Beyond Visualization

Presentation prepared for
ESRI Annual Conference
July 10, 2001
“By the climatic Yorktown campaign, the dearth of maps suitable for military operations had been corrected to a large extent. ... The perception of war at the time was that of an orderly and scientific pursuit. However, to effectively pursue one’s opponent, accurate maps were essential. The allied success at Yorktown was due in no small part to the contribution of the military engineers and mapmakers. To date, 130 maps of the Yorktown campaign have been identified.”
A Plan of the entrance of Chesapeake [sic] Bay, with James and York Rivers; wherein are shewn the respective positions (in the beginning of October) 1. of the British Army commanded by Lord Cornwallis, at Gloucester and York in Virginia; 2. of the American and French forces under General Washington, 3. and of the French fleet under Count de Grasse. By an officer.

CREATED/PUBLISHED
[1781]
“… the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary’s ability to do the same.”
Information Superiority
Key Components

Common Relevant Operational Picture

- All-source intelligence
- Situational Awareness
- Information Visualization

NIMA
Information Visualization
Fused Imagery and Geospatial Information

Step 1: Collect digital terrain elevation data
Step 2: Build three dimensional terrain model
Step 3: Drape controlled imagery over model
Step 4: View fused visualization model

Supports mission planning, mission rehearsal, battlespace visualization, treaty monitoring, accident analysis, sensor placement
Information Visualization Objective 2010

- High end visualization technology migrating to lower echelons
  - Volumetric display with time sensitivity
  - High resolution, geospatially controlled
  - Easily accessible, user adaptable
  - Platform independent
  - Intelligent icons
- Collaborative environment including:
  - Weather
  - All source intelligence
  - On line support
  - Multi-sensor
- Views of alternative strategies for "intuitive" decision making
  - Tailored views
  - Knowledge based
An example showing the difference in the positional accuracy of WVS versus a TM scene. The TM scene from EarthSat’s GeoCover Ortho program that has an independently validated accuracy of 19 meters.

Some of these changes could be normal coastal changes. The vector is off approximately 350 meters north/south and 230 meters east/west.
Uncertainty

- Assessment of accuracy
- Appropriateness of selected information
- Desired completeness of the abstraction
- Timeliness of the source or the delivery
- Interoperability with other “system” elements
- Accompanying Analysis
Assessment of accuracy

**Reference Framework**
- Datum: WGS84
- Dimensions: 2-D, 3-D, and time

**Sources**
- Mathematical models
- Phenomenology models

**Spatial accuracy is critical as the foundation of information superiority**

**Processes**
- Database population
- Quality control and assurance
- Metadata capture

**Expertise**
- Producers
- Acquirers
- Users

**Tools**
- GOTS
- COTS
- SCOTS
It’s always about content!

Resolution

Attribution

Data models
  • Conceptual
  • Logical
  • Physical

Users want the right information - and only the right information - at the right time.
Complex contributions from all that can work together as one

One coherent virtual world

One real world

Many interests, perspectives

Complex data needs

One enterprise conceptual data model

A few functional subsets

Several physical designs and implementations

UCDM

LDM

LDM

LDM

PDMs

Many fielded systems
What we do to meet “right information” needs...

**Imagery**

Provide the *foundation*...
- Broad Area Geospatial Coverage
- Point Target Intelligence Coverage
- Commercial Imagery Coverage
- Ortho-rectified, geopositioned images

**Geospatial Information**

Provide the *geospatial framework*...
- Elevation and Terrain Data
- Feature Data
  - Aeronautical
  - Hydrographic
  - Topographic
  - Cultural
- Precise Positioning

**Imagery Intelligence**

Provide the *focused mission information*...
- Targets
- Weapons Systems
- Threats
- Ingress/Egress

**Integrated Production**

Provide *tailored, customer-specific solutions*...
- A *synergistic combination* of
  - Imagery
  - Imagery Intelligence
  - Geospatial Information
- *Enhanced analysis* and *visualization*
Integrated Production or Collaborative Work

Multi-disciplinary Workgroup

NIMA Sites

- Imagery Analyst
- Geospatial Analyst
- Contractors or Co-producer
- Tasking Specialist

Homogeneous Workgroup

Integrated Information Libraries

- Imagery
- Topographic
- Hydrographic
- Intelligence
- Aeronautical
- Geodesy/Geophysics
- Elevation
- Names & Bnds
- Points
- Other Information

Customer Site

- Cartographer
- Dissemination Specialist
- Customer Support
- Rendition Support

Contractor/Co-producer Site

- Information Retrieval and Dissemination

Multi-disciplinary Workgroup

- Communication

Integrated Production or Collaborative Work
Desired Completeness

- Image “apparently” has all the elements
- Many needed attributes come from collateral supplementary information sources
- Not everyone identifies the same needed elements
- Missing - though available - elements vary the common relevant operational picture
- Global readiness is increasingly desired

The information passed to the planner or the decision-maker is seldom complete. The compilation and exploitation processes themselves require generalizations and omissions.
Automate or buy what we can...

Build what we must

Data Quality
- edition
- date

Boundaries

Hydrography

Population

Transportation

Vegetation

Elevation

Aeronautical and Hydrographic Safety of Navigation and Geodesy and Geophysics

Foundation Data

Controlled Image Base 5M

Digital PPDB

Continuous

Maintenance

Buy

Automate

12,200 cells
Timeliness of the source or the delivery

- Currency
- Seasonal variations
- History over time
- Availability in a timely fashion
A Readiness and Responsiveness Strategy

Foundation Data - Global Readiness

Broad area imagery
- Controlled Image Base (CIB) © 5M
- Digital Point Positioning Database (DPPDB)

Planning level data
- Digital Terrain Elevation Data (DTED) ©
- Foundation Feature Data (FFD)

Basic imagery intelligence
- Digital Nautical Chart (DNC) ©
- Navigation Safety
- Geodesy & Geophysics

Mission-Specific Data

Mission Responsiveness
- Mission-driven
- Highly level of detail
- Timely, accurate, and relevant
- Ability to accurately reference information to the earth
- Delivery in hours to days, not weeks to months

Increasing Detail
3D & 4D Site Models and Fly Thrus
“On 12 Aug, a reporter sighted a creature, about 50ft long, submerging in Swamp Lake.”

“15 strangely dressed individuals were seen advancing toward the I-70/US 40 underpass at noon 15 Aug.”

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39.50N, 92.30W, 612ft
39.40N, 92.30W, 625ft
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\(X, Y, Z = \text{WGS84 Ellipsoid}\)
(N, W, h = \text{Latitude, Longitude, height above mean sea level})
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Analytical tradecraft
intensity and proficiency

...a more valuable and valued workforce

Geospatial analysis - a rapidly emerging, interdisciplinary technology. It combines geography, remote sensing, computers, cartography, and information networks for dealing with practical and scientific problems of the world. Geospatial analysis is now used in many governmental, commercial, educational, scientific, engineering, and military situations.

Emporia State University description

Geospatial analysis - study data about geospatial features and explore how those objects and their related events can or might be used to affect or reflect human actions.

NIMA
Geospatial Analyst

- Understands customer needs
- Understands content value of today’s production and tomorrow’s data maintenance environments
- Assesses quality and relevance and “pedigree” of extant commodity sources
- Extracts needed/missing data (foundation or mission specific) from known sources
  - as oversight advisors, quality control monitors, contract partners
  - as in-house exploiters
- Provides value-adding analysis for customer by understanding patterns, trends, relationships in data over a specific area or relevant to a specific functional issue
- Builds integrated production processes and procedures with imagery analysts (geospatial accuracy, geographic relevance, visualization)
"The want of accurate maps has been a grave disadvantage to me. I have in vain endeavored to procure them, and have been obliged to make shift with such sketches as I could trace out of my own observations and that of gentlemen around me. I think if gentlemen of known character and probity could be employed in making maps (from actual surveys) it would be of the greatest advantage."

- Gen. George Washington
1777
Achieving JV 2020 and USI GS 2010 goals and objectives

- Decision Superiority
- Information Superiority
- Dominant Battlespace Awareness
- Common Relevant Operational Picture
- Trusted Geospatial Framework
- Mission Specific Data

Foundation
Production Strategy for GGI&S - a 1995 projection

Existing Global Production Objectives

- Digital Chart of the World revision in 1995
- Digital Nautical Chart worldwide coverage by 1998
- Selective world-wide Controlled Image Base by 2000
- Vector Smart Map, level 1, worldwide coverage by 2005
- Master Seafloor Digital Data Base populated by 2005
- Digital Terrain Elevation Data landmass by 2005

Technology Insertion Objectives

- Improved readiness for unpredictable regional crises
- Improve responsiveness with datasets vice products
- Improved update and value-adding delivery using communication advances
<table>
<thead>
<tr>
<th>Foundation Data Product</th>
<th>Available as of September 2000</th>
<th>Current Baseline Projection for end of FY 05</th>
<th>USIGS Requirement GT Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled Image Base Meter</td>
<td>6,122 cells</td>
<td>10,669 cells</td>
<td>19,200 cells by end of FY 05</td>
</tr>
<tr>
<td>Digital Point Positioning Data Base</td>
<td>3,892 cells</td>
<td>5,784 cells</td>
<td>6,600 cells by end of FY 05</td>
</tr>
<tr>
<td>Digital Terrain Elevation Data Level 2</td>
<td>483 cells</td>
<td>14,657 cells</td>
<td>19,200 cells by 2010</td>
</tr>
<tr>
<td>Foundation Feature Data</td>
<td>401 cells</td>
<td>2,165 cells does not include maintenance</td>
<td>10,700 cells by end of FY 10 with maintenance in high priority regions</td>
</tr>
<tr>
<td>Vector Map - 1</td>
<td>156 CDs</td>
<td>234 CDs (Complete Coverage)</td>
<td>Replace with FFD as cells are completed</td>
</tr>
<tr>
<td>Digital Nautical Chart</td>
<td>90 % of Complete Coverage</td>
<td>Complete Coverage 48% in continuous maintenance</td>
<td>Complete coverage and 100% in continuous maintenance by FY 04</td>
</tr>
</tbody>
</table>