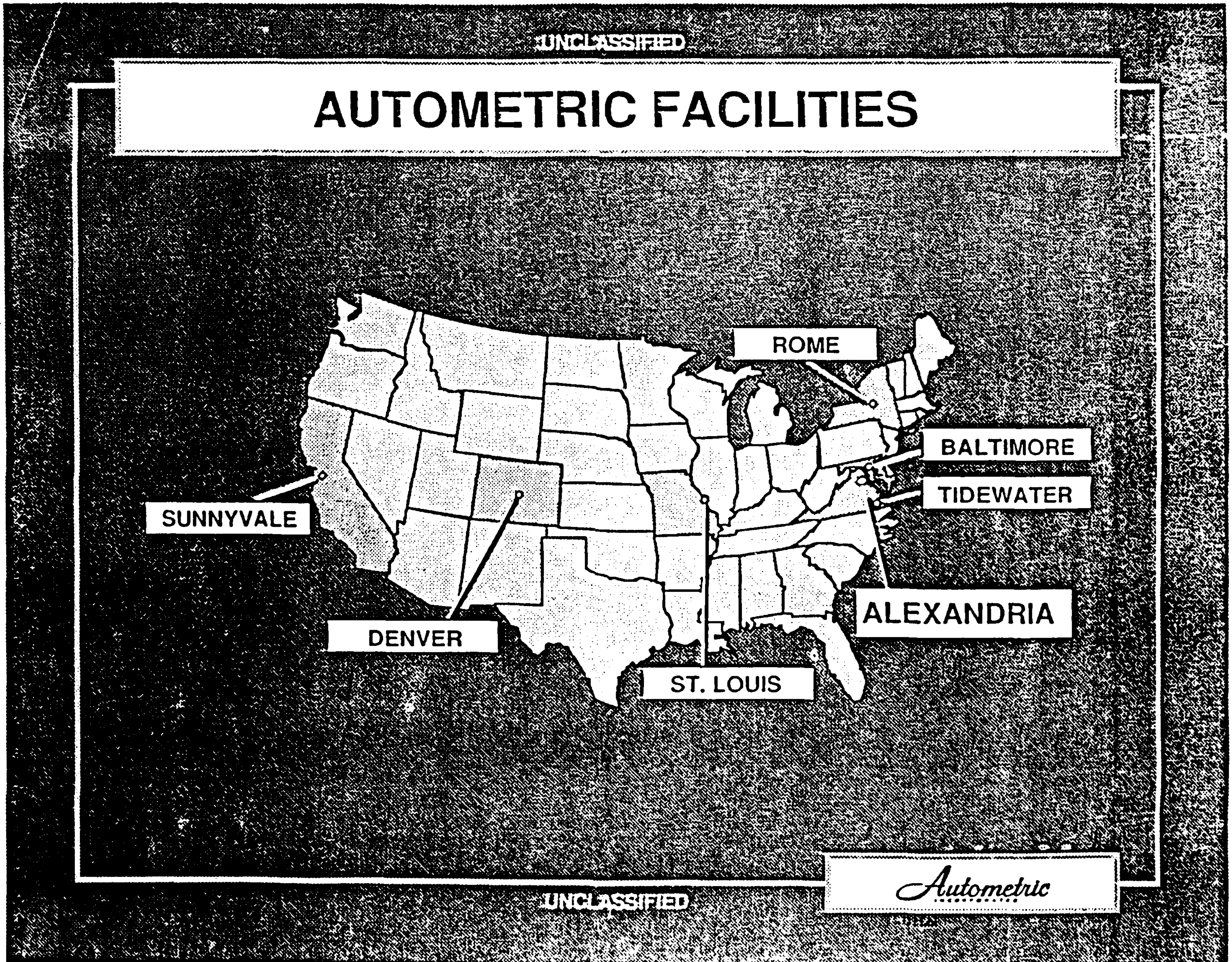
PRODUCTION	GEO-INTEL CAPABILITIES				
DATA INPUT	DATA INTEGRATION	DATA DERIVATION	MANAGEMENT/ MAINTENANCE	APPLICATIONS DEVELOPMENT	OUTPUT
Image Scanning	Common Data Base	Micro Relief	Basic Functions	Geopositioning	Software
Map Scanning	Tiling	High Res Features	Temporal Mgmt	Perspective Scene	Workstations
Raster to Vector	Warping	Images as Maps		Real Time	Media
Color Separation	Data Fusion	Rectification		Cultural	CD ROM
Laser-Scan Functions	Overlays	Orthophotos		Sensor Prediction	Video
Feature Attributing	Inclusion	Tactical Rect.		Tailored Output	Hardcopy
New Sources	Exclusion	AI Techniques		Functional Use	
Multi-Spectral	GIS Functions			AI Techniques	
SAR	AI Techniques				

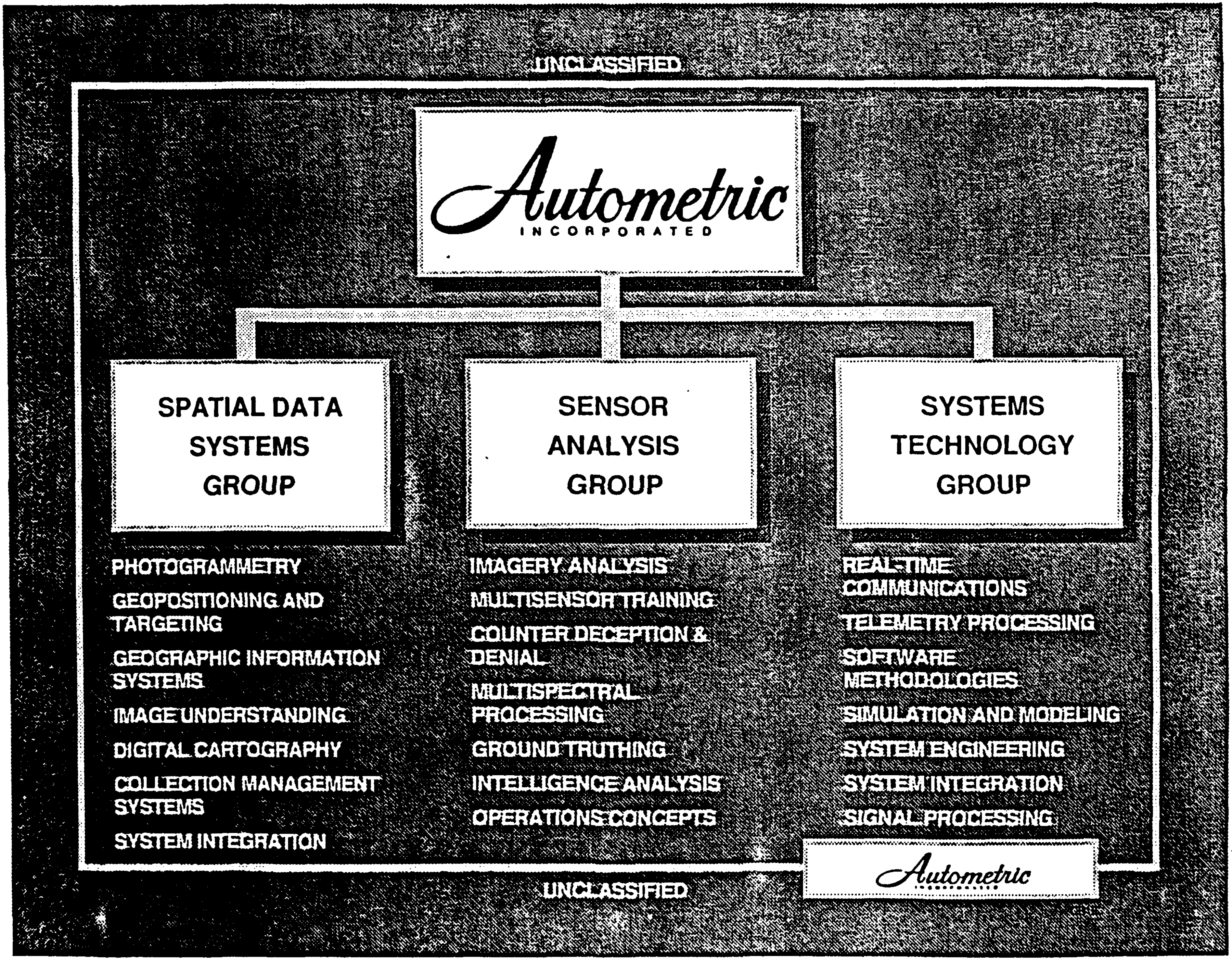
Autometric
INCORPORATED

Bruce W. Morse, Ph.D.
Principal Scientist
Director Western Operations

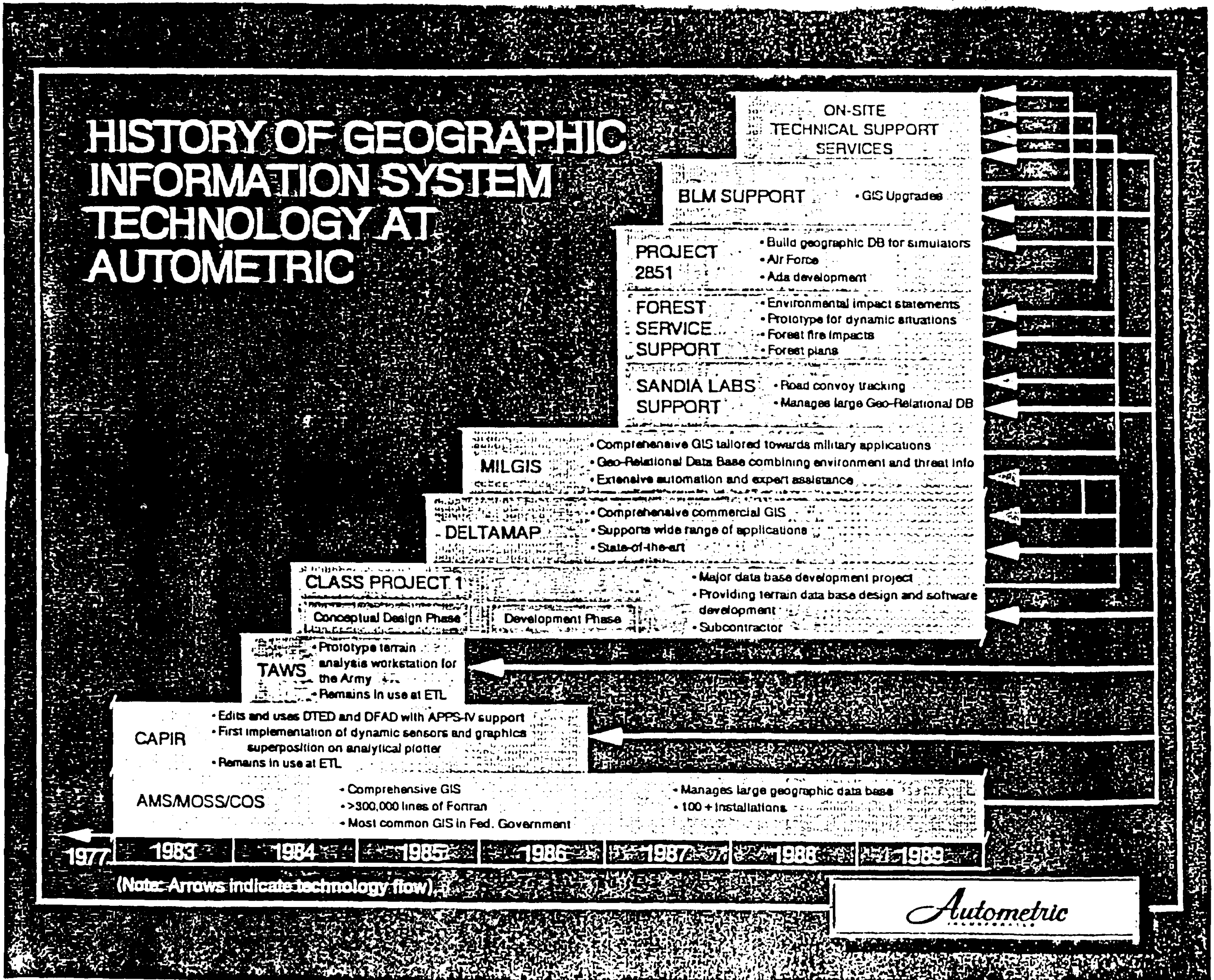
CORPORATE
5301 Shawnee Road
Alexandria, Virginia 22312-2312
703-658-4000

Western Operations Office
165 So. Union Blvd.
Suite 902
Lakewood, Colorado 80228-2214
(303) 989-6377


UNCLASSIFIED
AUTOMETRIC FACILITIES
ROME
BALTIMORE
TIDEWATER
SUNNYVALE
ALEXANDRIA
DENVER
ST. LOUIS
Autometric
UNCLASSIFIED


UNCLASSIFIED
Autometric
INCORPORATED
SPATIAL DATA SYSTEMS GROUP
SENSOR ANALYSIS GROUP
SYSTEMS TECHNOLOGY GROUP
PHOTOGRAMMETRY
GEOPOSITIONING AND TARGETING
GEOGRAPHIC INFORMATION SYSTEMS
IMAGE UNDERSTANDING
DIGITAL CARTOGRAPHY
COLLECTION MANAGEMENT SYSTEMS
SYSTEM INTEGRATION
IMAGERY ANALYSIS
MULTISENSOR TRAINING
COUNTER DECEPTION & DENIAL
MULTISPECTRAL PROCESSING
GROUND TRUTHING
INTELLIGENCE ANALYSIS
OPERATIONS CONCEPTS
REAL-TIME COMMUNICATIONS
TELEMETRY PROCESSING
SOFTWARE METHODOLOGIES
SIMULATION AND MODELING
SYSTEM ENGINEERING
SYSTEM INTEGRATION
SIGNAL PROCESSING
Autometric
UNCLASSIFIED

.019


HISTORY OF GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY AT AUTOMETRIC
ON-SITE TECHNICAL SUPPORT SERVICES
BLM SUPPORT
• GIS Upgrades
PROJECT 2851
• Build geographic DB for simulators
• Air Force
• Ada development
FOREST SERVICE SUPPORT
• Environmental impact statements
• Prototype for dynamic situations
• Forest fire impacts
• Forest plans
SANDIA LABS SUPPORT
• Road convoy tracking
• Manages large Geo-Relational DB
MILGIS
• Comprehensive GIS tailored towards military applications
• Geo-Relational Data Base combining environment and threat info
• Extensive automation and expert assistance
DELTAMAP
• Comprehensive commercial GIS
• Supports wide range of applications
• State-of-the-art
CLASS PROJECT 1
Conceptual Design Phase
Development Phase
• Major data base development project
• Providing terrain data base design and software development
• Subcontractor
TAWS
• Prototype terrain analysis workstation for the Army
• Remains in use at ETL
CAPIR
• Edits and uses DTED and DFAD with APPS-IV support
• First implementation of dynamic sensors and graphics superposition on analytical plotter
• Remains in use at ETL
AMS/MOSS/COS
• Comprehensive GIS
• >300,000 lines of Fortran
• Most common GIS in Fed. Government
• Manages large geographic data base
• 100 + Installations
1977
1983
1984
1985
1986
1987
1988
1989
(Note: Arrows indicate technology flow)
Autometric

MOSS Family

- **MOSS** (Map overlay Statistical System)-point, line, polygon analysis
- **MAPS** (Map Analysis and Processing System)-cell/raster analysis
- **AMS** (Analytical Mapping System)-data entry and edit
- **COS** (Cartographic Output System)-automated hardcopy output
- **UTILITY**-Misc. Utility Programs
- **REFORM**-Data Reformatting Programs

Autometric INCORPORATED

MOS19

Federal Agencies Using MOSS

- U.S. Forest Service
- Los Alamos and Sandia National Laboratories
- Bureau of Land Management
- U.S. Fish and Wildlife Service
- U.S. Corps of Army Engineers
- National Park Service
- Soil Conservation Service
- Bureau of Indian Affairs
- U.S. Geological Survey

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MOS17

Milestones in the Evolution of MOSS

- 1976 - AMS developed as first arc/node data entry system
- 1977-8 - Initial development of MOSS
- 1979 - AMS and MOSS used in production environment
- 1980 - Integration of AMS and MOSS
- 1982 - Integration of MOSS and MAPS
- 1983 - First MOSS User's Conference
- 1986 - DOI hardware procurement for MOSS
- 1988 - Fortran 77 version of MOSS
- 1989 - 32-bit version of MOSS

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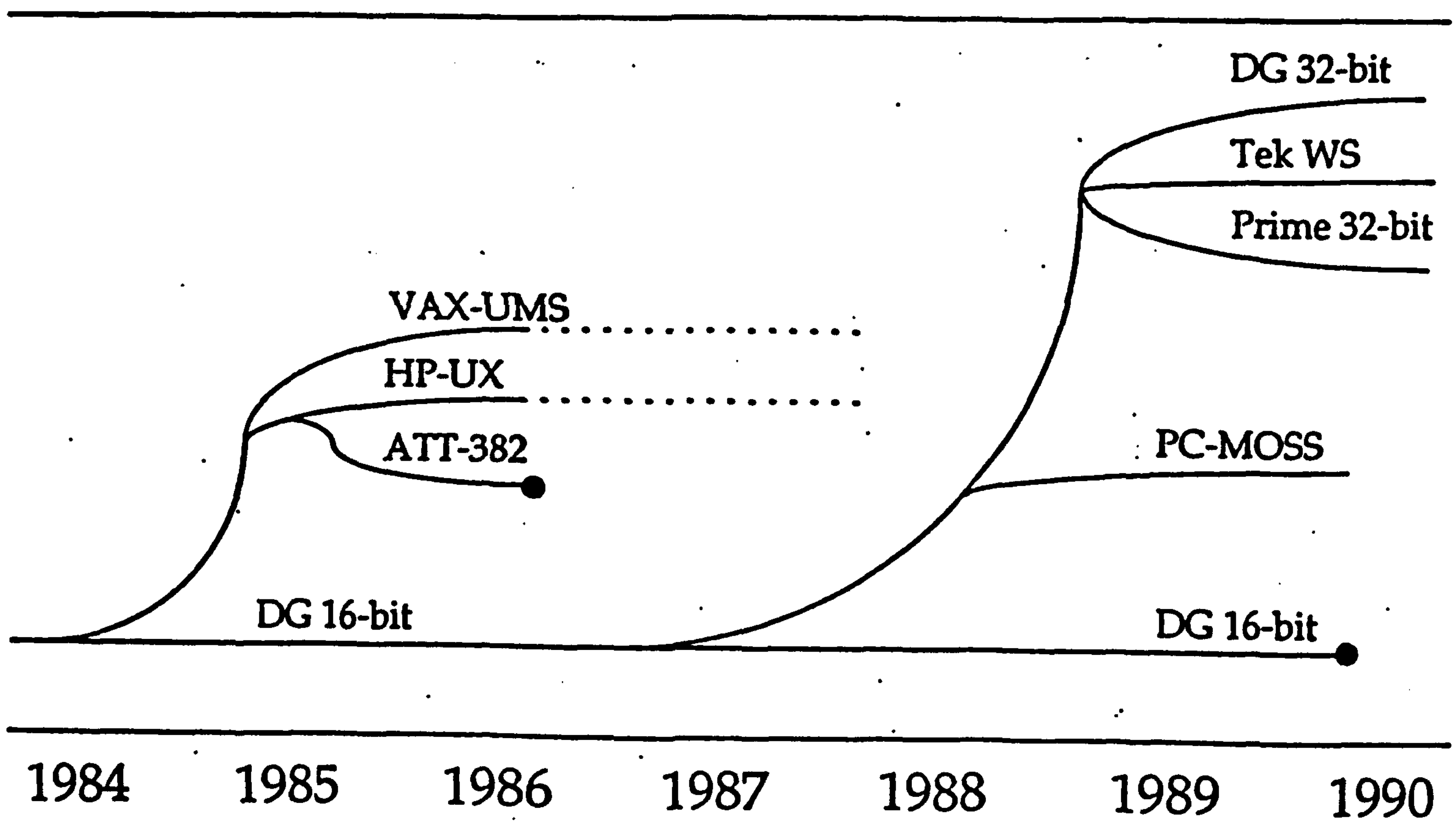
MOS24

The Evolution of MOSS



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MOS23

Significant Features of the Spring 1989 MOSS/MAPS Release

- FORTRAN 77
- Virtual Memory
- Consistency
- Reliability
- Primatives
- Color
- Precision

- Data Conversion
- Map Files
- Directory Structure
- Projection
- Active maps
- System Parameters
- Raster MOSS

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MOS15

DATABASE RETRIEVAL

- SELECT ENTIRE MAP
- SELECT SINGLE FEATURE
- SELECT FEATURES WITH CERTAIN SUBJECT AND ATTRIBUTE CODES
- APPLY BOOLEAN LOGIC INVOLVING MULTIPLE ATTRIBUTES
- RETRIEVE BY SIZE OR LENGTH CRITERIA
- RETRIEVE SEVERAL MAPS
- SELECT FEATURES IN A GIVEN AREA
- SELECT BASED ON A PROXIMITY OR CONTIGUITY
- RANDOMLY SELECT FEATURES

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COL03

MULTIPLE ATTRIBUTE ANALYSIS

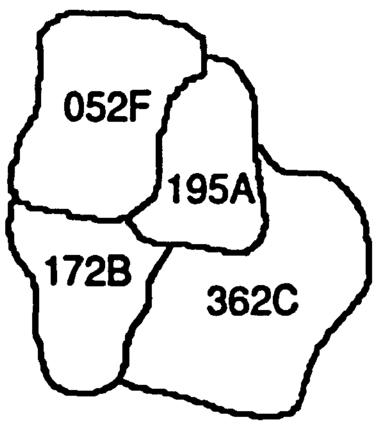
- GENERIC INTERFACE TO FLAT FILE
- SPECIFIC INTERFACE TO SQL DATABASE
- CREATE AND EDIT ATTRIBUTES
- SUMMARY REPORTS TO SCREEN OR FILE
- "SPREADSHEET" FUNCTIONALITY
- GRAPHIC QUERY
- RETRIEVE USING MAP AND ATTRIBUTE DATA

Autometric

COL02

MOSS Multiple Attributes

MOSS Map



Multiple Attribute File

Subject	Area	Tree Type	SI	Planted
052F	320	DF	55	1947
195A	295	PP	90	1938
172B	332	DF	70	1968
362C	390	LP	65	1972

Autometric Incorporated

MOS20

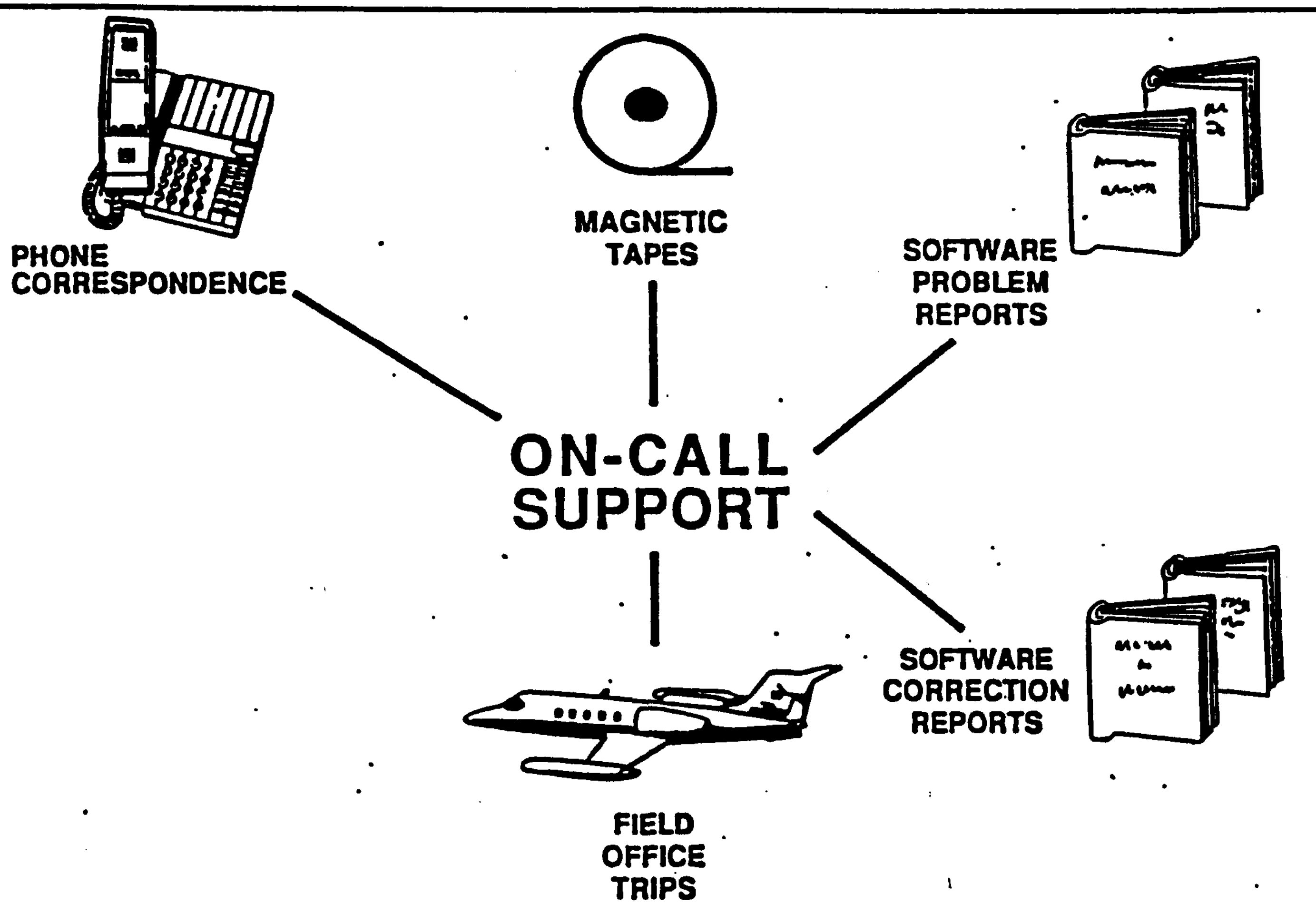
ELEVATION (X, Y, Z) ANALYSIS

- IMPORT DEM DATA
- CONVERT CONTOUR LINES TO DEM
- CONVERT VECTOR MAPS TO CELL MAPS
- POINT-TO-GRID INTERPOLATION
- CREATE CONTOUR LINES
- AUTOMATICALLY LABEL LINES
- DISPLAY CROSS-SECTION OR PROFILE
- CALCULATE SLOPE, SLOPE LENGTH, ASPECT
- DETERMINE VISIBILITY
- DISPLAY A 3-D PERSPECTIVE

Autometric

COL04

Autometric Software Subscription Service



SP139-25

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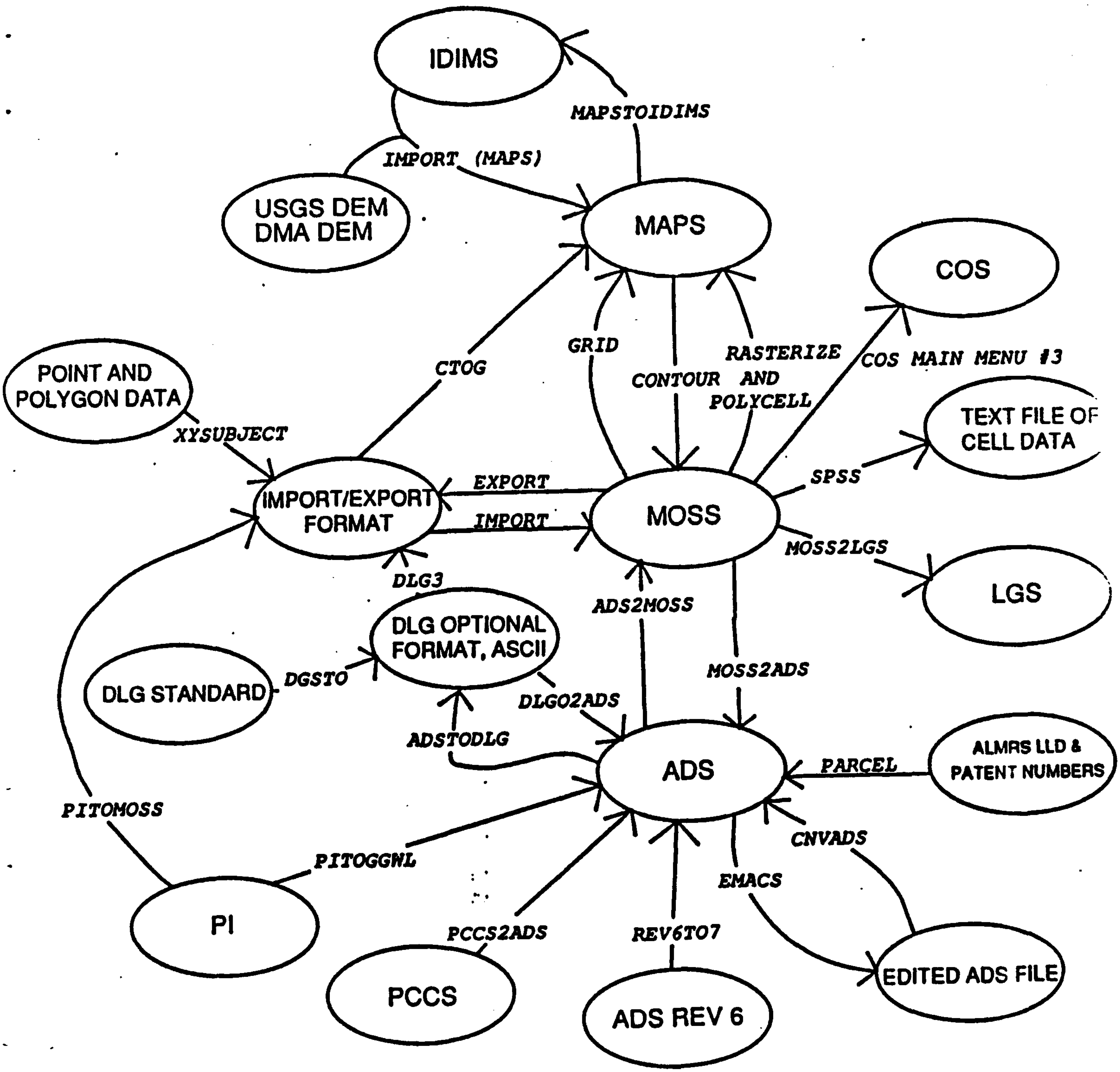
MOSS and MAPS System Interfaces



Evaluating Groundwater Pollution Potential Using Geographical Information Systems

by

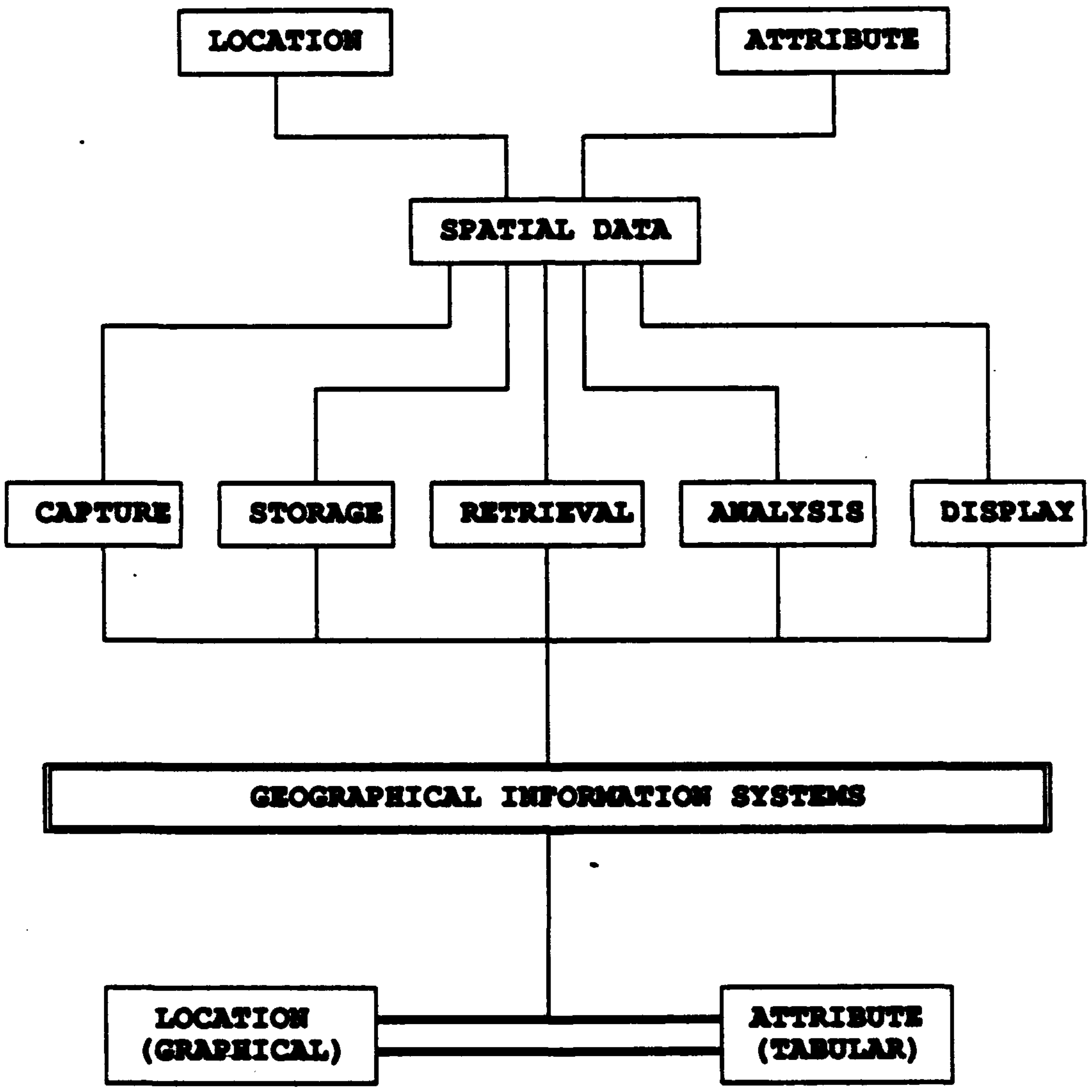
Douglas D. Hickey

School of Civil Engineering
Purdue University
West Lafayette, Indiana

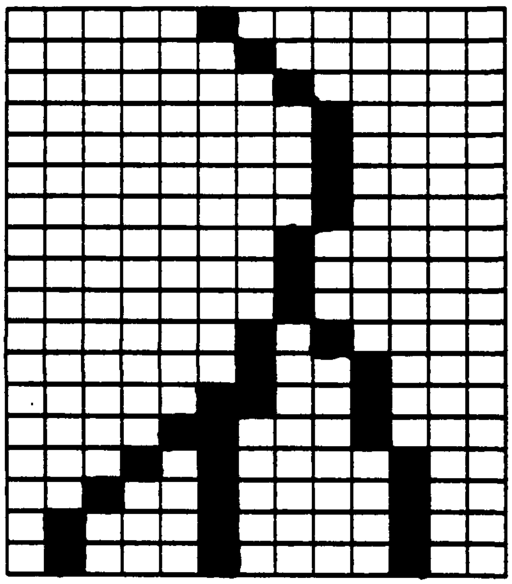
Outline

- ☐ Overview of GIS (GRASS)
- ☐ Groundwater Applications of GIS
- ☐ Pollution Potential Mapping (DRASTIC)
- ☐ Model Integration and Results

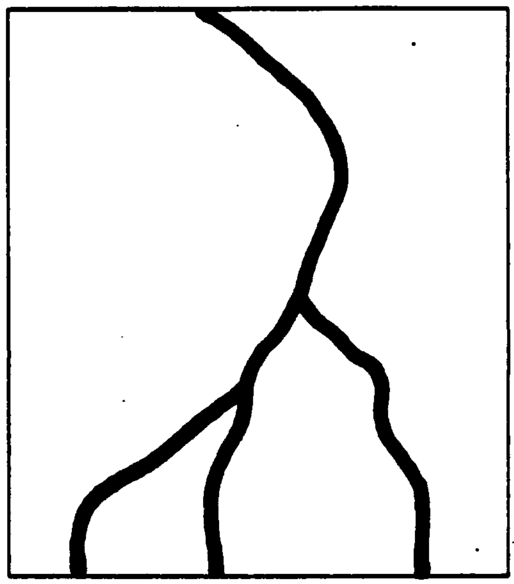
Definition of GIS



Data Representation
(Raster vs. Vector)



RASTER FORMAT



VECTOR FORMAT

Map Overlays in a Grid-cell GIS:

Each layer contains data for one attribute of interest

Common Spatial Analysis Capabilities of GIS

OPERATION	DESCRIPTION
Arithmetic	Add, subtract, multiply, and divide existing map layers
Boolean combinations	Combine groups of attributes from different map layers to form a new map
Weighting	Assign weights to attributes of several map layers, thereby signifying relative importance
Coincident tabulation	Chart the mutual occurrences of attributes between two map layers
Neighborhood	Enhance or subdue an attribute value by considering surrounding values
Distance proximity	Produce a map layer based on distance from an attribute of an existing map
Clumping	Group physically discrete areas into a unique attribute value
Surfacing	Fit a smooth surface by interpolating between known values
Morphologic operations	Determine characteristics of a given area's shape or form
Slope	Generate a slope layer from elevation data
Aspect	Generate an aspect layer from elevation data

The Geographical Resources Analysis Support System
GRASS

1. Grid-Cell Data Analysis
    a. Coincident tabulations
    b. Map overlay tool
    c. Weighted map overlay tool
    d. Neighborhood operations tool
    e. Distances analysis tool
2. Graphical Analysis
    a. Monitor display routines
    b. Hard-copy production routines
    c. Three dimensional display routines
    d. Image enhancement routines (his)
3. Map Generation
    a. Area masking features
    b. Regrouping features
    c. Reclassification features
4. Sites Analysis
    a. Site location tools
    b. Site DBMS tools
5. Map information management
    a. Report preparation utilities
    b. Mapset query utilities

Data Layer Reclassification

DEPTH TO WATER DATA LAYER

RECLASS

Original layer	
category	attribute
0	no data
1	1 feet
2	2
•	•
•	•
499	499
500	500

Reclassed layer	
category	attribute
0	no data
1	100+ feet
2	75-100
3	50-75
5	30-50
7	15-30
9	5-15

Goals of GIS in Groundwater Engineering

- To provide a comprehensive database of necessary environmental information
- To provide a means for easily updating time-dependent information
- To provide decision support that would otherwise be infeasible or unavailable
- To obtain a conceptual understanding of the groundwater system and the spatial relationships associated with it
- To improve interagency and/or interdepartmental cooperation in the capture, storage, and use of digital geographic data
- To provide a means for producing publication quality illustrations for reports and presentations that can be understood by decision makers

Applications of GIS in Groundwater Engineering

Protection Planning

- Water Quality Classification
- Water Quality Monitoring
- Pollution Potential Mapping
- Relationships Between Quality and Public Health
- Identification of Well Capture Zones
- Identification of Recharge Zones
- Land Use Control

Groundwater Management

- Resource Identification
- Public Well Site Selection
- Water Use Monitoring
- Input and Output for Flow Models
- Remedial Investigations and Feasibility Studies
- Evaluate Impacts of Contamination Incidents
- Quantity Assessment
- Aid in Landfill Site Selection

Empirical Assessment Methodologies.

Method	Primary Use	Reference #
EPA	monitoring priorization	12,32
Decision tree	waste site selection aid	32
Criteria list	waste site selection aid	32
Water balance	landfill assessment	32
LeGrand	waste site assessment	32
Hagerty	hazardous waste assessment	32
Phillips	waste-soil-site combination	32
DRASTIC	regional protection aid	1
Canter	oil and gas field activities	12
G.O.D.	rapid regional assessment	18
LeGrand	waste site evaluation	28
Stack maps	regional or site assessment	26

DRASTIC

A Standardized System for Evaluating Groundwater Pollution Potential

Function:

$$D_rD_w + R_rR_w + A_rA_w + S_rS_w + T_rT_w + I_rI_w + C_rC_w = INDEX$$

Where:

r = *Rating*

w = *Weight*

D = *Depth to Water*

R = *Net Recharge*

A = *Aquifer Media*

S = *Soil Media*

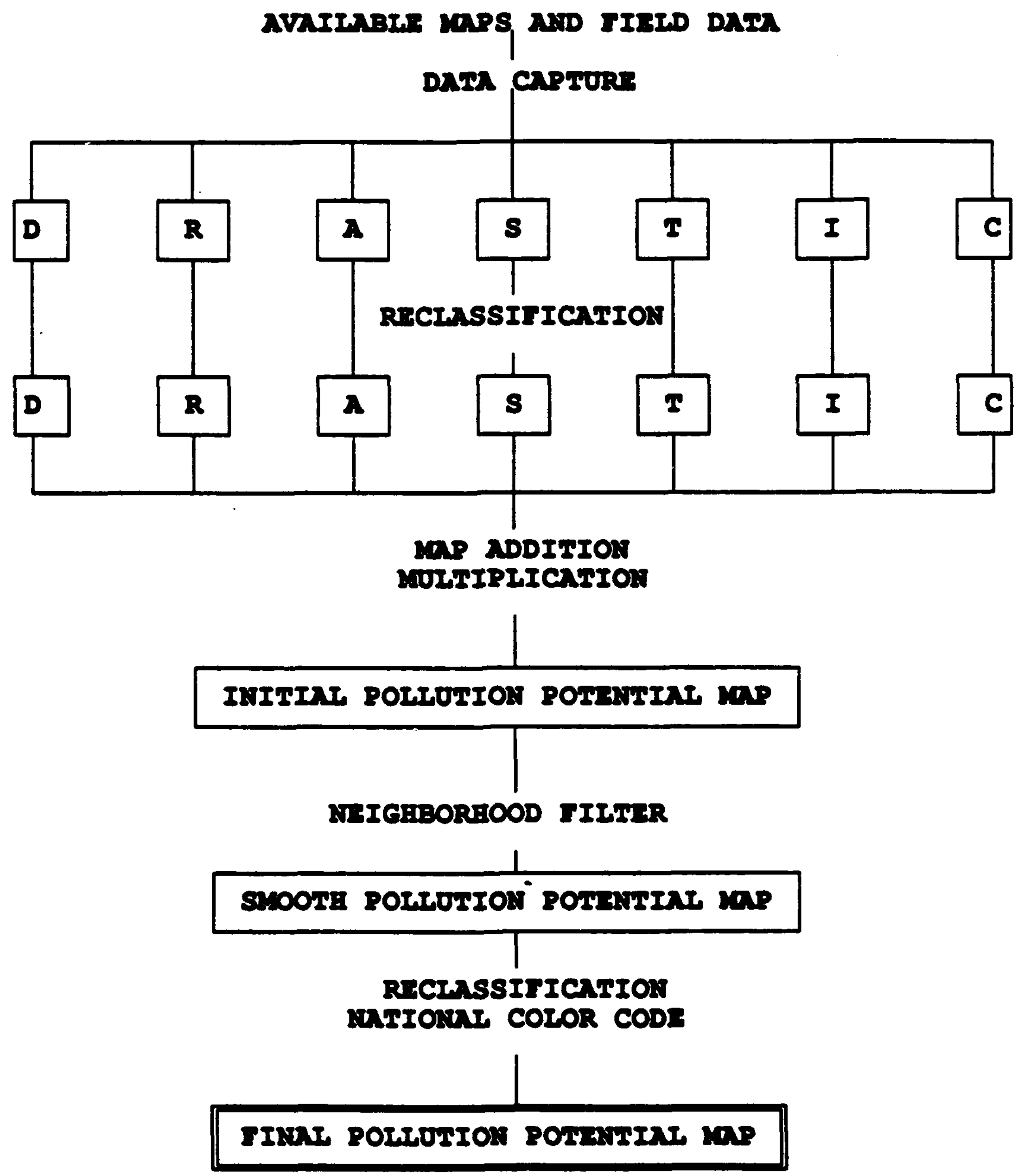
T = *Topography (Slope)*

I = *Impact of the Vadose Zone*

C = *Hydraulic Conductivity*

INDEX = *Pollution Potential Index*

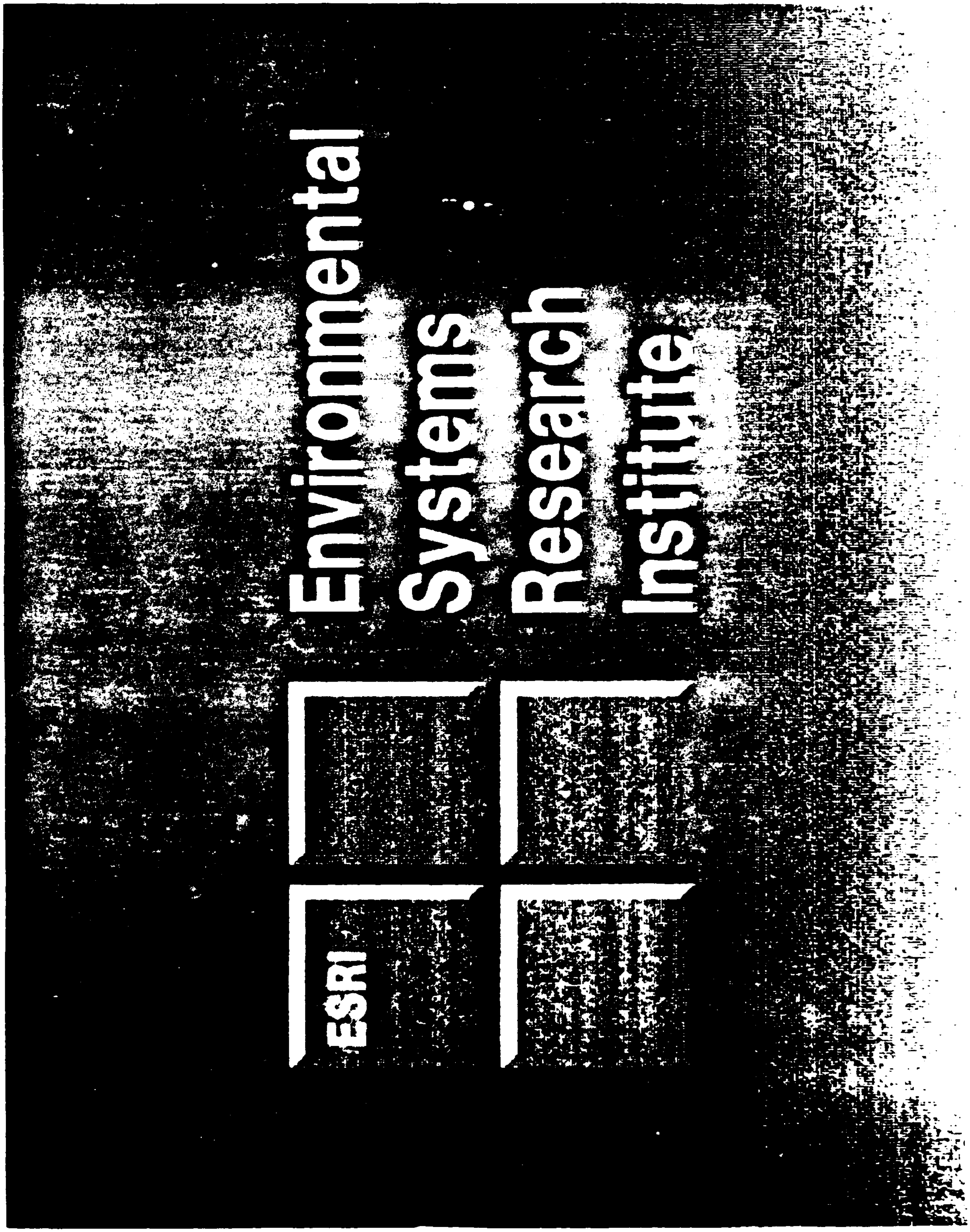
Developing DRASTIC Maps in a GIS Format

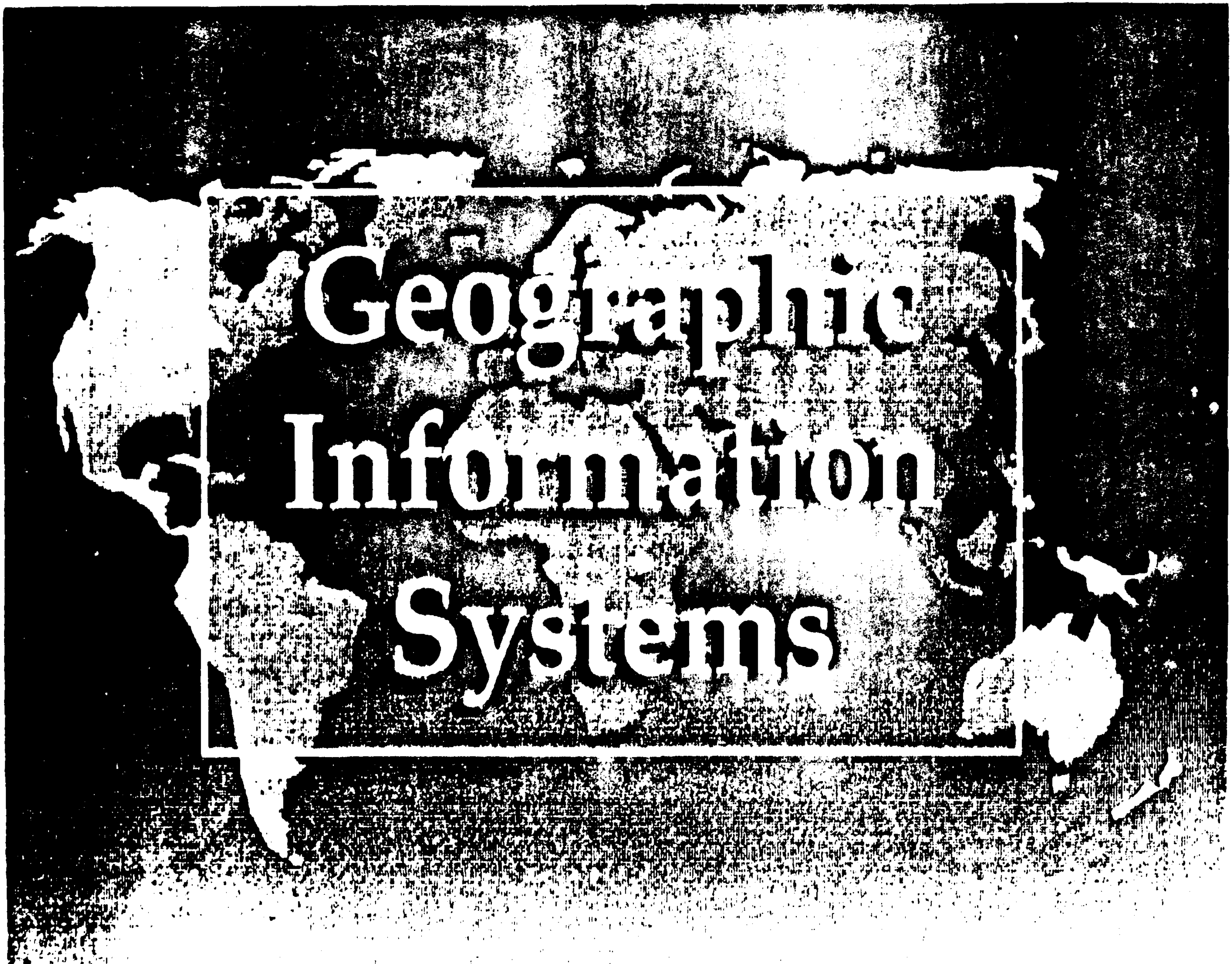


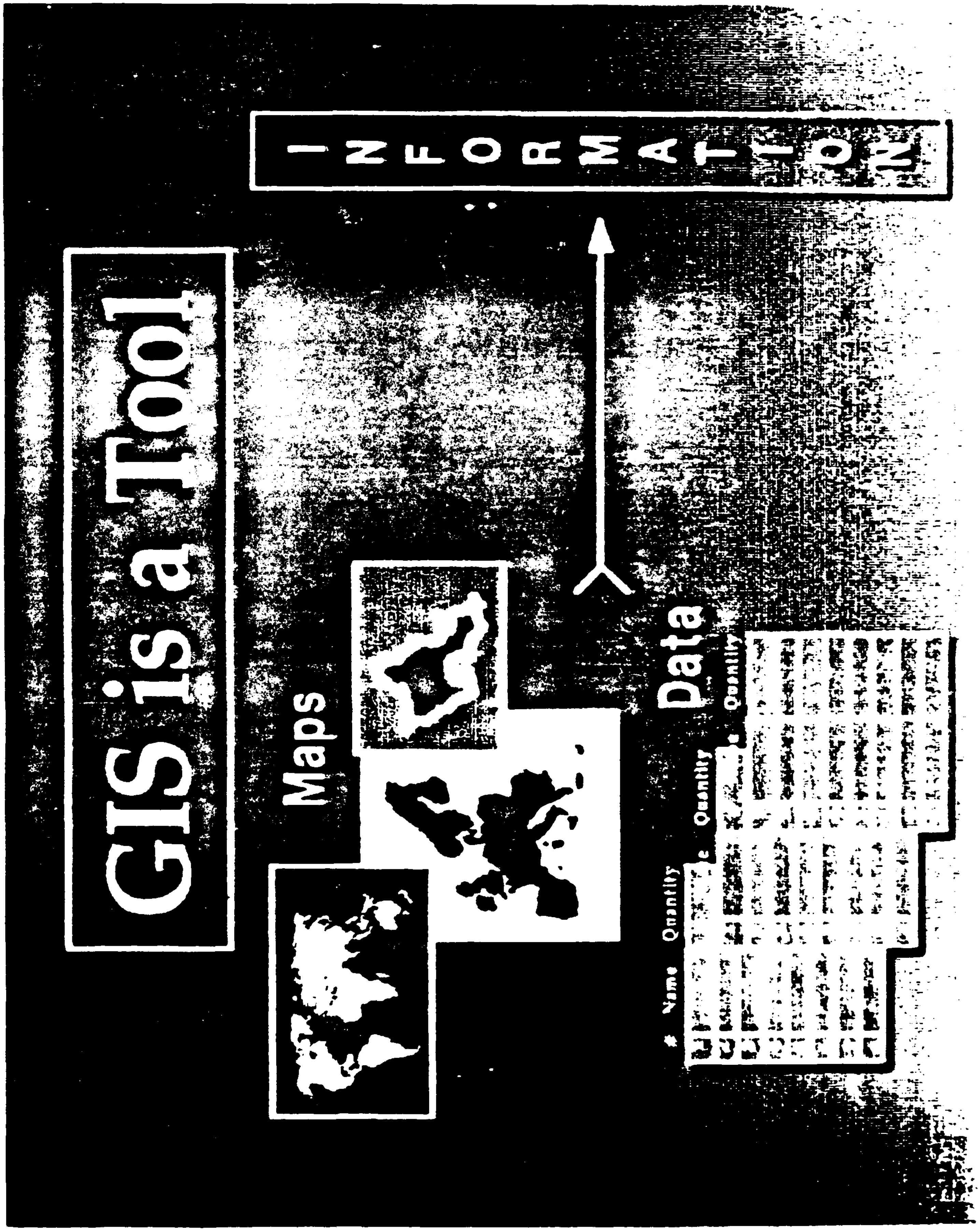
Geographic Information Technology: Software and Hardware Strategies

Jack McCarthy, ESRI

A presentation on a state-of-the-art geographic database model designed for open architecture and industry standard hardware platforms. Presentation to include discussion of the distributed computing environment, open database architecture, a user interface/application approach, and integration to other related geographic technologies.

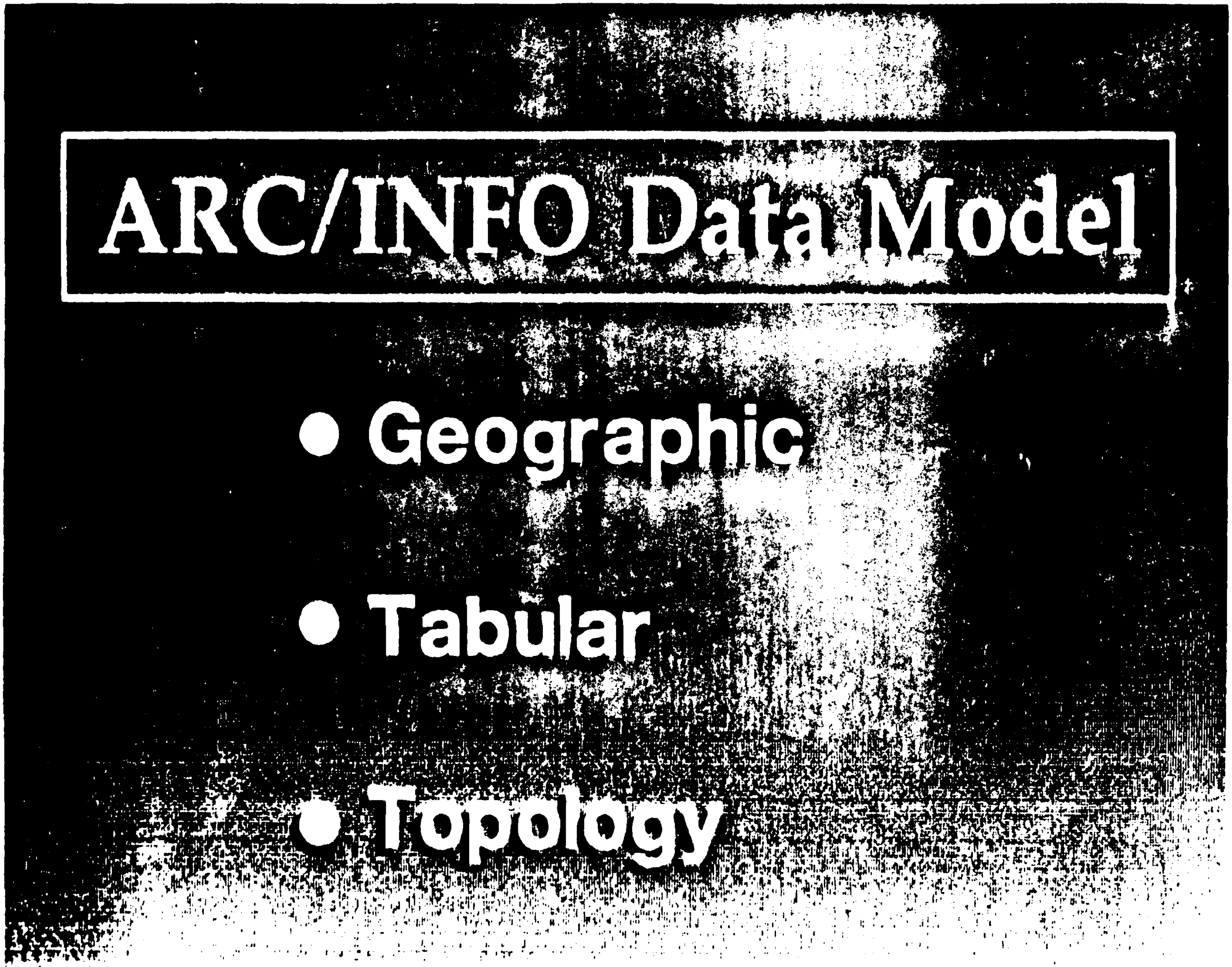

ESRI
Environmental
Systems
Research
Institute

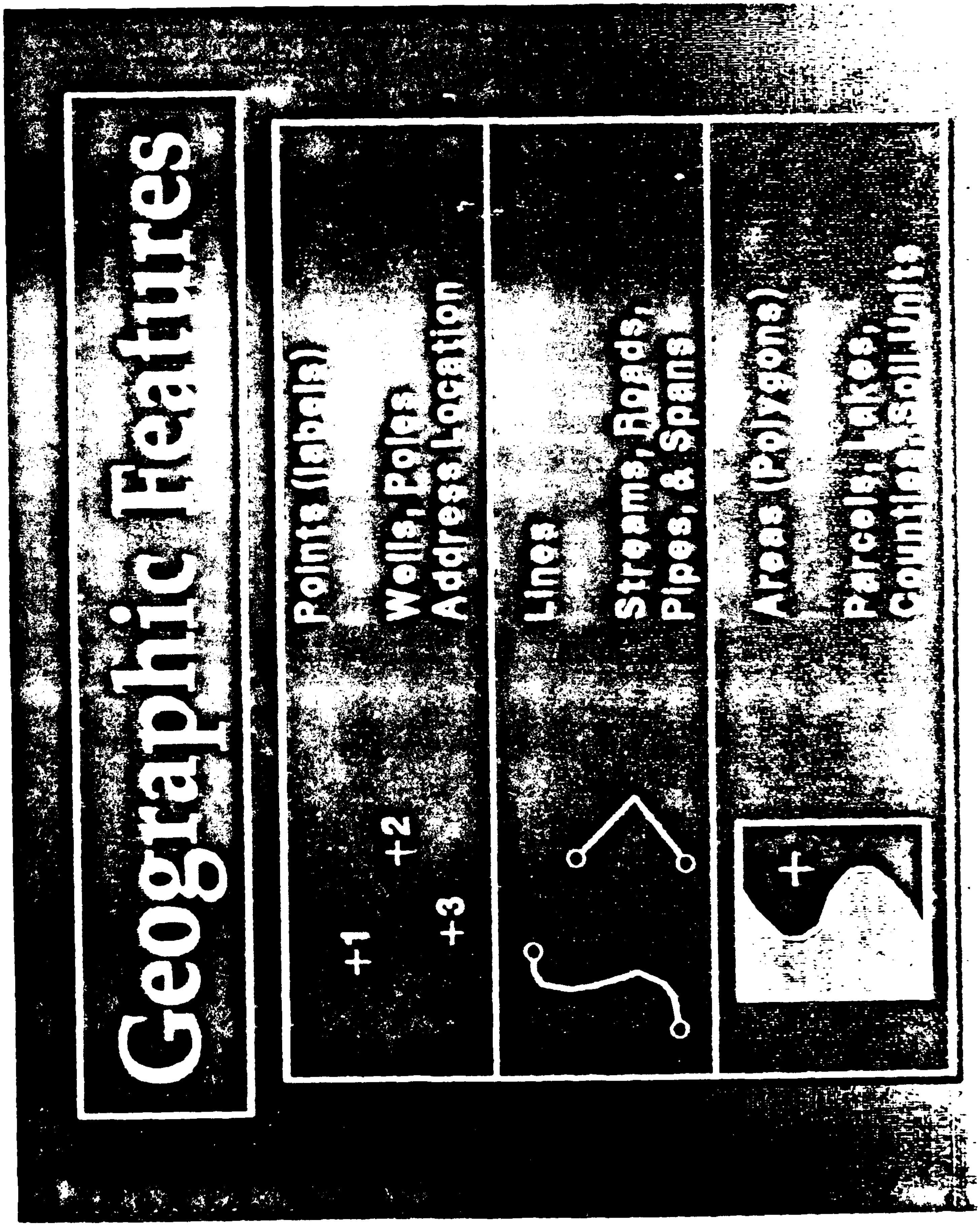

Geographic
Information
Systems


GIS is a Tool
Maps
Data
INFORMATION
Name
Quantity

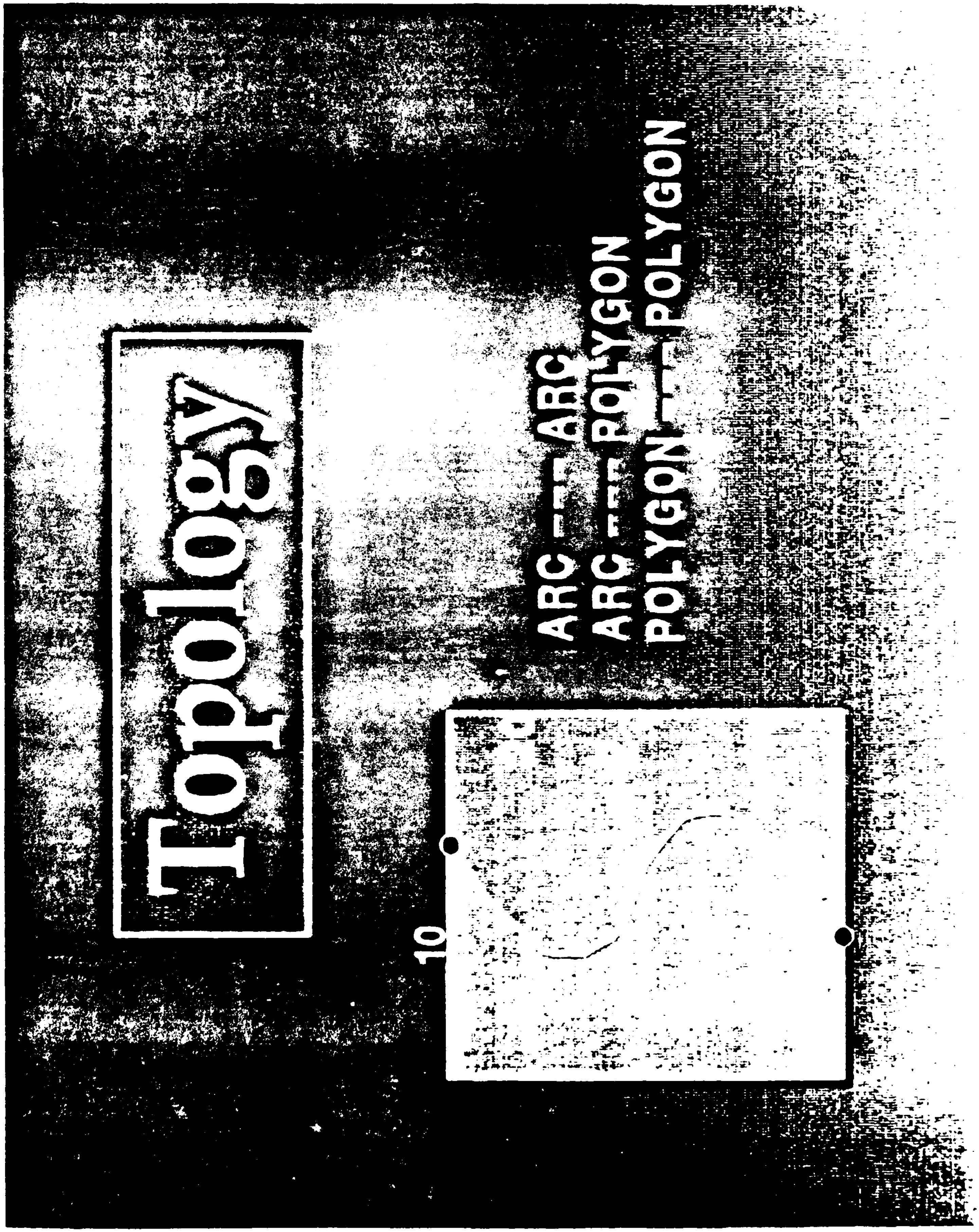
GIS Characteristics

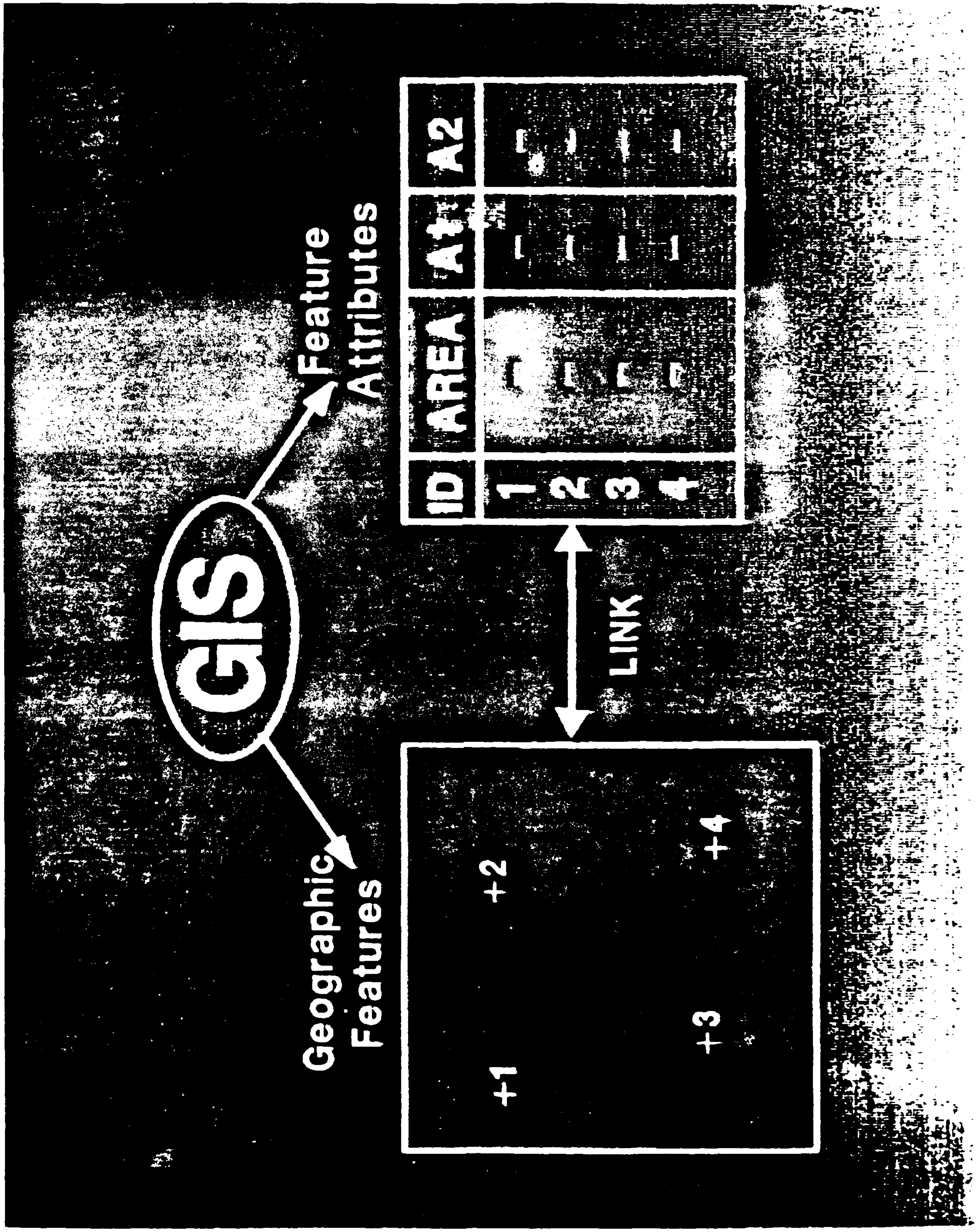
- Geographic & Tabular Data
- Integrated & Shared Data
- Limited Redundancy
- Transactional Updates
- Analysis
- Maps, Reports & Queries

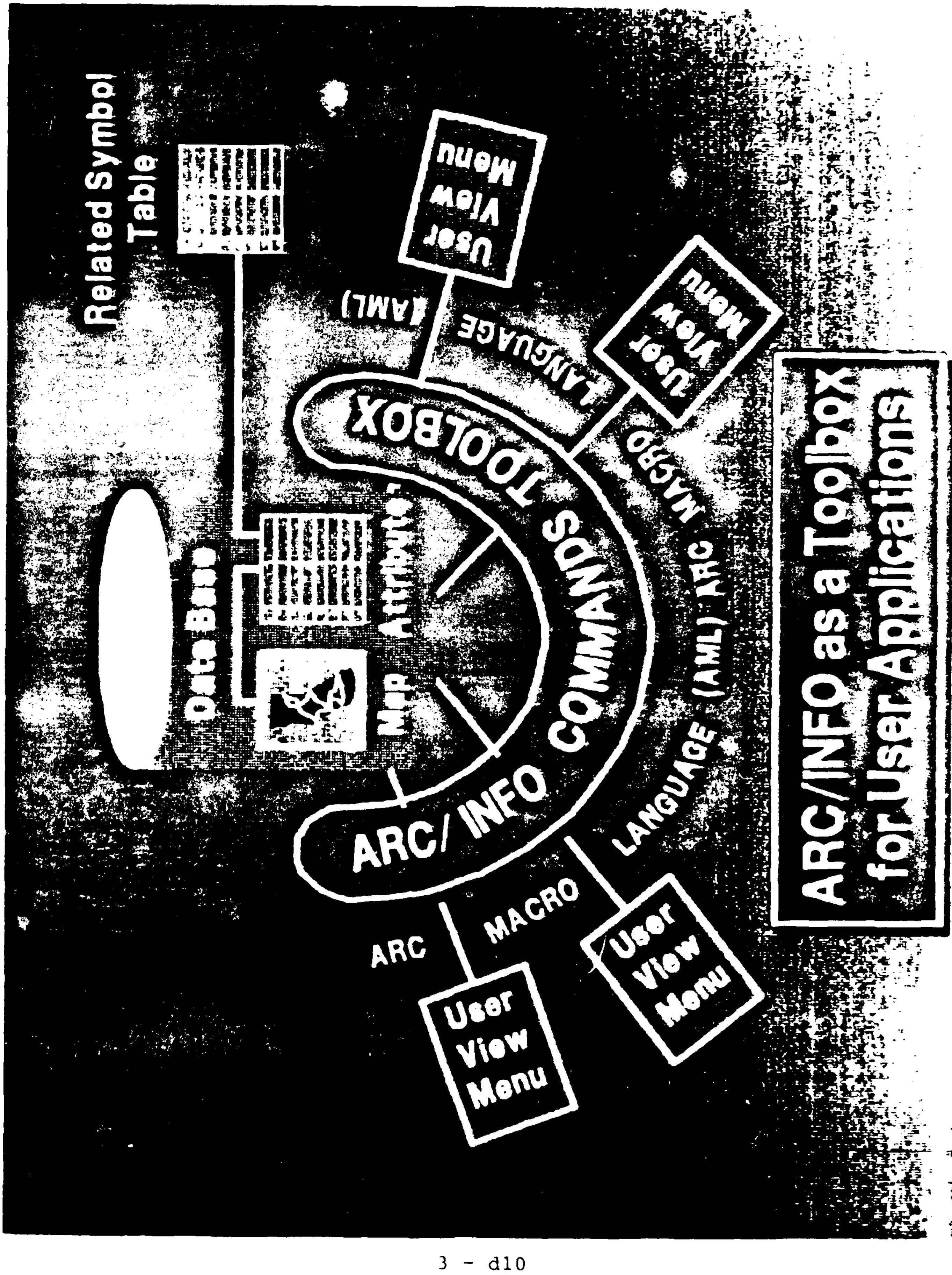

ARC/INFO Data Model
• Geographic
• Tabular
• Topology

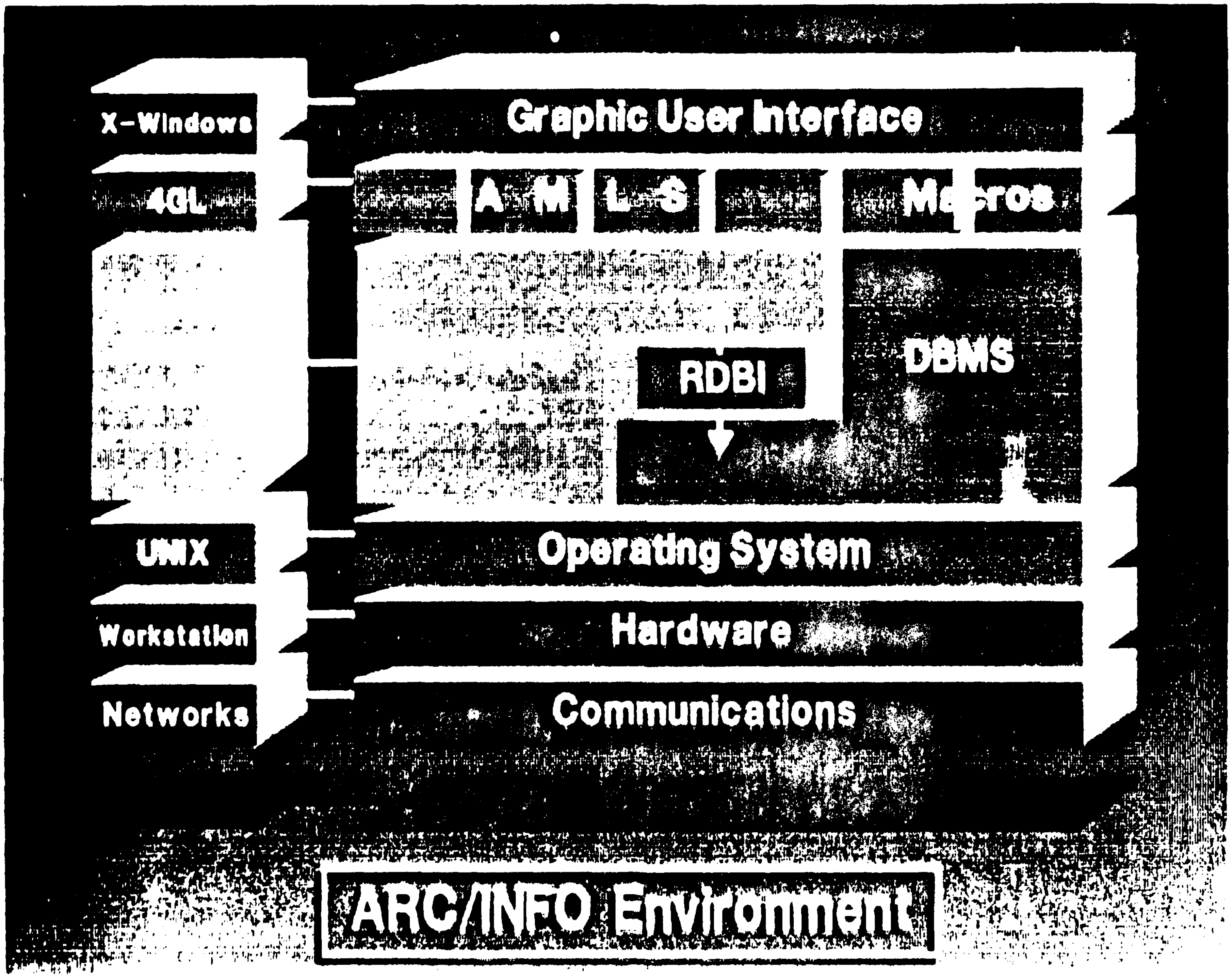

Geographic Features
Points (labels)
+1
+2
+3
Wells, Poles
Address Location
Lines
Streams, Roads,
Pipes, & Spans
Areas (Polygons)
Parcels, Lakes,
Counties, Soil Units

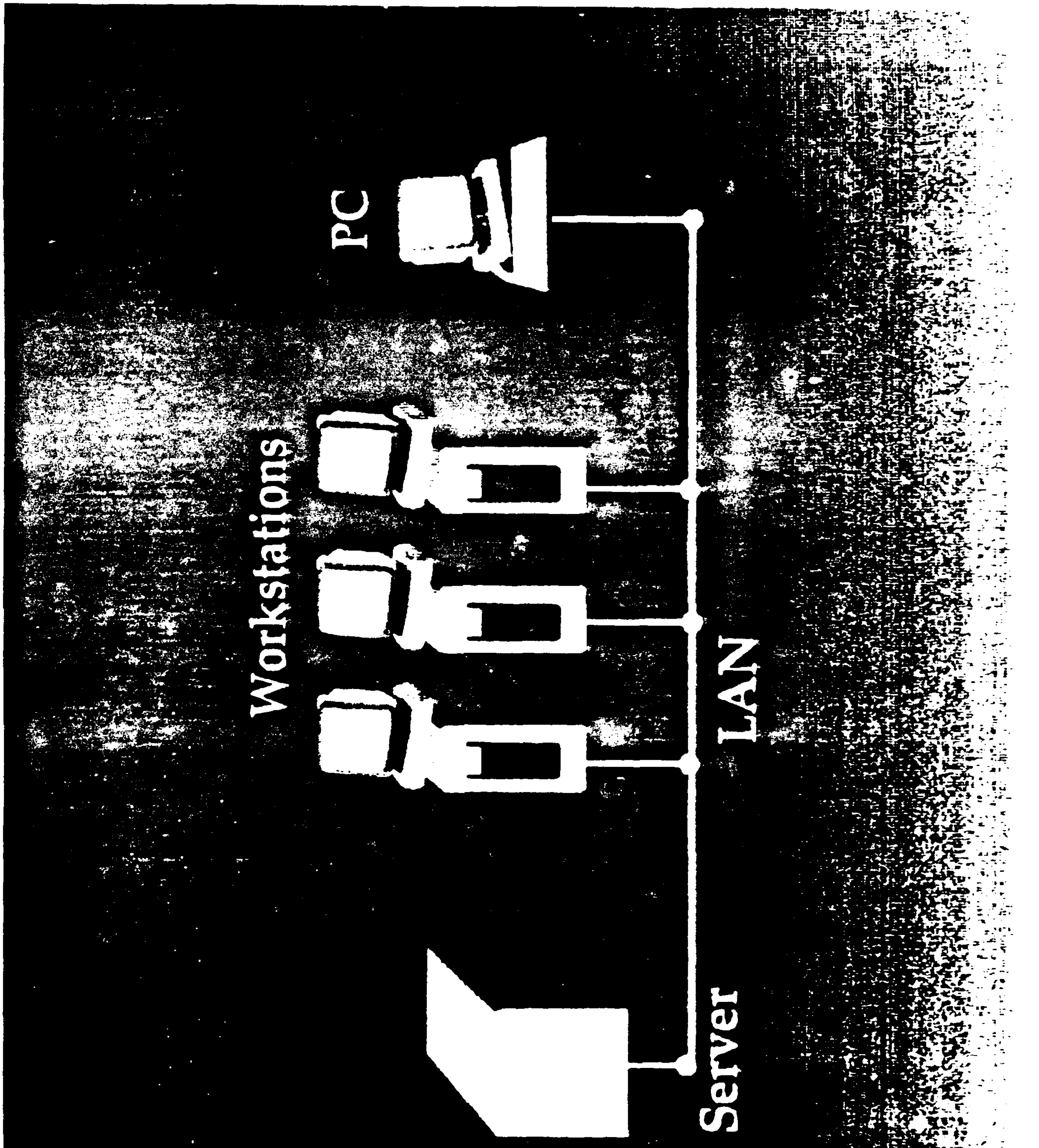

Tabular Data
ID
NUM#
OTHERS
ID
NUM#
OTHERS
ID
NUM#
OTHERS
+1
+2
+3
1
2

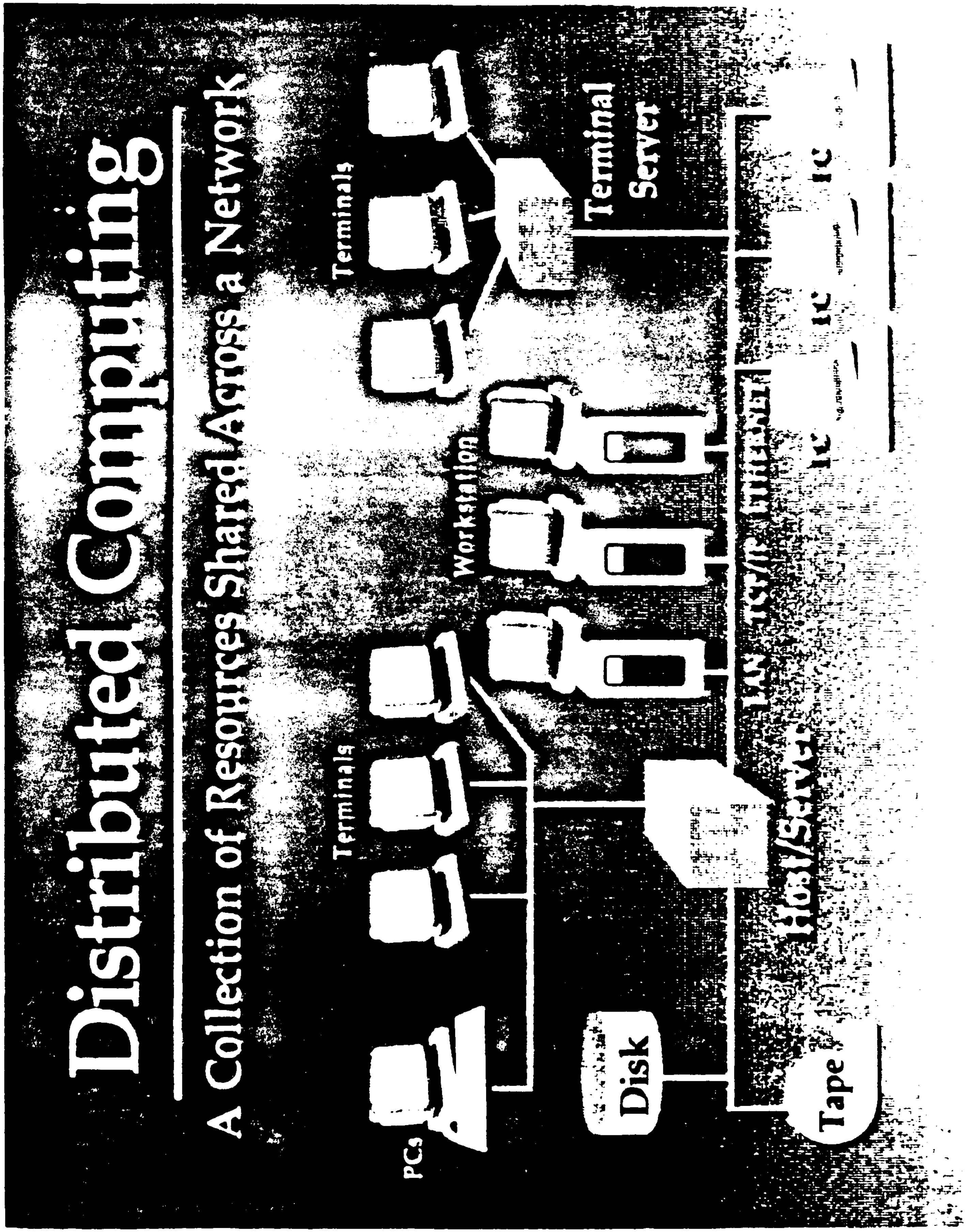

Topology
ARC — ARC
ARC — POLYGON
POLYGON — POLYGON
10

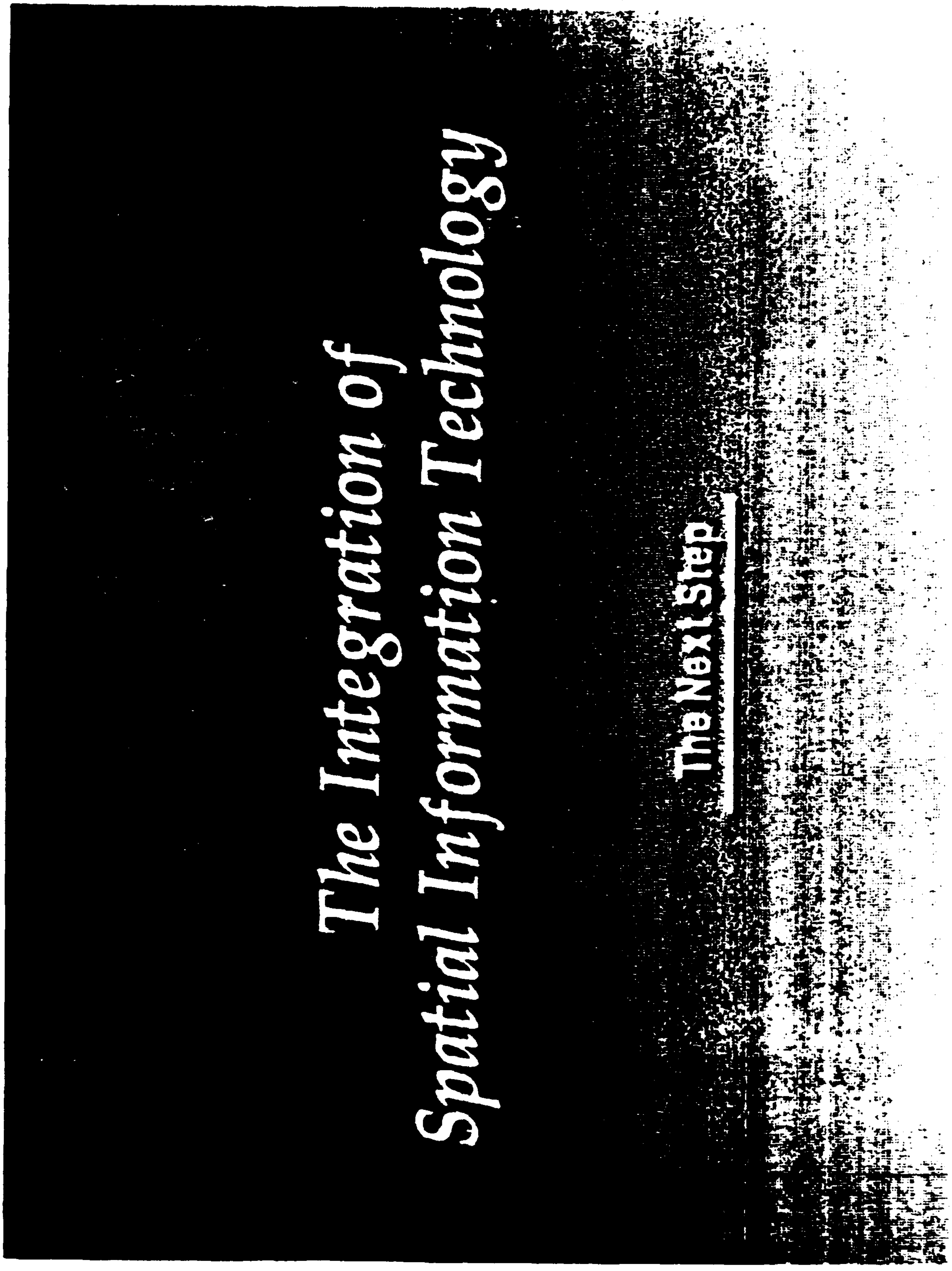

GIS
Geographic Features
Feature Attributes
LINK
ID
AREA
A1
A2
1
2
3
4
+1
+2
+3
+4


Related Symbol Table
Data Base
Map
Attribute
ARC/ INFO COMMANDS TOOLBOX
ARC MACRO LANGUAGE (AML)
ARC MACRO LANGUAGE (AML)
User View Menu
User View Menu
User View Menu
User View Menu
ARC/INFO as a Toolbox for User Applications


X-Windows
4GL
UNIX
Workstation
Networks
Graphic User Interface
A M L S
Macros
RDBI
DBMS
Operating System
Hardware
Communications
ARC/INFO Environment


PC
Workstations
LAN
Server


Distributed Computing
A Collection of Resources Shared Across a Network
PCs
Terminals
Workstation
Terminals
Terminal Server
Disk
Tape
Host/Server


The Integration of
Spatial Information Technology
The Next Step

GIS Technology Evolved From Four Distinct Needs

- To Automate Map Making
- To Analyze Imagery
- To Manage Large Spatial Data Sets
- To Analyze and Manipulate Spatial Data

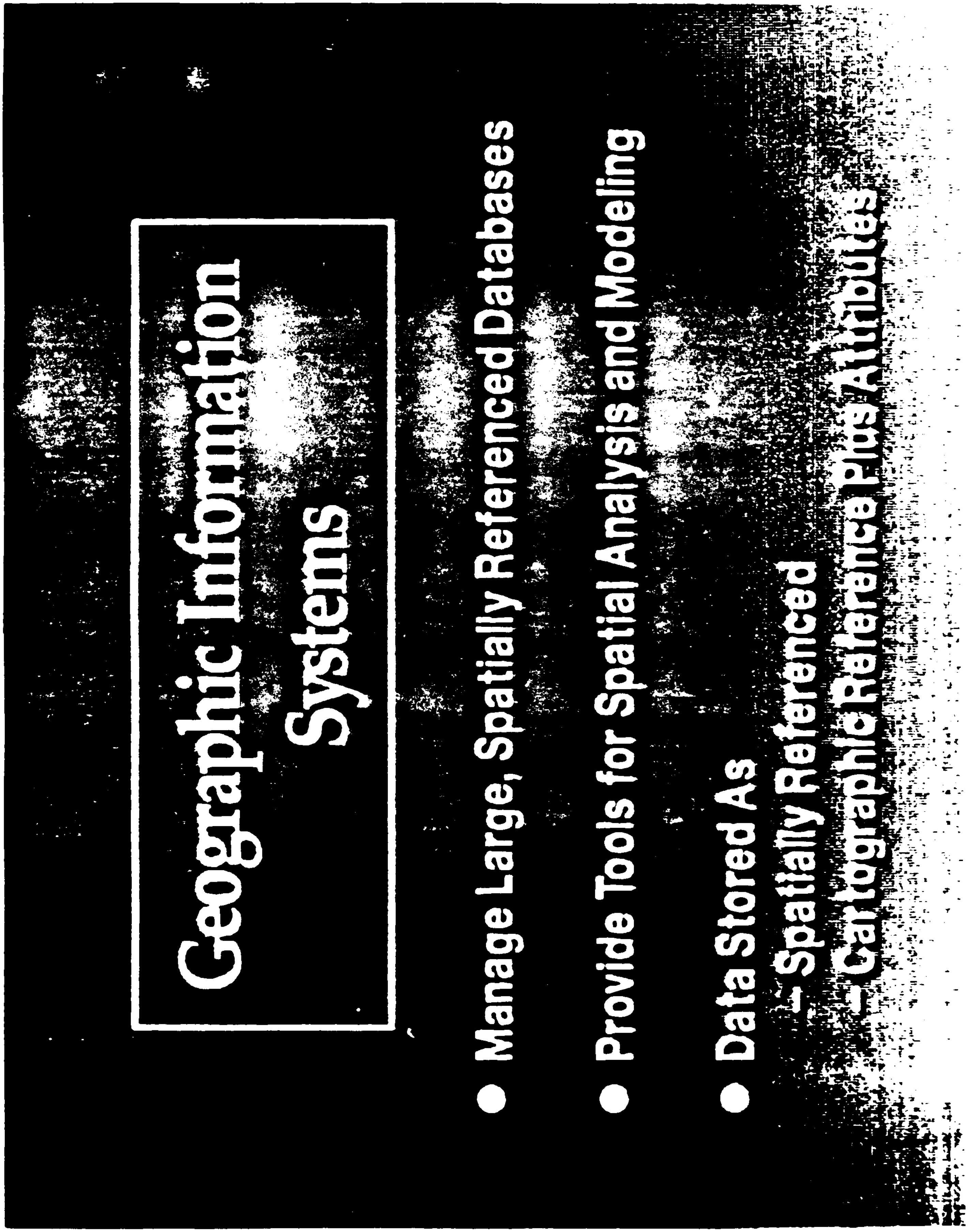

To Meet These Needs Three Kinds of Systems Emerged
Computer Assisted Drafting (CAD)
Image Processing
Geographic Information Systems (GIS's)

CAD Systems

- Digitally Assist in Drafting & Cartography
- Interactive Graphics
- Data Stored As
  - Sets of Graphic Primitives (Lines, Circles, Curves, etc.)
  - Layers

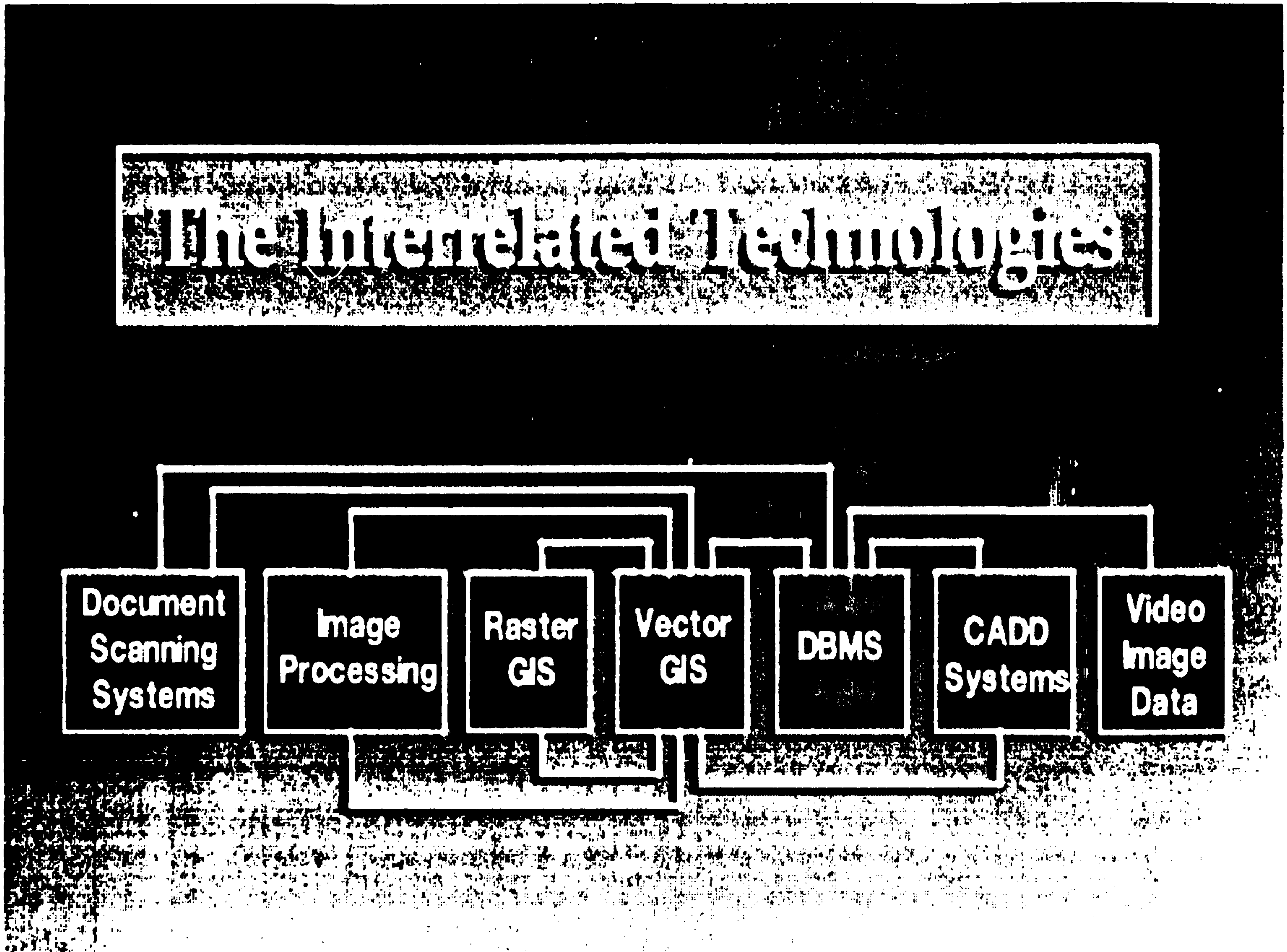
Image Processing Systems

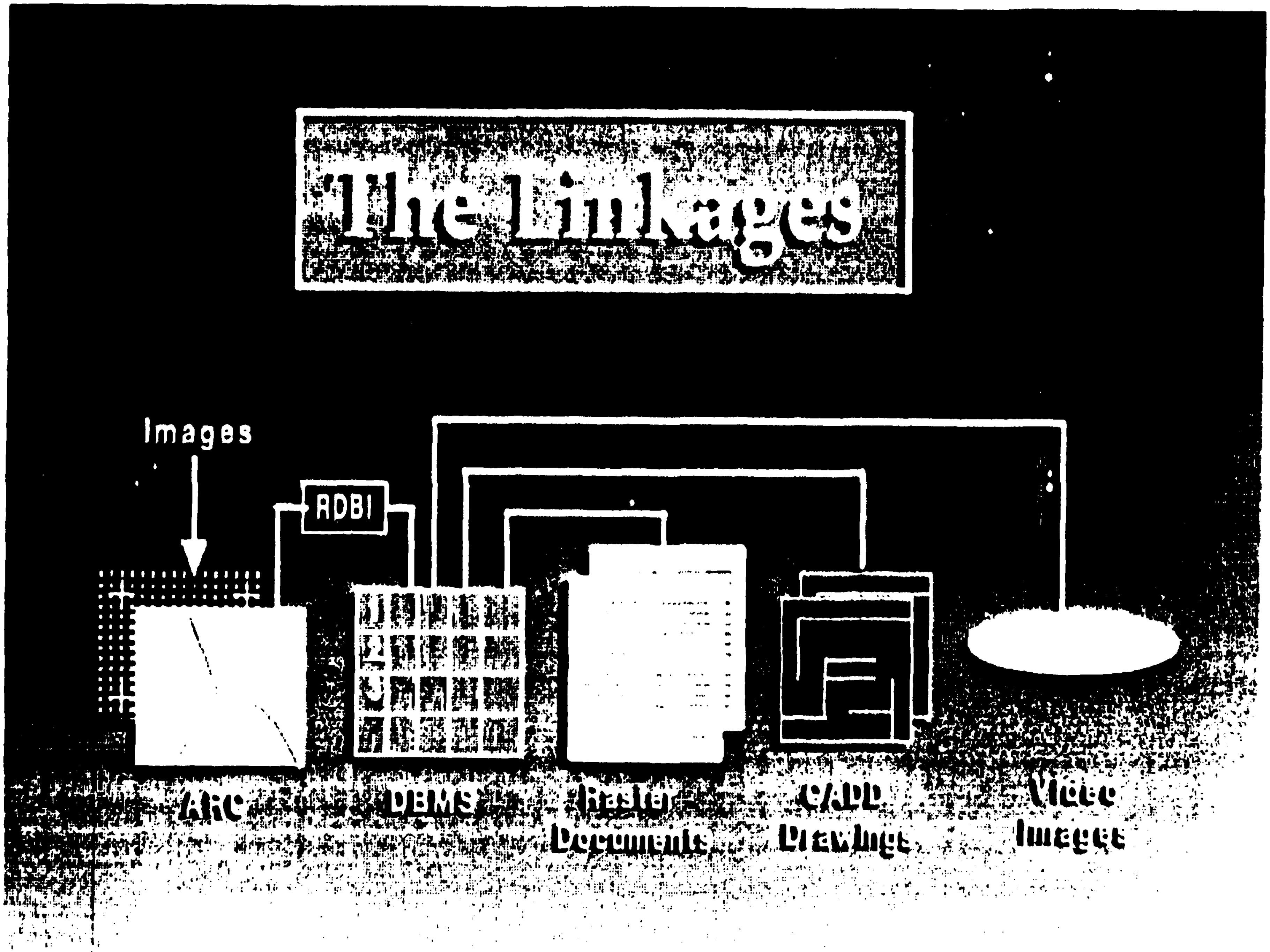
- Digitally Process Remote Sensing
- Image Classification, Analysis, Interpretation
- Data Stored As
  - Image Planes
  - Rasterized Sets



Geographic Information Systems
● Manage Large, Spatially Referenced Databases
● Provide Tools for Spatial Analysis and Modeling
● Data Stored As
– Spatially Referenced
– Cartographic Reference Plus Attributes

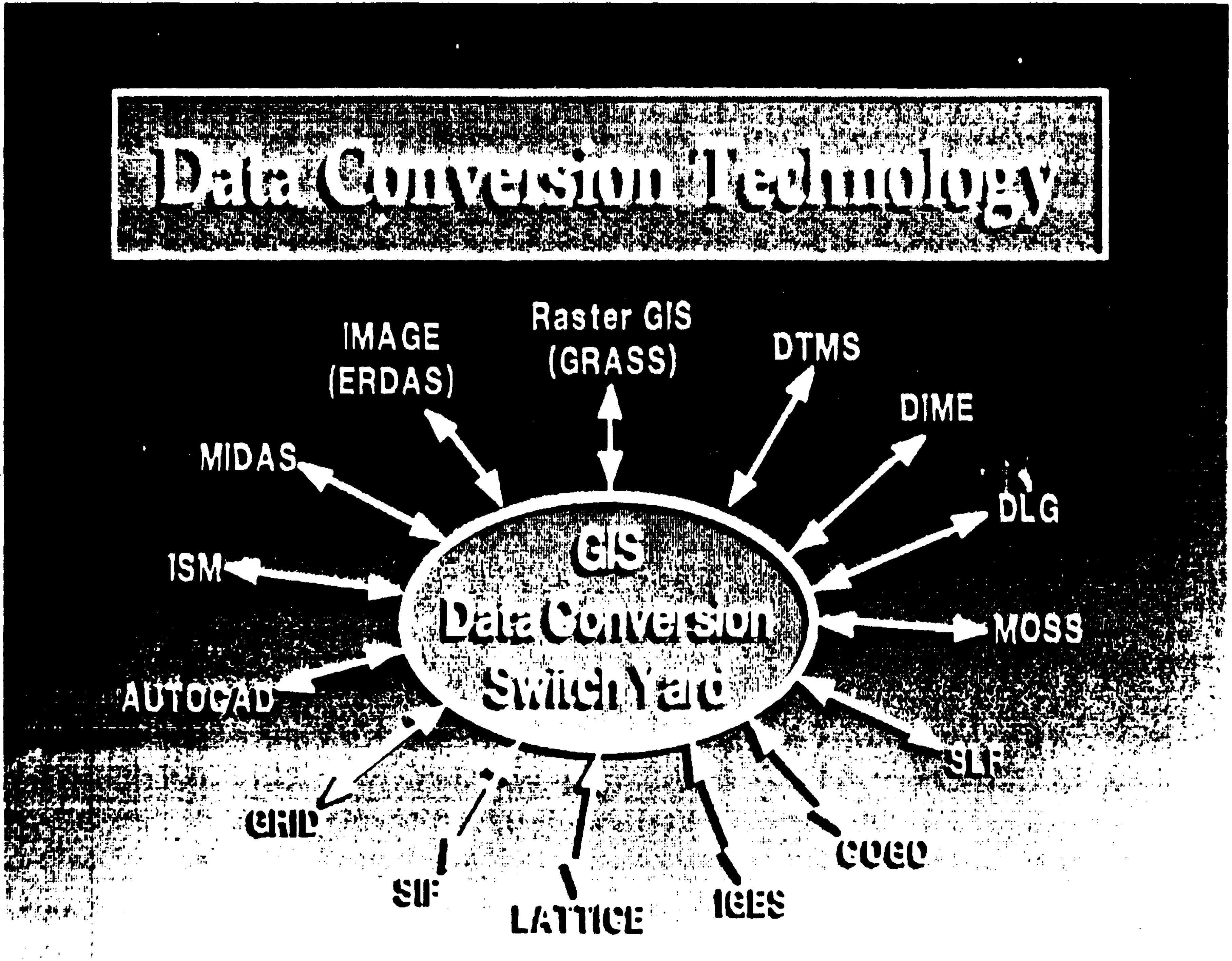
It is Becoming Possible to Integrate these Three Kinds of Systems and Integrate Their Functions


The Interrelated Technologies
Document Scanning Systems
Image Processing
Raster GIS
Vector GIS
DBMS
CADD Systems
Video Image Data


The Linkages
Images
RDBI
ARC
DBMS
Raster Documents
CADD Drawings
Video Images

Integration Tools

- GIS–DBMS (Feature/Record)
- GIS–CADD/Image (Feature/Image)
- Visual Integration (Raster/Vector Overlay)
- Data Conversion (Switchyard)


Data Conversion Technology
IMAGE (ERDAS)
Raster GIS (GRASS)
DTMS
DIME
MIDAS
DLG
ISM
MOSS
AUTOCAD
GIS
Data Conversion
Switch Yard
SLF
GRID
COGO
SIF
LATTICE
IGES

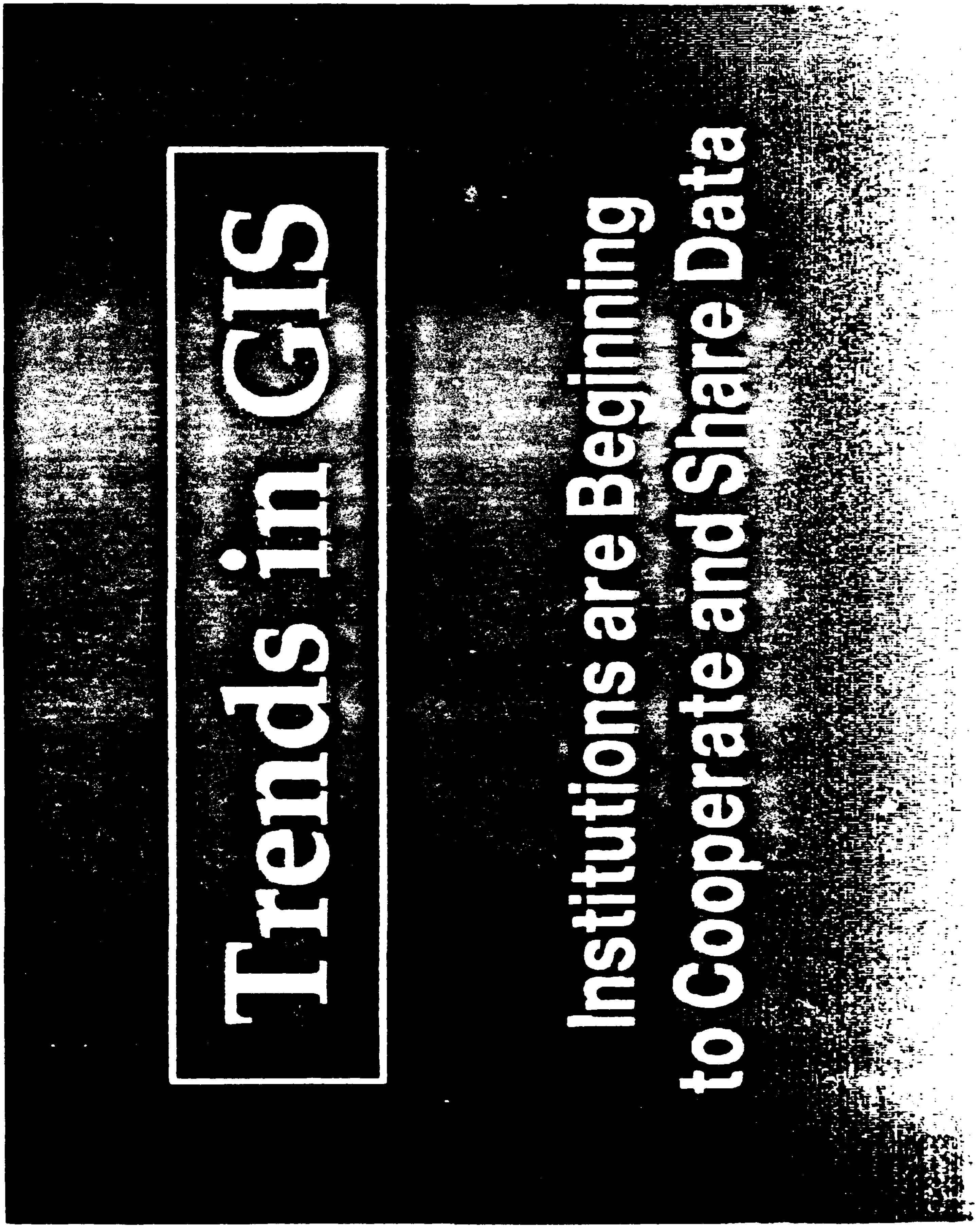
Trends in GIS

Technology is Rapidly Advancing

- Data Structures
- Software Functionality
- User Interfaces

Trends in GIS

Professionals and Managers are becoming more Technically Oriented


Trends in GIS
Institutions are Beginning
to Cooperate and Share Data

WORKING GROUP

REPORT

A. REMOTE SENSING IN HAZARDOUS & TOXIC WASTE

B. PLANNING AND MARKETING GROUP

C. RASTER/VECTOR INTEGRATION

D. SINGLE DISCIPLINE TASK GROUP

WORKING GROUP REPORT

a. Remote Sensing in Hazardous and Toxic Waste

DISCUSSION:

1. Problems with acquiring data from 20-40 years ago - Warehouse of uncataloged aerial photos are located countrywide - Our mission has changed to Environmental work. Data from NIKE/Ammunition plants, landfills is not readily available.

2. When aerial photos are obtained they are done by various entities. The problem results in different scales. There exists a need to make aerial photos more usable.

3. A need exists to digitize aerial photos and form a data base so that present and future acquisition time is lessened.

4. Need exists for thermo-emmisivity remote sensing data to determine problem areas. Would probably be useful on large areas (ammunition/ordnance plants - 25,000+ acres).

5. Place responsibility to acquire aerial photos in real estate section since responsibility rests with them to dispose of data.

6. Need for S.O.P. handbook for acquiring data.

RECOMMENDATION:

1. Thermo-emissivity pilot project on a large area to see what can be learned.

2. Cost-sharing Corps-wide for data collection, etc.

3. Use of indirect engineering overhead for data acquisition.

b. Planning and Marketing Group

Recommendations:

1. OCE should establish a GIS Center of Expertise.

2. The Center should be responsible for a bulletin board and newsletter.

3. The Center should (probably) develop a set of GIS planning guidelines.

4. The Center should (on request) review GIS plans, establish long-range plans and recommend future direction.

5. Management should be educated, as was done with CADD, on the utility of GIS's especially about return-on-investment or cost/benefit issues.

6. A Corps-wide GIS inventory should be done and made available.

7. Establish a central point to acquire data to eliminate duplicate buys.

8. Establish GIS user's groups at a sub-national geographic level (SE, SW, NE, etc.) to meet, exchange information/expertise, etc.

9. Incorporate GIS guidance and plans into District- and FOA- level Information Management Plans (IMPs); this could reinforce GIS approval and give it visibility.

10. Make sure GIS is included in the organizations' IM architecture.

11. Include the organization's Information Steering or Coordinating Committee in GIS decision-making.

c. Raster/Vector

Recommendations:

1. Desire expressed to have software available to perform concurrent processing of vector and raster data. Information was presented to the group that ETL/ALBE and software from Delta Data Co now perform concurrent processing.

2. There needs to be more sharing of data and interchangeability of data between various commercial or Federal systems. Recommend an open data structure which would allow interchange between CADD and GIS.

3. Recommend a corps voice be present at ANSI to assist in development of interchange standards for GIS data.

4. Need exists for a central Corps site for obtaining and distributing digital mapping and imagery data. A library would be an appropriate central point for existing data.

d. Single Discipline Task Group

Discussions on Formulation of a CADD Center (USAWES)

One topic of the break-out sessions, at the USATHAMA/USACERL GIS Information Exchange Meeting held in Denver, CO, was to discuss interest in formulation of a GIS-SDTG under the USAWES CADD Center.

Mr. Sandy Stephens, Chief, CADD Center, discussed the role of the SDTG's in meeting the CADD Center's charter, that being to enable the Corps to optimize use of CADD technology quickly. The SDTG's are the vehicle for grass roots input from the field offices to Corps-wide CADD Activities, particularly those which involve technical considerations related to the consolidated procurement contract with the Intergraph Corporation.

SDTG's have either already been formulated or are in the process of being formulated for ten application areas, including: civil/site design, structural design, electrical, mechanical, architectural, geotechnical, surveying and mapping, hydraulics and hydrology, systems management, and DEH support. SDTG's are normally formed with up to 12 active members, with a general functional and geographic sampling of users of Intergraph-based systems, including lab and field representatives, along with an OCE proponent and CADD Center representative.

Mr. Stephens stated that Army Installations to date have not been explicitly represented on the SDTG's. HQ discussions will likely lead to the Directorate of Engineering and Housing (DEH) representation on a number of the SDTG's or creation of a SDTG specifically dealing with CADD utilization at the Installations.

The role of SDTG's are primarily to identify advancements needed in software development through the Intergraph consolidated contract and to promote information exchange among users. The SDTG's also address needs for software certification within the agency for standarization of analysis and-modeling.

Discussions during the break-out session focused primarily on the need for formulation of a SDTG to address the needs of GIS applications on Intergraph hardware/software systems. A second major focus of the proposed GIS-SDTG was to act as a technical forum for CADD/GIS transportability issues between Intergraph systems and other hardware or software systems. Issues related to porting of the Corps' GRASS software system on Intergraph platforms would also be included. Specific needs and activities of the proposed SDTG are outlined below.

The specific needs for formulating a GIS-SDTG were presented to the conference body. Considerable concerns was voiced that this proposed group not be represented as the only body discussing Corps-wide GIS developments, particularly covering those offices not involved in the Intergraph procurement. The findings contained in the Ad-Hoc GIS Committee report were reiterated that it was not recommended that the Corps standardize GIS developments around a single vendor's system, but rather promote broader implementation across the agency. Until much broader issues outlined in the Ad Hoc GIS committee report are resolved, considerable debate will naturally continue. A listing of broader Corps-wide GIS development needs and concerns were drawn up and are presented below.

Specific Needs for Single Discipline Task Group (SDTG) for GIS Under the USAWES CADD Center

- Data Exchange / Transportatability / Porting Support between CADD and GIS
- Evaluate standards for Intergraph GIS Mapping / Analysis / Modeling for: Attribute Schema, Symbology, Weights, Fonts, QA/QC, Genealogy, Error Budgeting, etc.
- Promote Information Exchange (i.e., Newsletters, EMAIL, etc.)
- Identify GIS / Technical Contacts
- Software Evaluations / Needs for new or Improved Intergraph Modules
- Software and Translator Certification of Intergraph Modules
- Recommend CADD Contract Modifications / Pricing Strategies
- Training Needs Assessments / Information Exchange
- Interface to Other SDTG's

Broad Needs for Corps-Wide GIS Development

- Develop a functional GIS infrastructure within the Corps
- Develop field-level working groups for input to OCE GIS Steering Committee
- Promote field level GIS database / analysis / modeling coordination
- Evaluate needs for the formulation of a Corps GIS center(s)
- Evaluate needs for GIS regional support centers / data repositories
- Develop Corps-wide GIS mapping /analysis / modeling standards for: attribute schema, symbology, weighting, QA/QC, genealogy, error budgeting, etc.
- Assess Corps-specific GIS software development needs
- Create a R&D program for GIS modeling / analysis
- Assess GIS training needs / offerings
- Promote technology transfer forums