

Identifying the Skills and Competencies for Geospatial Technology Careers and Curriculum

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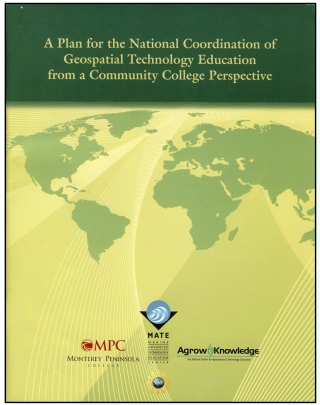
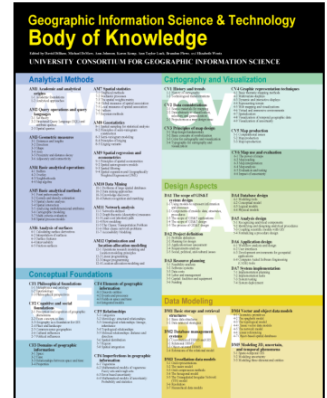
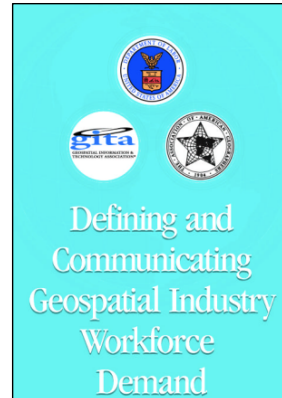
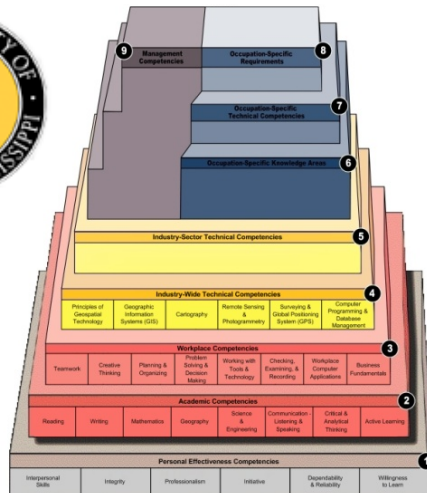
In the beginning

- **Questions:**
 - **What should I teach?**
 - **How should it be taught?**
 - **What does a graduate need to know to be successful in a career in geospatial technology?**

A photograph showing a large fire with thick black smoke rising into a blue sky. The smoke is dense and billowing, with some lighter, greyish clouds visible in the background. The fire itself is a bright orange line at the bottom of the frame.

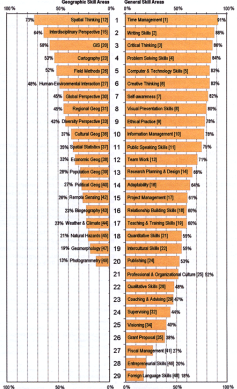
Table 4
Geospatial Technology Competency Model

Competency Area	Competency	GIS Skills				Other Skills
		GIS Skills	GIS Skills	GIS Skills	GIS Skills	
Technical Skills	Ability to Acquire, Manage, Store, Query, and Display Geospatial Data	•	•	•	•	•
	Ability to Analyze and Interpret Geospatial Data	•	•	•	•	•
	Ability to Design and Develop Geospatial Applications	•	•	•	•	•
	Ability to Implement and Maintain Geospatial Systems	•	•	•	•	•
	Ability to Support and Train Users of Geospatial Systems	•	•	•	•	•
	Ability to Evaluate and Improve Geospatial Systems	•	•	•	•	•
	Ability to Communicate Geospatial Information	•	•	•	•	•
	Ability to Collaborate with Other Professionals	•	•	•	•	•
	Ability to Lead and Manage Geospatial Projects	•	•	•	•	•
	Ability to Innovate in Geospatial Technology	•	•	•	•	•
Professional Skills	Communication Skills	•	•	•	•	•
	Teamwork Skills	•	•	•	•	•
	Problem-Solving Skills	•	•	•	•	•
	Decision-Making Skills	•	•	•	•	•
	Time Management Skills	•	•	•	•	•
	Organizational Skills	•	•	•	•	•
	Interpersonal Skills	•	•	•	•	•
	Self-Management Skills	•	•	•	•	•
	Leadership Skills	•	•	•	•	•
	Global Awareness Skills	•	•	•	•	•



DACUM Research Chart for GIS Technician: Consolidated - Part A

Objectives	Tasks
A. Evaluate & Acquire Data	A1 Acquire data (1) A2 Coordinate data collection (1) A3 Evaluate data (1) A4 Research data (1)
B. Manage Software & Hardware	B1 Back up data (1) B2 Create & implement data management schedules (1) B3 Create & implement database performance (1) B4 Create & implement software (1)
C. Develop Spatial Database	C1 Create spatial database (1) C2 Define feature relationships (1) C3 Import data (1) C4 Organize the database structure (1) C5 Validate data (1)
D. Analyze & Interpret Data	D1 Conduct geospatial analysis (1) D2 Conduct geospatial analysis (1) D3 Conduct geospatial analysis (1) D4 Conduct geospatial analysis (1) D5 Conduct geospatial analysis (1)
E. Create & Modify Data	E1 Create data (1) E2 Collect data manually using GPS & other (1) E3 Collect data manually using GPS & other (1) E4 Edit & update data (1) E5 Create spatial database (1)
F. Create & Modify Data	F1 Create data (1) F2 Create data (1) F3 Create data (1) F4 Create data (1) F5 Create data (1)
G. Create & Modify Data	G1 Create data (1) G2 Create data (1) G3 Create data (1) G4 Create data (1) G5 Create data (1)
H. Professional Development	H1 Acquire and maintain certification (1) H2 Attend workshops (1) H3 Attend workshops (1) H4 Attend workshops (1) H5 Attend workshops (1)
I. Professional Development	I1 Attend workshops (1) I2 Attend workshops (1) I3 Attend workshops (1) I4 Attend workshops (1) I5 Attend workshops (1)



Defining “the geospatial industry”

“The geospatial technology industry includes any technology being used to collect, process, analyze, use, or display geospatial data and information to create a useful product for an end user.” (2001)



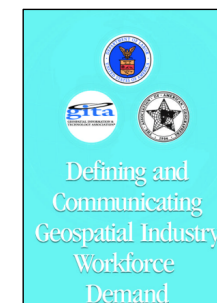
“The remote sensing industry is viewed as those commercial firms, not-for-profit organizations, governmental agencies and academic institutions involved in the capture, production, distribution, and application of remotely sensed geospatial data and information.” (2004)



“The geospatial industry produces location- and time-specific data, transforms data into maps, images and many other forms of useful information, and applies information to create knowledge about the Earth and the human activities the Earth supports.” (2006)



“The geospatial industry acquires, integrates, manages, analyzes, maps, distributes, and uses geographic, temporal and spatial information and knowledge. The industry includes basic and applied research, technology development, education, and applications to address the planning, decision-making, and operations needs of people and organizations of all types.” (2006)



Geospatial industry sectors & markets

Daratech “GIS/Geospatial Industry”

Software	\$1.5 B
Data	\$0.7 B
Services	\$0.5 B
Hardware	\$0.1 B

2004 revenue \$2.8 B

Daratech markets

Public
Regulated (i.e. utilities, telecom,
 transportation and education)
Private

ASPRS “Remote Sensing Industry”

Data Collection
Data processing
Software & Hardware “support”
“Intermediaries”

2004 revenue \$2.9 B

ASPRS markets

Commercial/NFP
Government
Academia



University of Southern Mississippi– Geospatial Technology Competency Model (2003)

Technical

Interpersonal

Analytical

Business

UCGIS *GIS&T Body of Knowledge* (2006)

Knowledge Area: Analytical Methods (AM)

Unit AM1 Academic and analytical origins
Unit AM2 Query operations and query languages
Unit AM3 Geometric measures
Unit AM4 Basic analytical operations
Unit AM5 Basic analytical methods
Unit AM6 Analysis of surfaces
Unit AM7 Spatial statistics
Unit AM8 Geostatistics
Unit AM9 Spatial regression and econometrics
Unit AM10 Data mining
Unit AM11 Network analysis
Unit AM12 Optimization and location-allocation modeling

Knowledge Area: Conceptual Foundations (CF)

Unit CF1 Philosophical foundations
Unit CF2 Cognitive and social foundations
Unit CF3 Domains of geographic information
Unit CF4 Elements of geographic information
Unit CF5 Relationships
Unit CF6 Imperfections in geographic information

Knowledge Area: Cartography and Visualization (CV)

Unit CV1 History and trends
Unit CV2 Data considerations
Unit CV3 Principles of map design
Unit CV4 Graphic representation techniques
Unit CV5 Map production
Unit CV6 Map use and evaluation

Knowledge Area: Design Aspects (DA)

Unit DA1 The scope of GIS&T system design
Unit DA2 Project definition
Unit DA3 Resource planning
Unit DA4 Database design
Unit DA5 Analysis design
Unit DA6 Application design
Unit DA7 System implementation

Knowledge Area: Data Modeling (DM)

Unit DM1 Basic storage and retrieval structures
Unit DM2 Database management systems
Unit DM3 Tessellation data models
Unit DM4 Vector and object data models
Unit DM5 Modeling 3D, temporal, and uncertain phenomena

Knowledge Area: Data Manipulation (DN)

Unit DN1 Representation transformation
Unit DN2 Generalization and aggregation
Unit DN3 Transaction management of geospatial data

Knowledge Area: Geocomputation (GC)

Unit GC1 Emergence of geocomputation
Unit GC2 Computational aspects and neurocomputing
Unit GC3 Cellular Automata (CA) models
Unit GC4 Heuristics
Unit GC5 Genetic algorithms (GA)
Unit GC6 Agent-based models
Unit GC7 Simulation modeling
Unit GC8 Uncertainty
Unit GC9 Fuzzy sets

Knowledge Area: Geospatial Data (GD)

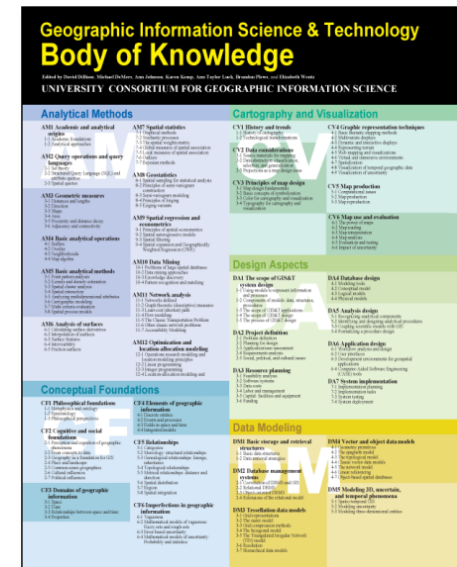
Unit GD1 Earth geometry
Unit GD2 Land partitioning systems
Unit GD3 Georeferencing systems
Unit GD4 Datums
Unit GD5 Map projections
Unit GD6 Data quality
Unit GD7 Land surveying and GPS
Unit GD8 Digitizing
Unit GD9 Field data collection
Unit GD10 Aerial imaging and photogrammetry
Unit GD11 Satellite and shipboard remote sensing
Unit GD12 Metadata, standards, and infrastructures

Knowledge Area: GIS&T and Society (GS)

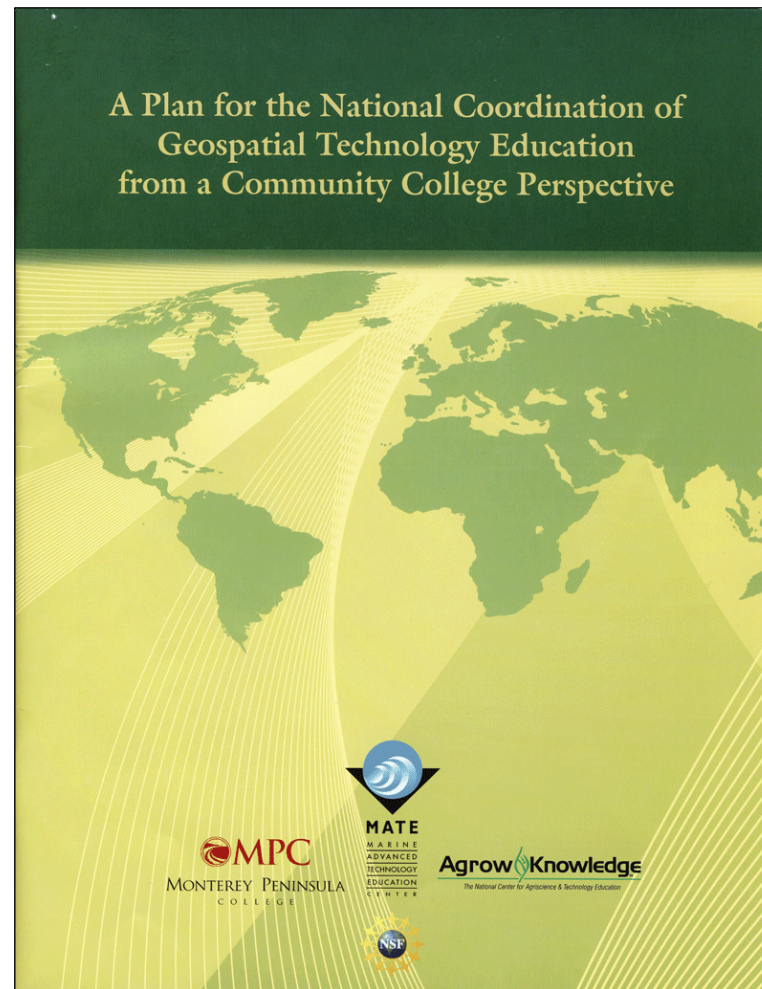
Unit GS1 Legal aspects
Unit GS2 Economic aspects
Unit GS3 Use of geospatial information in the public sector
Unit GS4 Geospatial information as property
Unit GS5 Dissemination of geospatial information
Unit GS6 Ethical aspects of geospatial information and technology
Unit GS7 Critical GIS

Knowledge Area: Organizational and Institutional Aspects (OI)

Unit OI1 Origins of GIS&T
Unit OI2 Managing GIS operations and infrastructure
Unit OI3 Organizational structures and procedures
Unit OI4 GIS&T workforce themes
Unit OI5 Institutional and inter-institutional aspects
Unit OI6 Coordinating organizations (national and international)



Still no “guide” for what to teach



www.marinetech.org/workforce/geospatial

GeoTech Center

- **Four Year, \$5 Million Grant, Start Sept. 2008**
 - **USA National Science Foundation Center of Excellence for Geospatial Technology**
 - **Two-year “community or technical” colleges**
- **Partnership between**
 - **8 Colleges**
 - **2 Universities**
 - **Education Consultants**
 - **Del Mar College as Leader/host**



Vision & Mission

- **Provide a national geospatial education infrastructure that has both the capacity and the educational effectiveness needed to satisfy workforce demand.**
- **Support community (two-year) college educators to expand and enrich geospatial technology education.**



Goals - Provide

- **National Leadership and Expertise**
- **Guidance on Skills and Competencies**
- **Educational Resources via Web Site**
 - **Geotechcenter.org**
- **Faculty Development and Outreach**
 - **Workshops and mentoring**
- **Student Engagement and Outreach**
 - **Including international links**



<http://www.geotechcenter.org>



Developing “standards” or “guidelines” for program content

- **Two Complementary Approaches**
 - **Collaborate with US Department of Labor to complete Draft Geospatial Technology Competency Model**
 - **Define specific Occupational competencies for entry level geospatial occupations**
 - **Hold “DACUM” events**
 - **Combine multiple DACUM outcomes into Meta-DACUM**



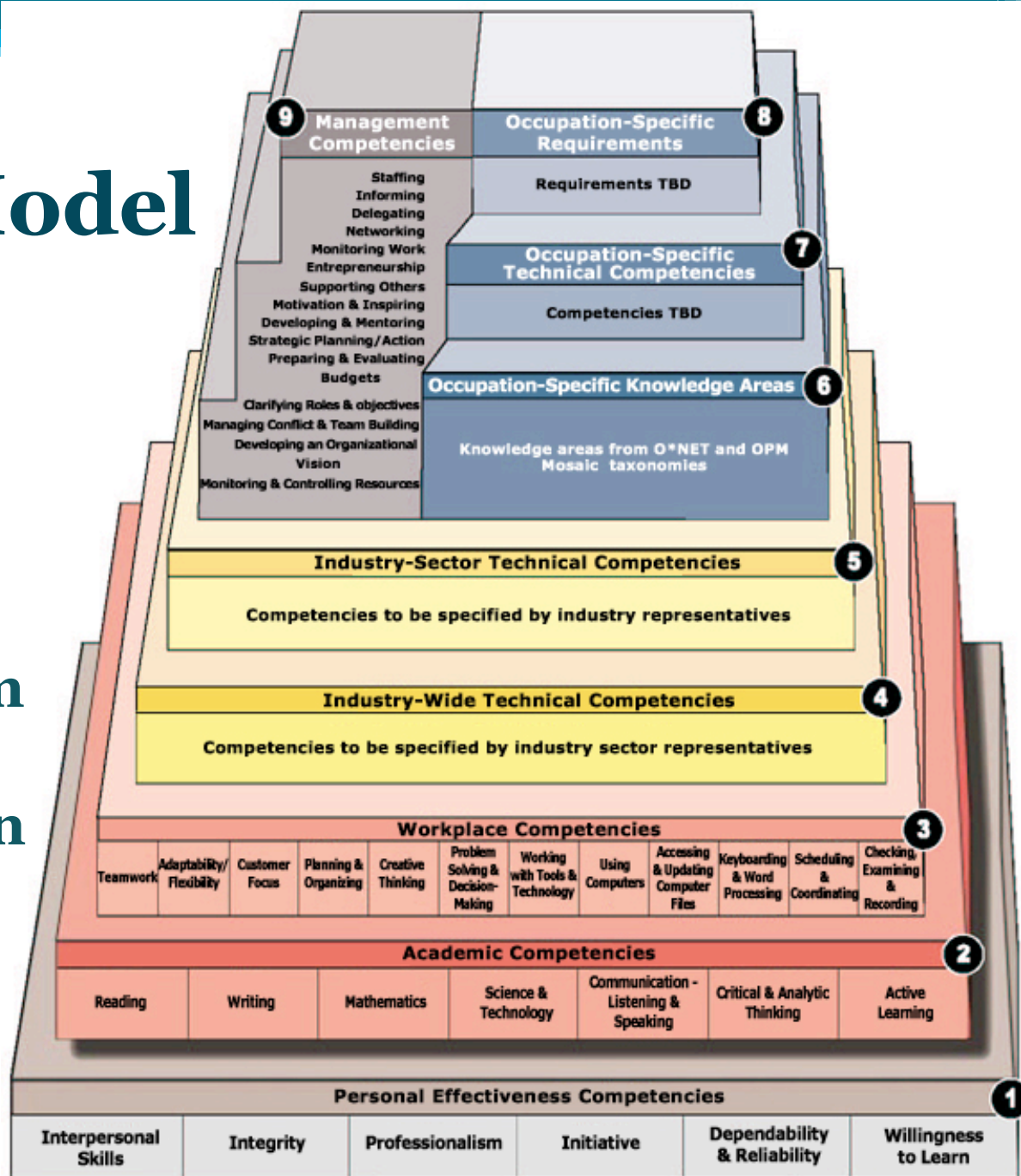
Finalizing the Geospatial Technology Competency Model

- **Lead by David DiBiase, Penn State University**
 - **GeoTech Center Co-PI**
- **Combined from:**
 - **Past Studies –some examples sources**
 - **Geospatial Workforce Development study (2003) – U of So Mississippi, Draft GTCM**
 - **UCGIS – Body of Knowledge (2006)**
 - **GISCI – Professional Certification**
 - **Expert User Forum**
 - **Opened to Public Comment**
 - **Revised and finalized in 2010**
 - **Approved by US Dept. of Labor July 2010**



Competency Model

“the capability to apply or use a set of related knowledge, skills, and abilities required to successfully perform ‘critical work functions’ or tasks in a defined work setting”



Tier 9: Management Competencies

Tier 8: Occupation-Specific Requirements

Tier 7: Occupation-Specific Technical Requirements

Tier 6: Occupation-Specific Knowledge Areas

Tier 5: Industry-Specific Technical Competencies

Tier 4: Industry-Wide Technical Competencies

Tier 3: Workplace Competencies

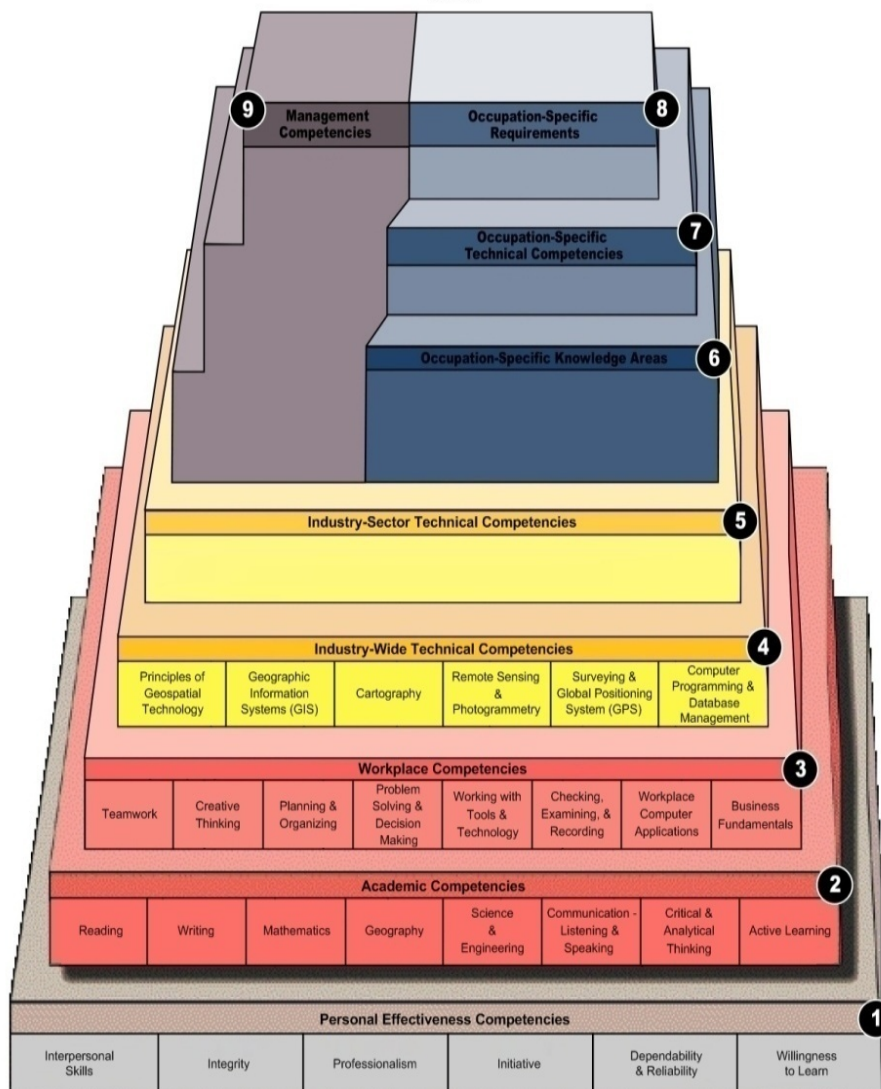
Tier 2: Academic Competencies

Tier 1: Personal Effectiveness Competencies

Geospatial Technology Competency Model

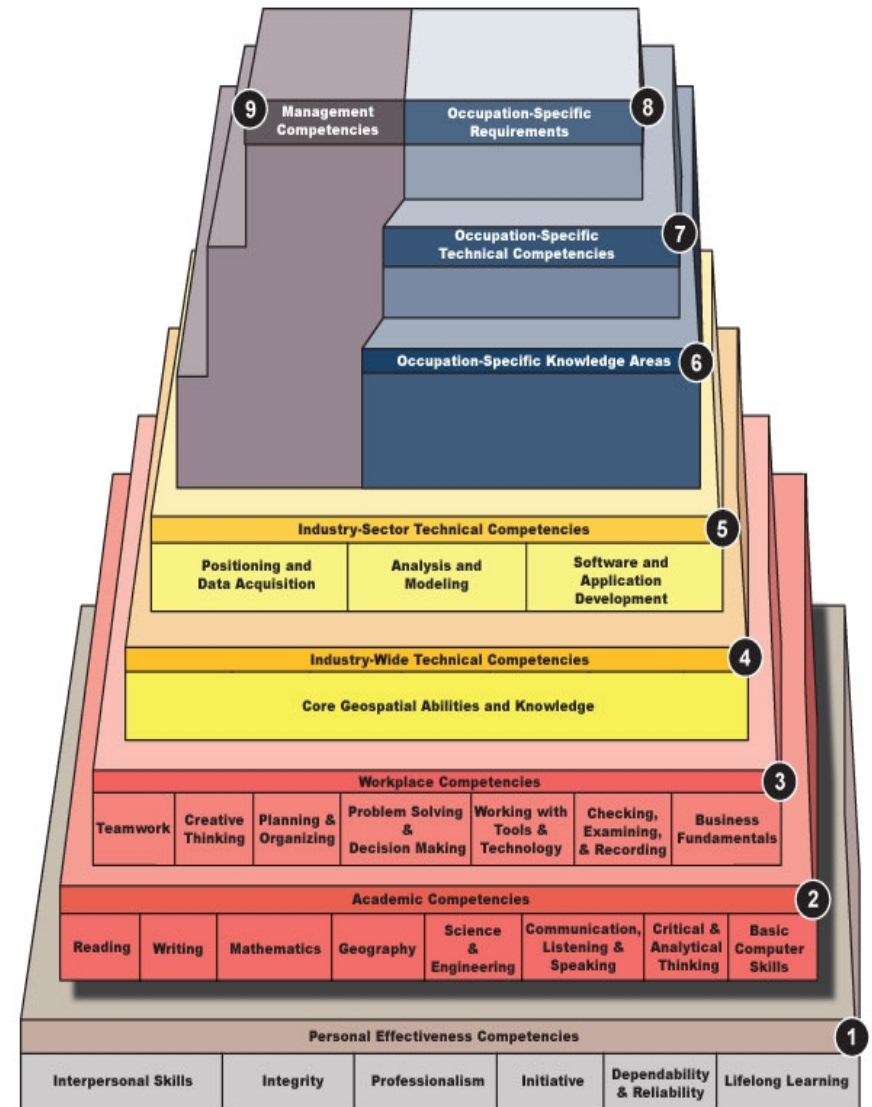
Geospatial Technology Competency Model

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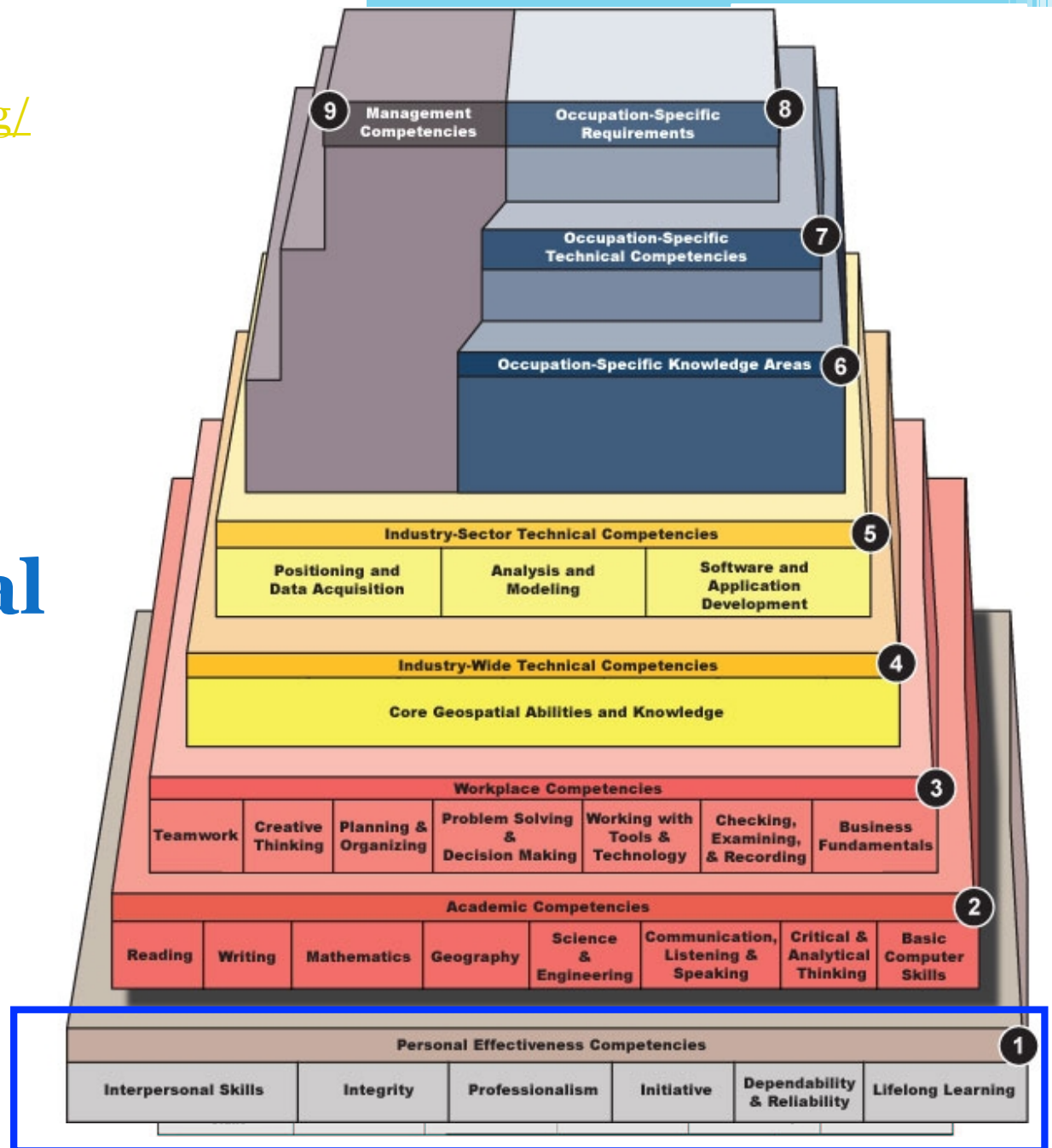
Geospatial Technology Competency Model

June 1, 2010



<http://www.careeronestop.org/competencymodel/>

Tier 1 - Personal Effectiveness



Tier 1 – Personal Effectiveness Competencies

1. Interpersonal Skills: Demonstrating the ability to work effectively with others.

- Interact appropriately and respectfully with supervisors and coworkers
- Work effectively with people who have diverse personalities and backgrounds
- Respect the opinions, perspectives, customs, and individual differences of others
- Use appropriate strategies and solutions for dealing with conflicts and differences to maintain a smooth workflow
- Be flexible and open-minded when dealing with a wide range of people
- Listen to and consider others' viewpoints

2. Integrity: Displaying accepted social and work behaviors.

- Treat others with honesty, fairness, and respect
- Respect the morals and beliefs of society
- Take responsibility for accomplishing work goals within accepted timeframes
- Accept responsibility for one's decisions and actions

3. Professionalism: Demonstrating commitment to the values, standards of conduct, and well being of one's profession.

- Stay calm, think clearly, and act decisively in stressful situations
- Accept criticism and attempt to learn from mistakes
- Demonstrate a positive attitude towards work
- Strengthen your profession by mentoring junior colleagues and championing continuing professional development
- Follow rules and standards of dress and personal hygiene
- Refrain from substance abuse

4. Initiative: Demonstrating gumption at work.

- Take initiative in seeking out new responsibilities and work challenges
- Pursue work with energy, drive, and effort to accomplish tasks
- Persist at a task despite interruptions, obstacles, or setbacks
- Establish and maintain personally challenging but realistic work goals
- Strive to exceed standards and expectations

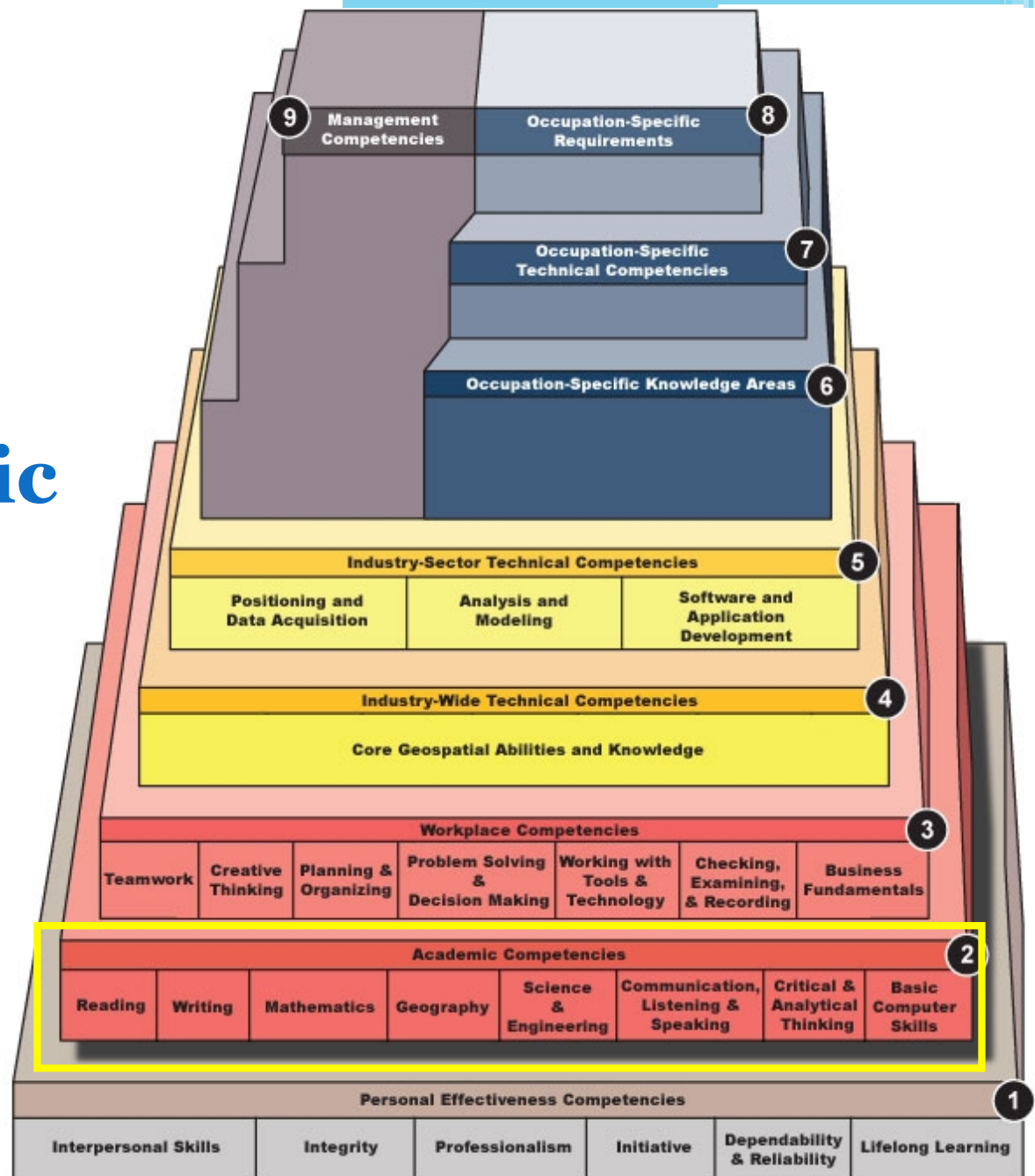
5. Dependability and Reliability: Displaying responsible behaviors at work.

- Behave consistently, predictably, and reliably
- Fulfill obligations, complete assignments, and meet deadlines
- Follow written and verbal directions
- Comply with organizational rules, policies, and procedures

6. Lifelong Learning: Displaying a willingness to learn and apply new knowledge and skills.



Tier 2 - Academic Competencies



Mouse Over a “box” for details

[Back to model pyramid](#)

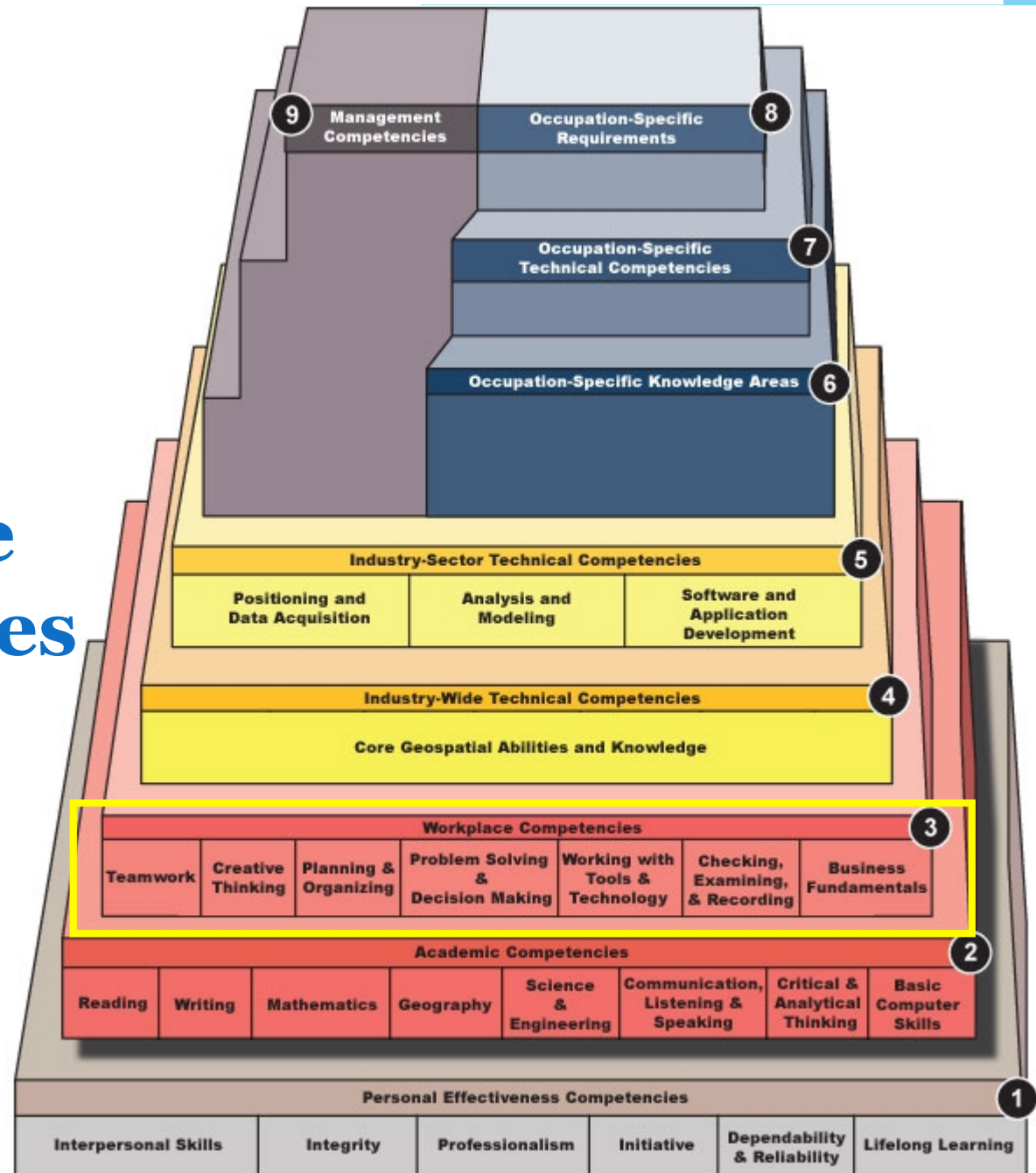
Problem Solving and Decision Making

Applying critical-thinking skills to solve problems by generating, evaluating, and implementing solutions.

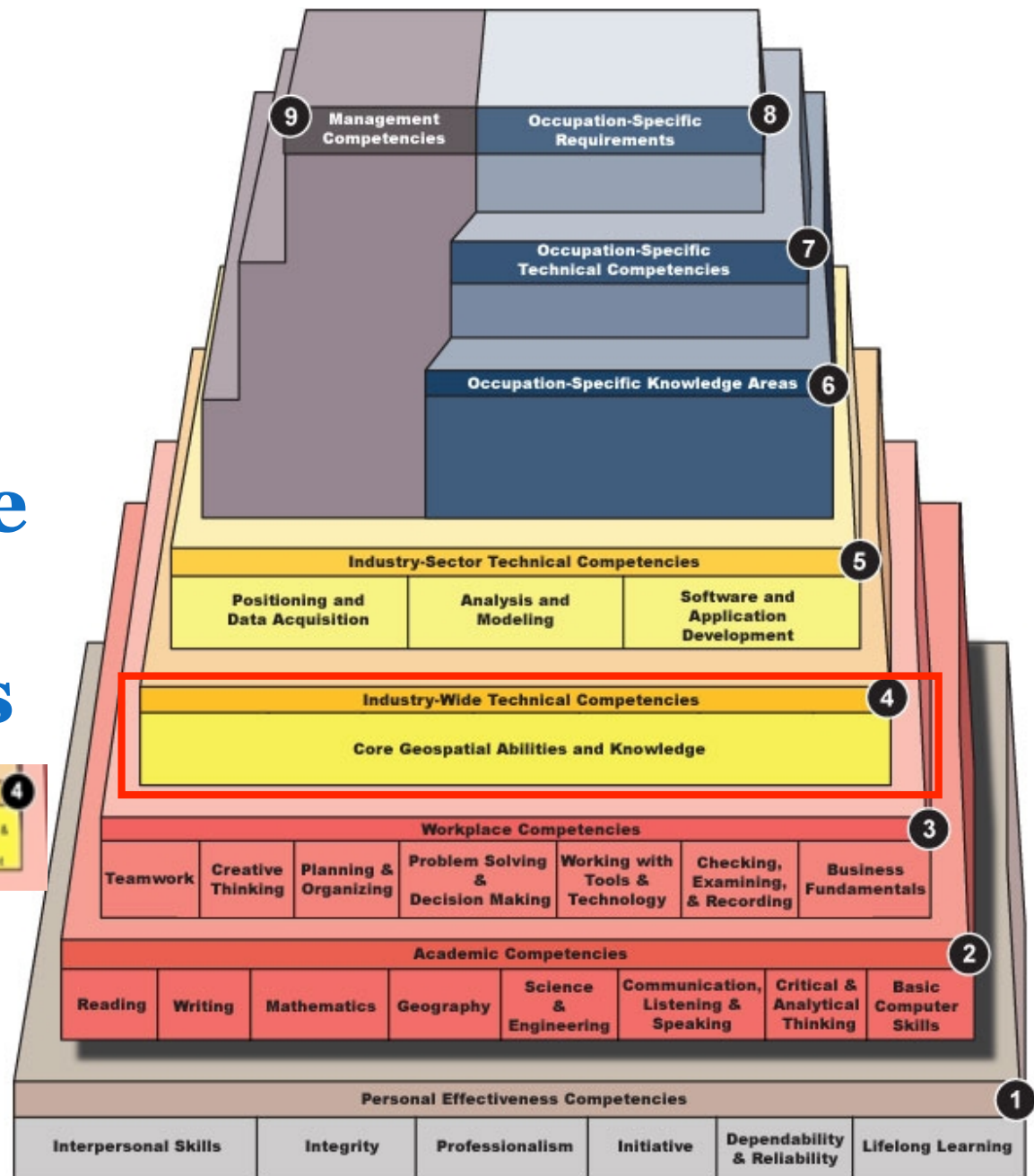
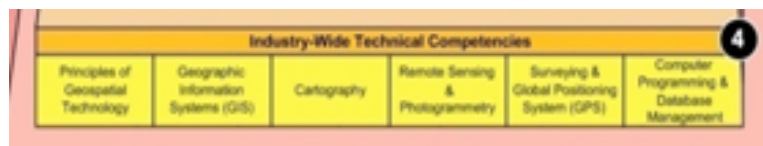
- **Identify the Problem**
 - Anticipate or recognize the existence of a problem
 - Identify the nature of the problem by analyzing its component parts and defining critical issues
 - Locate, obtain, and review information relevant to the problem
- **Generate Alternatives**
 - Generate a variety of approaches to the problem
 - Think creatively to develop new ideas for and answers to work related problems
 - Use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems
 - Build models to conceptualize and develop theoretical and practical frameworks
- **Choose and Implement a Solution**
 - Decisively choose the best solution after contemplating available approaches to the problem
 - Commit to a solution in a timely manner
 - Use strategies, tools, resources, and equipment to implement the solution
 - Observe and evaluate the outcomes of implementing the solution to assess the need for alternative approaches and to identify lessons learned



Tier 3 – Workplace Competencies



Tier 4 - Industry-Wide Technical Competencies



Tier 4 - details

Listed in this tier are 43 examples of "Critical Work Functions" that many geospatial professionals will be expected to perform during their careers. Following the Work Functions are "Technical Content Areas" – the background knowledge upon which skills and abilities are based. These lists are exemplary, not exhaustive; geospatial professionals are called upon to demonstrate other abilities and knowledge depending on their particular roles and positions. Furthermore, few if any workers are responsible for every Critical Work Function in any one job. Thus, the examples cited represent both the core competencies of the geospatial field and the diversity of professional practice within it.

Core Geospatial Abilities and Knowledge

Critical Work Functions

- **Earth Geometry and Geodesy**

- Discuss the roles of several geometric approximations of the earth's shape, such as geoids, ellipsoids, and spheres
- Describe characteristics and appropriate uses of common geospatial coordinate systems, such as geographic (latitude and longitude), UTM and State Plane Coordinates
- Explain the relationship of horizontal datums, such as North America Datum of 1983 (NAD 83) or the World Geodetic System of 1984 (WGS 84), to coordinate system grids and geometric approximations of the earth's shape
- Describe characteristics and appropriate uses of common map projections, such as Transverse Mercator, Lambert Conformal Conic, Albers Conic Equal Area, Azimuthal Equidistant, and Polar Stereographic

- **Data Quality**

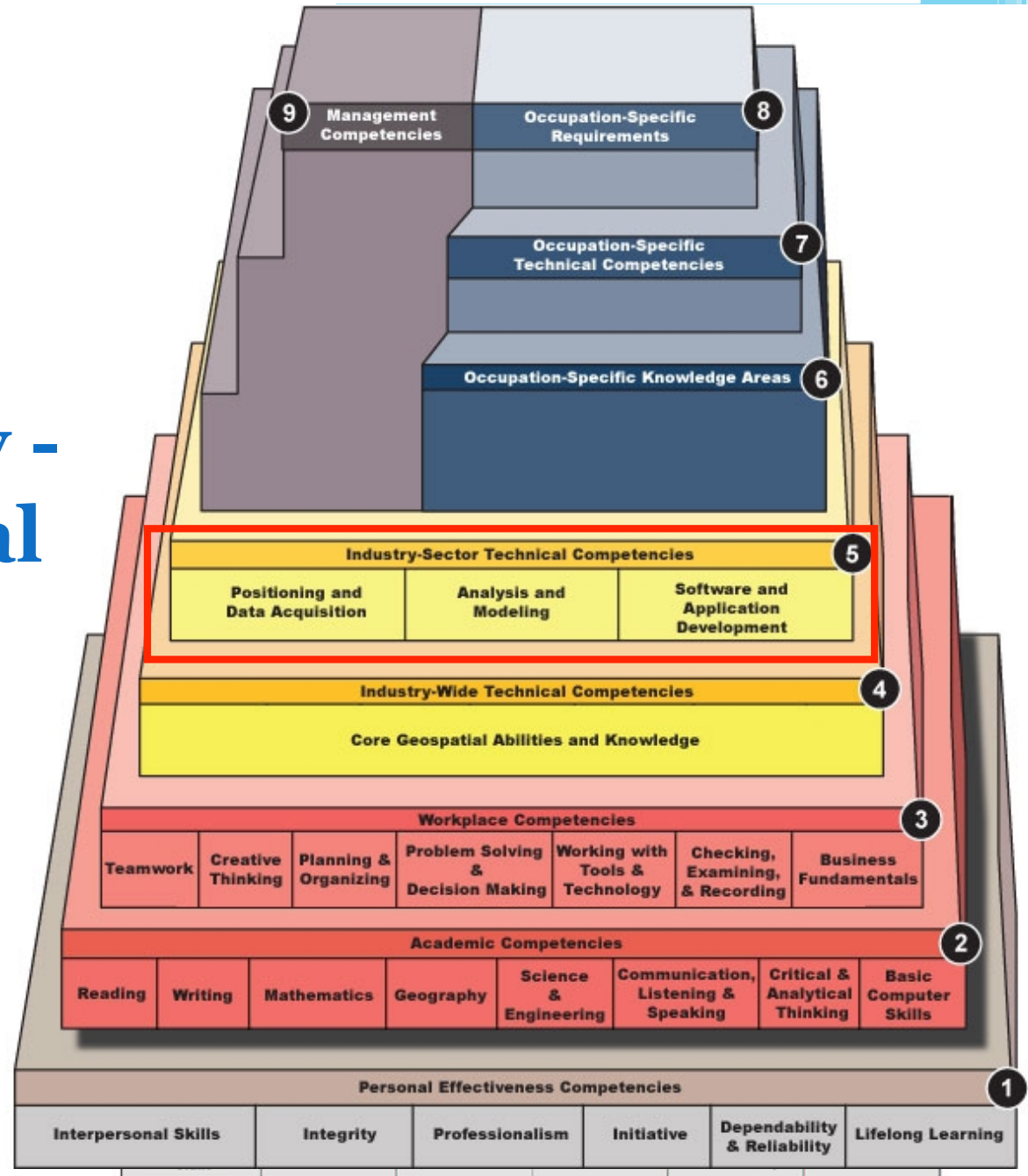
- Discuss the elements of geospatial data quality, including geometric accuracy, thematic accuracy, resolution, precision, and fitness for use
- In the context of a given geospatial project, explain the difference between quality control and quality assurance
- Identify data quality and integration problems likely to be associated with geospatial and attribute data acquired with legacy systems and processes
- Calculate and interpret statistical measures of the accuracy of a digital data set, such as Root Mean Square Error (RMSE)

- **Satellite Positioning and Other Measurement Systems**

- Describe the basic components and operations of the Global Navigation Satellite System (GNSS), including the Global Positioning System and similar systems
- Explain the distinction between GNSS data post-processing (such as U.S. National Geodetic Survey's Online Positioning User Service) and real time processing (such as Real-Time Kinematic)
- Collect and integrate GNSS/GPS positions and associated attribute data with other geospatial data sets
- Compare differential GNSS and autonomous GNSS
- Plan a GNSS data acquisition mission that optimizes efficiency and data quality



Tier 5 - Industry - Sector Technical Competencies

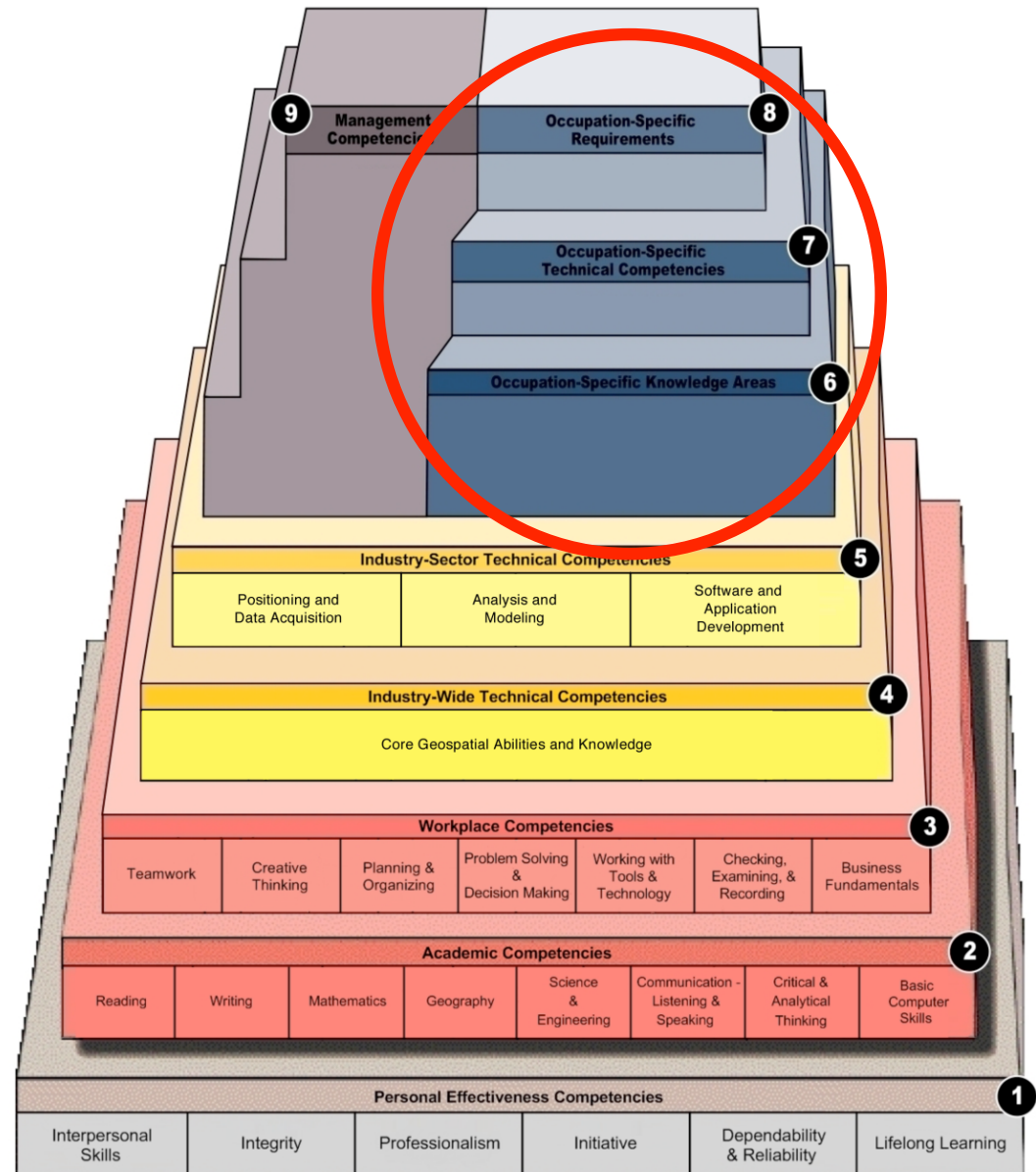


**Tiers 6, 7 & 8
need specific
occupation
competencies
- DACUM
process**



Geospatial Technology Competency Model

June 1, 2010



Five New Occupational Codes



O*NET OnLine

Occupation Quick Search:



[Help](#)

[Find Occupations](#)

[Advanced Search](#)

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[O*NET Sites](#)

Quick Search for:
geospatial

Occupations matching "geospatial"

The search results are listed in a rank order that is calculated on the [relevance](#) of the occupational title, alternate titles, description, tasks, and detailed work activities associated with the keyword you entered.

Select the **Relevance Score** to view the specific items matched by your search within the occupation.

The following terms have been used to augment your search: "spatial". You may wish to check your spelling and search again if you received unexpected results.

Relevance Score	Code	Occupation	
100	15-1099.06	Geospatial Information Scientists and Technologists	
54	19-2099.01	Remote Sensing Scientists and Technologists	
43	15-1099.07	Geographic Information Systems Technicians	
41	19-4099.02	Precision Agriculture Technicians	
40	17-1021.00	Cartographers and Photogrammetrists	
13	19-4099.03	Remote Sensing Technicians	
4	19-3092.00	Geographers	
1	17-1011.00	Architects, Except Landscape and Naval	
0	19-1021.00	Biochemists and Biophysicists	
0	25-1064.00	Geography Teachers, Postsecondary	
0	17-1012.00	Landscape Architects	
0	17-1022.00	Surveyors	
0	17-3031.01	Surveying Technicians	
0	17-3031.02	Mapping Technicians	



<http://online.onetcenter.org/find/quick?s=geospatial>

Details for Geographic Information Systems Technicians

[Help](#)[Find Occupations](#)[Advanced Search](#)[Crosswalks](#)[O*NET Sites](#)

Summary Report for:

15-1099.07 - Geographic Information Systems Technicians

[Partially updated 2009](#)

Assist scientists, technologists, and related professionals in building, maintaining, modifying, and using geographic information systems (GIS) databases. May also perform some custom application development and provide user support.

This title represents an occupation for which data collection is currently underway.

View report:

Summary

[Details](#)

[Custom](#)

[Tasks](#) | [Interests](#) | [Work Values](#) | [Wages & Employment](#) | [Additional Information](#)

Tasks

- Design or coordinate the development of integrated Geographic Information Systems (GIS) spatial or non-spatial databases.
- Design or prepare graphic representations of Geographic Information Systems (GIS) data using GIS hardware or software applications.
- Enter data into Geographic Information Systems (GIS) databases using techniques such as coordinate geometry, keyboard entry of tabular data, manual digitizing of maps, scanning or automatic conversion to vectors, and conversion of other sources of digital data.
- Maintain or modify existing Geographic Information Systems (GIS) databases.
- Perform geospatial data building, modeling, or analysis using advanced spatial analysis, data manipulation, or cartography software.
- Analyze Geographic Information Systems (GIS) data to identify spatial relationships or display results of analyses using maps, graphs, or tabular data.
- Interpret aerial or ortho photographs.
- Review existing or incoming data for currency, accuracy, usefulness, quality, or completeness of documentation.
- Transfer or rescale information from original photographs onto maps or other photographs.
- Select cartographic elements needed for effective presentation of information.

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Interests



Identifying Core Competencies for GIS Technicians

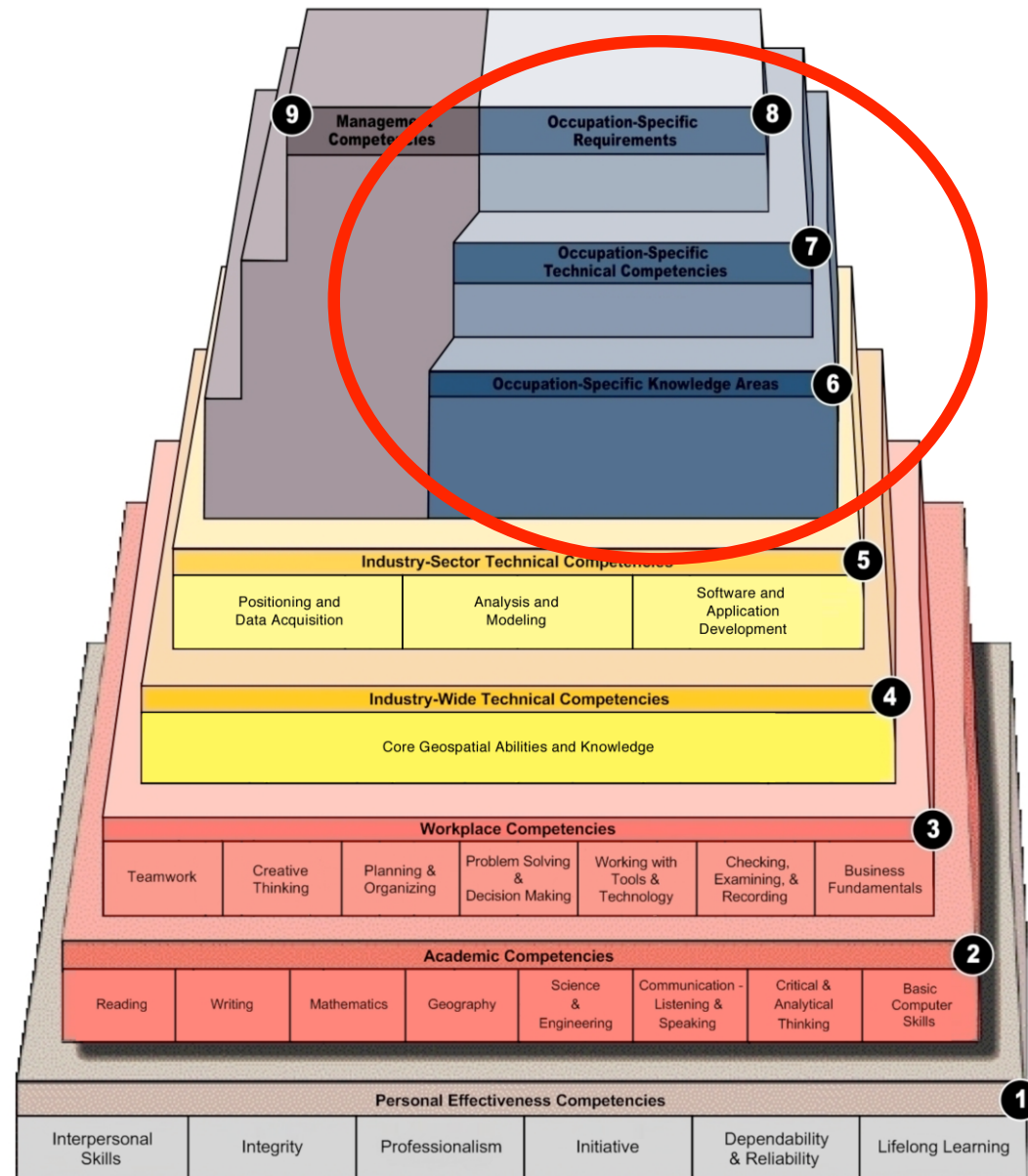


Defining Competencies for Tiers 6, 7 & 8 using DACUM



Geospatial Technology Competency Model

June 1, 2010



Developing A Curriculum “DACUM”

- Process used as an occupational analysis tool
 - Typically involves a two-day workshop
 - Panel of 5-12 expert workers (with the help of a trained facilitator)
 - Systematically constructs a DACUM Research Chart
 - Profiles their job or occupation
 - Includes a comprehensive list of their duties



DACUM Workshop

- ~12 expert workers
- Hotel Conference room
- 2 days
- Meals & Refreshments
- Facilitator – John Johnson
- Note Taker



What do you do? Duties & Tasks

DACUM Research Chart for GIS Technician

January 15th – 16th, 2009

Duties		Tasks											
A	Manage Tasks	A-1 Develop project scope	A-2 Develop project schedule	A-3 Document operating procedures	A-4 Create project status report								
B	Manage Equipment	B-1 Maintain GPS & field equipment (e.g. digital camera, laser range finder, DMI)		B-2 Maintain Vehicle	B-3 Maintain plotter / printer	B-4 Maintain scanner							
C	Gather Data	C-1 Define data requirements (e.g. domains)	C-2 Identify data sources / resources	C-3 Define data collection methods (e.g. GPS, air photo)	C-4 Acquire existing data (e.g. digital, hard copy)	C-5 Connect to external data sources (e.g. ODBC, GIS services)		C-6 Scan hard copy maps	C-7 Collect data using GPS	C-8 Collect data using field sheet			
D	Process Data	D-1 Post process GPS data (e.g. differential correction)	D-2 Define data's spatial reference	D-3 Change data's spatial reference	D-4 "Heads-up" digitize data	D-5 Digitize data using COGO (e.g. metes & bounds)	D-6 Normalize data structure (e.g. schema)	D-7 Perform data conversions	D-8 Georeference data	D-9 Geocode addresses	D-10 Linear reference data	D-11 Derive new data (e.g. generate contours from DEM, data generalization)	
D	Process Data (continued)		D-12 Edit attribute data	D-13 Edit spatial data	D-14 Evaluate spatial data accuracy	D-15 Validate tabular data	D-16 Validate spatial data (e.g. topology, build, verification)						
E	Manage Data	E-1 Organize digital data (e.g. data library)	E-2 Organize non-digital data	E-3 Create / update metadata	E-4 Join tables (e.g. link, join, relate)	E-5 Perform spatial join	E-6 Post / reconcile edits (e.g. changes)	E-7 Archive data					
F	Analyze Data	F-1 Perform viewshed analysis	F-2 Generate statistical reports	F-3 Model linear networks	F-4 Perform site selection	F-5 Identify shortest route	F-6 Identify service area	F-7 Conduct slope analysis	F-8 Identify least-cost path	F-9 Perform proximity analysis			
G	Generate Deliverables	G-1 Create thematic maps (e.g. zoning)	G-2 Create reference maps (e.g. streets)	G-3 Create data analysis reports (e.g. tables, charts)	G-4 Develop presentations	G-5 Provide training	G-6 Create animation (e.g. 3D, 4D)						
H	Professional Development	H-1 Conduct self-assessment	H-2 Participate in workshops & conferences	H-3 Obtain professional certification (e.g. GISP, ASPRS)	H-4 Cross-training (e.g. mentoring, coaching)	H-5 Research current/emerging trends (e.g. publications, on-line)		H-6 Attend training					

DACUM Research Chart: GIS Technician

General Knowledge

Geoprocessing methods
Relational databases
(Informix, Oracle)
Spatial projections
Basic scripting (SQL, VB,
HTML, Python, ASP,
CSS, Query)
GIS Industry standards
Client/company standards
Naming conventions
Raster / Vector
Export formats, properties &
settings
Spatial awareness
Units of measure
Map scale

Plats & deeds
Industry jargon
Data sources
Google Earth (KML)
Adobe Illustrator
Crystal Reports
File types (SHP, GDB,
Coverage, CAD, DGN,
TXT, IMG, TIF, SID,
Flash, PDF, GeoPDF, e00,
PKZIP, RAR, TAR
Related Industries
Mathematics (geometry,
statistics, trigonometry,
algebra)
Legacy technology

Skills

Typing
Unit conversions
Creating models
Time management
Organizational
Troubleshooting
Problem solving
Basic computer
GPS operation
Laminating
Modify user interface
Microsoft office
Map reading
Adding data to a project
(GIS, CAD)
Create TIN model
Interpolation
Cartographic license
Verbal & written
communication
Burn to disk
FTP site
Create map book
Interpersonal
Plotter operation
Graphing & reporting

Worker Behaviors

Self-improvement
Networking
Creativity
Detail oriented
Willingness to learn
Analytical
Punctuality
Self-motivated
Enthusiastic
Multi-tasking

Team player
Diplomatic, tactful
Common sense
Positive attitude
Ethical
Independent
Logical, intelligent
Visionary
Abstract thinker (outside the
box)

Tools, Equipment, Supplies and Materials

ArcGIS Desktop
Adobe Illustrator
AutoCAD
ERDAS Imagine
Microstation
Microsoft Office
GPS
Scanner/Plotter
Internet
Computer
Mobile devices (PDA)
Phone
Camera
Calculator
Vehicle
Software licensing

Future Trends

Web applications
GIS for the masses (Google,
Wikipedia)
User created mashups &
social networking
Pictometry
Broader use in other fields
Utility work / mapping
More access to data
Manage higher expectations
Quality control issues
More info. mapped
Greater accuracy
Lower price
Mapping abstract info
(military, social science)
Emergency response GIS
GIS use in mobile devices

Acronyms

AI	Adobe Illustrator	BMP	Bitmap file
ASPRS	American Society of Photogrammetry and Remote Sensing	DGN	Design file
CAD	Computer Aided Design	DXF	Drawing Interchange Format
COGO	Co-ordinate Geometry	GDB	Geodatabase file
DEM	Digital Elevation Model	JPEG	Joint Photographic Experts Group
DMI	Digital mile indicator	KML	Keyhole Markup Language-Google
Flash	Animation File-Adobe	MSID	Seamless Image Database-LizardTech
GISP	Certified GIS Professional	PDF	Portable Document Format-Adobe
GPS	Global Positioning Systems	RAR	Compression /Archive File
ODBC	Open Database Connectivity	SHP	Shape file
SWF	Shock Wave Flash	TIFF	Tagged Image File Format
TIN	Triangulated Irregular Network	ZIP	Compression /Archive File

DACUM Panel

Azar Khani, GIS Specialist III,
Fulton County Government
Brannon Schnelle, GIS Analyst,
Jordan, Jones & Goulding
Collin Horace, GIS
Developer/Analyst, CH2MHILL
Donald I. M. Enderle, GIS
Analyst, Photo Science Inc.
Dwight Lanier,
GIS/Environmental Science
Laboratory Coordinator,
Gainesville State College
Eric McRae, Director, Information
Technology Outreach Services
Lisa Jackson, Information
Analyst III, Center for GIS,
Georgia Institute of
Technology
Lisbeth Ruiz-Nunez, Regional
Resource Info. Coordinator,
US Forest Service
Mark Lane, GIS Manager, Hall
County Government
Melanie Tabb, GIS Administrator,
Gwinnett County
Ron Pate, Registered Land
Surveyor
Tripp Corbin, Vice President GIS,
Keck & Wood, Inc.

DACUM Facilitators

John Johnson, GIS Workshop
Facilitator
Carol Kraemer, Recorder

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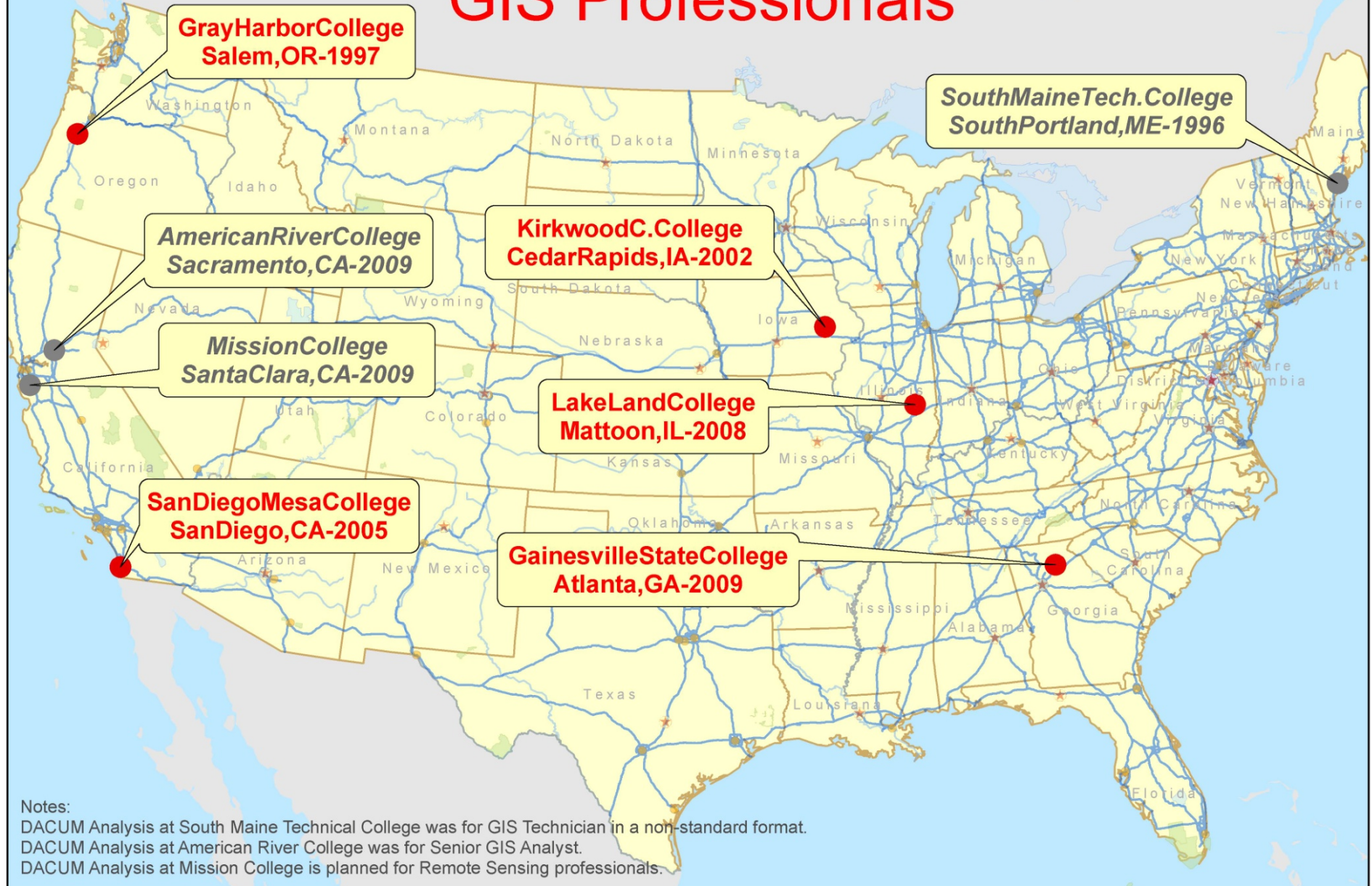


Date: January 15th-16th, 2009

DACUM Validation

Gainesville State College, GIS Technician - Task Verification Survey					
HOW IMPORTANT ARE THESE TASKS TO THE JOB PERFORMANCE OF A GIS TECHNICIAN? (177 Responses)					
Task	n/a	I M P O R T A N C E			Weighted Average
		Number of Responses			
		Not Very (1)	<----->	Very (3)	
D-12 Edit attribute data	1	3	32	141	2.78
D-13 Edit spatial data	3	4	33	137	2.76
G-2 Create reference maps (e.g. streets)	1	5	49	122	2.66
G-1 Create thematic maps (e.g. zoning)	2	6	50	119	2.65
C-4 Acquire existing data (e.g. digital, hard copy)	0	4	61	112	2.61
D-2 Define data's spatial reference	1	11	46	119	2.61
D-3 Change data's spatial reference	2	12	54	109	2.55
D-8 Georeference data	0	12	58	107	2.54
E-4 Join tables (e.g. link, join, relate)	0	9	63	105	2.54
H-6 Attend training	0	5	75	97	2.52
E-5 Perform spatial join	2	12	61	102	2.51
C-2 Identify data sources / resources	0	11	66	100	2.50
C-7 Collect data using GPS	3	11	67	96	2.49
D-14 Evaluate spatial data accuracy	0	13	64	100	2.49
B-1 Maintain GPS & field equipment (e.g. digital camera, laser range finder, DMI)	7	12	65	93	2.48
D-7 Perform data conversions	1	10	72	94	2.48
D-9 Geocode addresses	1	12	67	97	2.48
D-15 Validate tabular data	4	6	80	87	2.47
E-6 Post / reconcile edits (e.g. changes)	3	12	69	93	2.47
D-1 Post process GPS data (e.g. differential correction)	4	10	73	90	2.46
D-4 "Heads-up" digitize data	8	15	61	93	2.46
D-16 Validate spatial data (e.g. topology, build, verification)	5	12	70	90	2.45
E-3 Create / update metadata	1	17	64	95	2.44

6. DACUM Analyses of GIS Professionals



Meta-DACUM Analysis

- **The Meta-DACUM analysis seeks to identify a comprehensive set of tasks currently performed by GIS Technicians in USA**
 - **Consolidating results of five recent DACUMs**
 - **Combined input of over fifty GIS Technicians**
 - **Once validated**
 - **Foundation for the curriculum development**
 - **Basis of common core competencies for GIS Technicians**

Meta-DACUM Job Analysis

By consolidating the validated results from multiple DACUM analyses for a single job taken at various US locations, we can identify a comprehensive list of national competencies.

Geotech Center, 2009

Figure 1 shows five individual DACUM Research Charts for GIS Technician, each labeled 'DRAFT' and dated 'November 1997'. Each chart is a grid with tasks listed on the left and competencies listed at the top. Red arrows point from each of these five charts towards the central 'Meta-DACUM Research Chart for GIS Technician'.

Meta - DACUM Research Chart for GIS Technician

Duties		Tasks									
A	Manage Data	A1 Acquire data (1)	A2 Backup/restore data (5)	A3 Coordinate data collection (3)	A4 Define data requirements (2)	A5 Define relationships (2)	A6 Develop data maintenance schedule (2)	A7 Establish data custodianship (3)	A8 Import/export data (5)	A9 Organize data (1)	A10 Validate data (1)
A	Manage Data (cont.)			A11 Evaluate data (5)	A12 Evaluate data cost (2)	A13 Research available data (2)					
B	Generate Data	B1 COORD legal descriptions (3)		B2 Collect field data electronically (5)		B3 Collect field data manually (5)	B4 Edit/update data (1)	B5 Create/update metadata (2)	B6 Digitize data (4)	B7 Occure data (4)	B8 Geo-reference data (5)
B	Generate Data (cont.)		B9 Convert data (5)	B10 Postprocess GPS data (2)	B11 Rectify imagery (2)	B12 Scan non-digital data (3)					
C	Analyze Data	C1 Conduct performance (3)	C2 Conduct image analysis (3)	C3 Conduct network analysis (5)	C4 Conduct vector analysis (2)	C5 Conduct proximity analysis (2)	C6 Conduct spatial analysis (1)	C7 Conduct spatial interpolation (2)	C8 Conduct statistical analysis (3)	C9 Conduct surface analysis (3)	C10 Identify data anomalies (2)
D	Manage Software	D1 Connect to database (2)	D2 Customize commercial software (2)	D3 Create databases (3)	D4 Develop software applications (4)	D5 Define software/hardware requirements (2)	D6 Define software/hardware performance (3)	D7 Select/maintain software (4)			
E	Manage Projects	E1 Coordinate project activities (6)	E2 Determine project scope (2)	E3 Determine resource requirements (2)	E4 Develop policies & procedures (4)	E5 Develop project budget (3)	E6 Develop project timeline/schedule (3)	E7 Identify client needs (1)			
E	Manage Projects (cont.)		E8 Select/maintain equipment & supplies (4)								



Combine 5 DACUM's To Create one

Meta-DACUM Research Chart for GIS Technicians

2. DUTIES & TASKS

		Validation Survey ¹				Source			
		Rating							
		Low=1	Med=2	High=3					
Duty ³	Task ⁴	Original Task		Importance	Difficulty	Original Duty	Chart ²	Duty	Task
A Manage Data									
1 Acquire data (11)									
	Acquire existing data (e.g. digital, hard copy)	2.61	1.72	Gather Data		GSC	C	4	
	Acquire existing geospatial data	2.43	1.64	Collect / Create Data		LLC	A	4	
	Gather data for updates			Maintain & Update Data		GHC	B	4	
	Obtain agronomic data (e.g. soil test, yield)			Initiate GIS Projects		AGK	B	5	
	Obtain area of interest boundary data			Initiate GIS Projects		AGK	B	3	
	Obtain base map data (e.g. roads, streams, political boundaries, cities)			Initiate GIS Projects		AGK	B	4	
	Obtain climate data (e.g. precipitation, wind, temperature)			Initiate GIS Projects		AGK	B	9	
	Obtain imagery data (e.g. satellite, aerial)			Initiate GIS Projects		AGK	B	6	
	Obtain land use data			Initiate GIS Projects		AGK	B	8	
	Obtain terrain feature data (e.g. soil type, topography)			Initiate GIS Projects		AGK	B	7	
	Purchase new data	1.00	0.78	Create / Acquire GIS Data * (3)		SDM	A	3	
2 Back-up/restore data (6)									
	Archive / retrieve data (E,C)	1.40	1.00	Manage GIS Data		SDM	G	3	
	Archive data	2.28	1.54	Manage Data		GSC	E	7	
	Backup / restore data (E,C)	1.41	1.03	Manage GIS Data		SDM	G	4	
	Back-up Data	2.12	1.54	Maintain Data		LLC	C	2	
	Back-up finished project files			Create Usable Products		AGK	E	7	
	Back-up raw data			Initiate GIS Projects		AGK	B	10	
3 Coordinate data collection (5)									
	Adhere to policies for sharing and receiving data			Information Sharing Data Exchange		GHC	H	2	
	Contact data originator for acquisition			Data Acquisition & Development		GHC	A	4	
	Coordinate data collection			Define project parameters		AGK	A	5	
	Coordinate geodetic control prior to mapping			Data Acquisition & Development		GHC	A	6	
	Define data collection methods (e.g. GPS, air photo)	2.24	1.91	Gather Data		GSC	C	3	
4 Define data requirements (6)									
	Define data requirements (C)	1.53	1.44	Create / Acquire GIS Data * (3)		SDM	A	1	
	Define data requirements (e.g. domains)	2.09	2.10	Gather Data		GSC	C	1	
	Determine appropriate projections			GIS & Remote Sensing Analysis		GHC	D	2	
	Determine coverages to be managed			Database Design		GHC	G	2	
	Determine data needs / format			Data Acquisition & Development		GHC	A	1	
	Determine data to be obtained			Define project parameters		AGK	A	3	
5 Define relationships (6)									
	Create topology for related features (64%) (Adv.)	2.11	2.32	Modify Data		LLC	B	2	
	Define feature behaviors (e.g. sub-types & domains) (C)	1.34	1.75	Create / Acquire GIS Data * (3)		SDM	A	6	
	Define feature relationships / behaviors (relate tables, relationship classes) (C)	1.59	1.69	Create / Acquire GIS Data * (3)		SDM	A	5	
	Join non-spatial data	2.32	1.62	Modify Data		LLC	B	7	
	Join tables (e.g. link, join, relate)	2.54	1.62	Manage Data		GSC	E	4	
	Perform spatial join	2.51	1.71	Manage Data		GSC	E	5	
6 Develop data maintenance schedule (2)									
	Develop a data maintenance schedule			Maintain & Update Data		GHC	B	3	
	Develon a data maintenance schedules	1.36	1.29	Maintain GIS Data* (1)		SDM	C	1	



General Knowledge and Skills

Cartography (6)
Communication - reading (1)
Communication - verbal/presentation (6)
Communication - verbal/presentation & writing (4)
Communication -writing (6)
Computer basics (6)
Computer database (7)
Computer keyboarding (4)
Computer networks (3)
Computer operating systems, platforms (3)
Computer programming (4)
Computer software (6)
Contours (1)
Coordinate systems, projections (1)
Critical thinking (6)
Data models (3)
Data sources (1)
Data types, transfers & conversions (5)
Engineering drawings (3)
Equipment operation (4)
Geography (4)
Geoprocessing, modeling (3)
Industry applications (8)
Industry applications - engineering (2)

Tools, Equipment, Supplies and Materials

Date recorders (1)
CAD software (4)
Calculator (1)
Camera (3)
Computer (desk top, notebook) (8)
Computer (field, hand-held) (2)
Data storage devices (2)
Database software (4)
Digitizing Tablet (2)
GIS software (12)
GPS Receivers/Software (10)
Image processing software (6)
Internet (2)
Phone (1)
Plotters (3)
Presentation software (1)
Printer (3)
Report software (1)
Scanner (3)
Spreadsheet software (1)
Vehicle (2)
Web site publishing software (3)
Word processing/office software (4)

Jargon, acronyms (3)
Land divisions, measurements (6)
Legal issues (2)
Map reading (4)
Mathematics (geometry, statistics) (8)
Organizational (8)
Photogrammetry/Remote Sensing (7)
Problem solving (3)
Queries & analysis (3)
Research (5)
Scale (3)
Spatial awareness (4)
Standards (client, customer, industry) (6)
Time management (5)
Topology (1)
Troubleshooting (4)
Units of measurement (3)

Worker Behaviors

Analytical (5)
Common sense (2)
Creative (1)
Detail orientated (7)
Diplomatic (1)
Enthusiastic (1)
Ethical (2)
Flexible (1)
Good communicator (3)
Industrious (1)
Multi-tasking (3)
Open minded (1)
Outgoing, friendly (1)
Patient (1)
Positive attitude (3)
Professional (3)
Punctual / reliable (5)
Resourceful (1)
Self improvement (3)
Self motivated / independent (9)
Sense of humor (1)
Team Player (8)
Trustworthy (1)
Visionary (3)

Future Trends and Concerns

Decentralization of GIS (2)
Declining cost (2)
Emergency response GIS (2)
Explosion of data (6)
Growing awareness and use of geospatial data (10)
Growing importance of standards (2)
Growth in privacy / security issues (3)
Growth in technological change (1)
Growth of oblique photography (2)
Importance of certification (2)
Improved data accuracy (1)
Lack of competition (1)
Mobile GIS, location based services (LBS) (4)
Need for on-going training (1)
Open source systems (3)
Quality control issues (1)
Software integration (3)
User created mashups & social networking (1)
Web-based GIS (7)

Acronyms

See Part B

* Note: Numbers in brackets indicate the frequency that this item occurred in all DACUM Charts. For details see Section 3.



Meta - DACUM Research Chart for GIS Technician

Duties		Tasks									
A	Manage Data	A1 Coordinate data collection (5)	A2 Define data requirements (6)	A3 Join / relate data (3)	A4 Define feature behavior (3)	A5 Develop data maintenance schedule (2)		A6 Establish data custodianships (3)	A7 Evaluate data (6)	A8 Assess data cost (2)	A9 Research available data (4)
B	Generate Data	B1 COGO legal descriptions (3)		B2 Collect field data electronically (7)		B3 Collect field data manually (2)	B4 Digitize data (4)	B5 Geocode data (4)	B6 Scan non-digital data (3)	B7 Administer questionnaires (1)	
C	Process Data	C1 Acquire data (11)	C2 Organize data (9)	C3 Validate data (10)	C4 Back-up/restore data (6)	C5 Import/Export data (8)	C6 Create/update data (13)	C7 Create/update metadata (7)	C8 Georeference data (8)	C9 Convert data (6)	
D	Analyze Data	D1 Conduct geoprocessing (16)	D2 Conduct image analysis (3)	D3 Conduct network analysis (6)	D4 Conduct spatial analysis (7)	D5 Conduct geostatistical analysis (3)					
E	Manage Software	E1 Design / edit databases (5)	E2 Develop software applications (11)		E3 Define software/hardware requirements (2)		E4 Optimize database performance (4)	E5 Maintain software (3)			
F	Manage Projects	F1 Coordinate project activities (8)		F2 Determine project scope (2)	F3 Determine resource requirements (3)		F4 Develop GIS procedures (1)	F5 Develop policies & procedures (3)		F6 Prepare project cost estimates (3)	F7 Develop project timeline/schedule (3)
F	Manage Projects (con't)		F8 Identify client needs/deliverables (5)		F9 Maintain equipment & supplies (7)						
G	Generate Products	G1 Design / create maps (15)	G2 Create reports (10)	G3 Create tables / charts (3)	G4 Develop & make presentations (6)		G5 Disseminate products (7)	G6 Create animations (1)	G7 Create graphics (1)	G8 Create labels (1)	
H	Professional Development	H1 Communicate with others (7)	H2 Participate in conferences / workshops (10)		H3 Provide training (8)	H4 Develop user guides (4)	H5 Attend Training (4)	H6 Acquire professional certification (2)		H7 Conduct self-assessment (2)	H8 Promote / represent GIS (4)
H	Professional Development (con't)		H10 Review job related information (4)		H11 Supervise interns (2)						H9 Provide technical support (2)

Note: Numbers in brackets indicate the frequency that this item occurred in all 5 DAC

Meta - DACUM Research Chart DACUM Panels

DACUM Panels:

Gainesville State College,
Gainesville, GA
"GIS Technician"
January 15-16, 2009

Lake Land College,
Mattoon, IL,
"GIS Technician"
November 19-20, 2008

San Diego Mesa College,
San Diego, CA
"GIS Technician"
January 13-14, 2005

AgrowKnowledge,
Kirkwood Community College,
Cedar Rapids, IA
"GIS Technician/Analyst"
November 14-15, 2002

Grays Harbor College

**Consolidated
by**

Duty & Task Grouping
& Consolidation by:
John Johnson, Geotech Ctr.
Dan Forstberg, GISCI
Geney Terry, GISCI
Tom Mueller, GISCI
Tim Leach, GISCI
Kerri Brennan, GISCI

DACUM Charts:

GAINESVILLE
STATE COLLEGE
Geospatial Systems of Learning

Lake Land College

Mesa
San Diego Mesa College

AgrowKnowledge
Kirkwood Community College

GRAYS HARBOR COLLEGE
1001 University Dr., Grays Harbor, WA 99230 Phone: (509) 682-4400 Fax: (509) 682-4401

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[DUE # 0801892]

Date: January 27, 2010

General Knowledge and Skills

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Coordinate systems, projections (1)
Critical thinking (6)
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Data sources (1)
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Report software (1)
Scanner (3)
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Queries & analysis (3)
Research (5)
Scale (3)
Spatial awareness (4)
Standards (client, customer, industry) (6)
Time management (5)
Topology (1)
Troubleshooting (4)
Units of measurement (3)

Future Trends and Concerns

Decentralization of GIS (2)
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User created mashups & social networking (1)
Web-based GIS (7)

Acronyms

See Section 4

Worker Behaviors

Analytical (5)
Common sense (2)
Creative (1)
Detail orientated (7)
Diplomatic (1)
Enthusiastic (1)
Ethical (2)
Flexible (1)
Good communicator (3)
Industrious (1)
Multi-tasking (3)
Open minded (1)
Outgoing, friendly (1)
Patient (1)
Positive attitude (3)
Professional (3)
Punctual / reliable (5)
Resourceful (1)
Self improvement (3)
Self motivated / independent (9)
Sense of humor (1)
Team Player (8)
Trustworthy (1)
Visionary (3)



Geospatial Technology Competency Model and Assessment Tools

- **Validated by Industry**
- **Not just “one application area”**
- **Useful for Educators**
 - **Creating and updating curriculum**
 - **Articulation between levels/campuses**
- **Useful for Industry**
 - **Certification efforts**
 - **Personal check list for employees**
 - **HR Departments (hiring and job classifications)**
- **Students**
 - **Self Assessment**
 - **Compare programs**



GIS Technician Tasks (Font Size = relative importance)

Manage Data A

- Evaluate data A7
- Research available data A9
- Join & relate data A3
- Define feature behavior A4
- Coordinate data collection A1
- Define data requirements A2
- Develop data maintenance schedule A5
- Establish data custodianships A6
- Assess data cost A8

Generate Data B

- Digitize data B4
- Collect field data electronically B2
- Collect field data manually B3
- Geocode data B5
- COGO legal descriptions B1
- Scan non-digital data B6
- Administer questionnaire B7

Process Data C

- Create/update data C6
- Georeference data C8
- Acquire data C1
- Validate data C3
- Convert data C9
- Back-up/restore data C4
- Import/Export data C5
- Create/update metadata C7
- Organize data C2

Analyze Data D

- Conduct geoprocessing D1
- Conduct geostatistical analysis D5
- Conduct image analysis D2
- Conduct network analysis D3
- Conduct spatial analysis D4

Manage Software E

- Maintain software E5
- Design / edit databases E1
- Develop software applications E2
- Define software/hardware requirements E3
- Optimize database performance E4

Manage Projects F

- Develop GIS procedures F4
- Coordinate project activities F1
- Maintain equipment & supplies F9
- Determine resource requirements F3
- Develop policies & standards F5
- Prepare project cost estimates F6
- Identify client needs/deliverables F8
- Determine project scope F2
- Develop project timeline/schedule F7

Generate Products G

- Design / create maps G1
- Create reports G2
- Disseminate products G5
- Create graphics G7
- Create tables & charts G3
- Create labels G8
- Develop & make presentations G4
- Create animations G6

Professional Development H

- Communicate with others H1
- Attend Training H5
- Provide technical support H9
- Participate in conferences / workshops H2
- Conduct self-assessment H7
- Acquire professional certification H6
- Review job related information H10
- Provide training H3
- Develop user guides H4
- Supervise interns H11
- Promote / represent GIS H8



Source: National Geospatial Technology Center, GIS Certification Institute Working Group, Meta-DACUM Analysis, Feb., 2010

Assessment Tools

- FREE
- <http://resources.geotechcenter.org/>

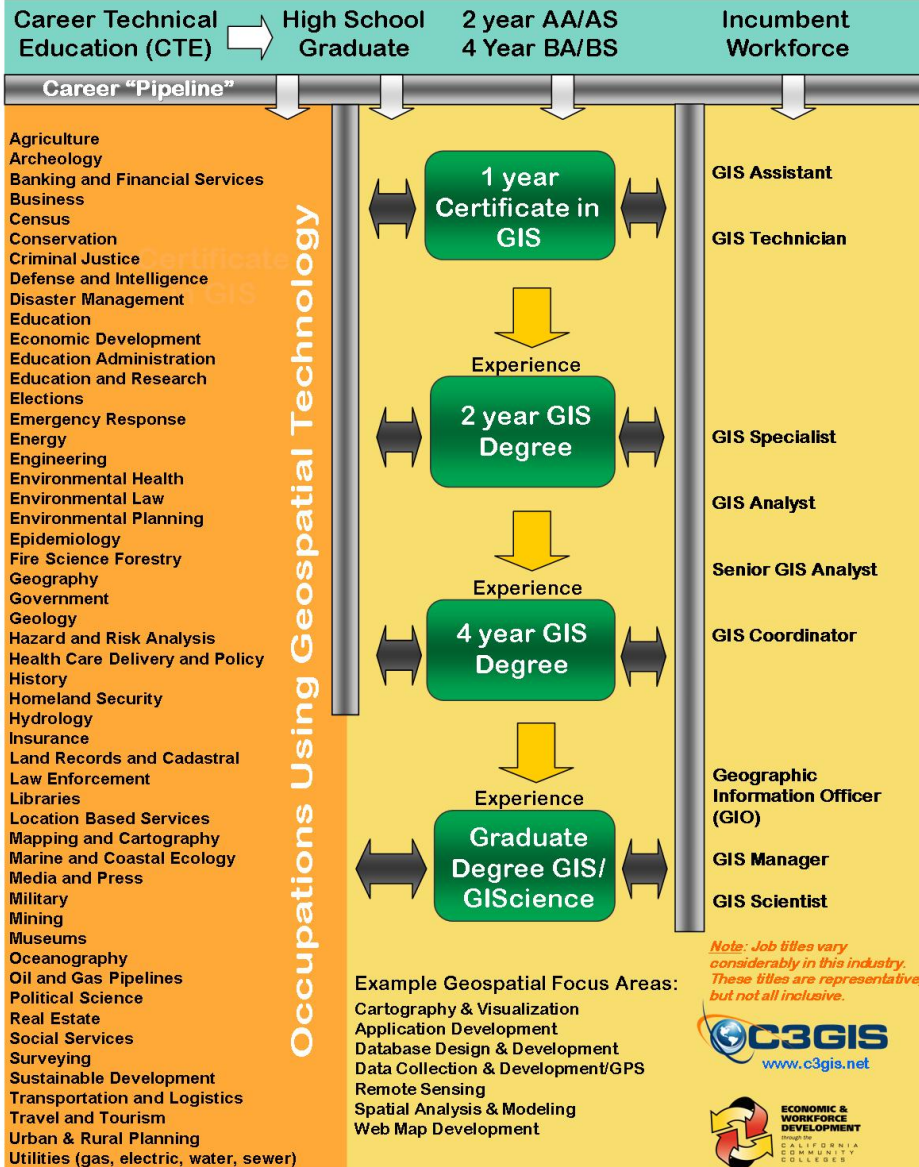


GeoTech Center - Future

- **DACUM and Meta-DACUMS**
 - **Remote Sensing Technicians**
 - **Surveyors**
 - **Others as they are identified**
- **Curriculum guides and other assessment tools**
- **Mentor colleges assessing programs**
- **Geospatial Program Maps**
 - **US Universities**
 - **International Universities**

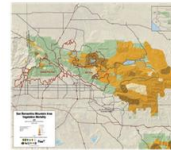


Geospatial Technology Career Pathway



Geospatial Technology Careers

On the opposite page is a list of some of the exciting job possibilities you can pursue if you know how to use geospatial technology. Follow the Pipeline to see how increasing your education and experience in geospatial technology can lead to higher paying and rewarding careers. Geospatial Technology includes:



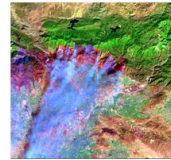
Geographic Information Systems (GIS)

Maps on the web and on TV are helping us to understand and solve problems such as where a wildfire is burning, what states have more cases of flu, or if bad weather is approaching. GIS is the technology that is helping create those maps. Learn more about GIS at gis.com



Global Positioning Systems (GPS)

A GPS can tell you where you are and help you navigate to another location by the best route. Professional grade GPS equipment can serve as a high precision field data collection tool to create locations of features on the ground for use in GIS or remote sensing. Learn more about the global positioning system at gps.gov



Remote Sensing

More remote sensing data is available than ever before to help make finding solutions for complex problems easier, faster and less expensive. People who understand how to use images and other data from satellites and ground sensors are in demand. Learn more about remote sensing at rst.gsfc.nasa.gov

What are the Career Opportunities?

Even with the downturn in the economy, opportunities continue to be good for people who know and can use geospatial technology — either part time as a tool, in another occupation, such as environmental science or crime analysis, or as a specialist focusing full time on geospatial technology. To learn more see directionsmag.com or visit esri.com/industries or videos at YouTube.com and search esrity.

Where can I find out more?

Occupational Sites: - articles about geospatial careers, occupations, jobs, and salaries

careervoyages.gov	geospatialcareers.net	GISjobs.com	gjc.org
directionsmag.com	giscafe.com	gislounge.com	online.onetcenter.org
Geojobs.org	giscareers.com	giwis.org	urisa.org

Professional Organizations: Some offer student internships at meetings and conferences.

Association of American Geographers	(AAG)	aag.org/careers
Geospatial Information & Technology Association	(GITA)	gita.org
National Council for Geographic Education	(NCGE)	ncge.org
The Imaging & Geospatial Information Society	(ASPRS)	asprs.org
The Society for Conservation GIS	(SCGIS)	scgis.org
Urban and Regional Information Systems Association	(URISA)	urisa.org

Certification: GISCI gisci.org

ASPRS asprs.org

Digital Quest: digitalquest.com

Thank you!

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