Assessment of Workforce Demands to Shape GIS&T Education

Gudrun Wallentin, Barbara Hofer, Christoph Traun

Gudrun.wallentin@sbg.ac.at

University of Salzburg, Dept. of Geoinformatics – Z_GIS, Austria

www.gi-n2k.eu
What should we know as GIS professionals?

- NCGIA Core Curriculum
- University Consortium for GIS (UCGIS)
- BoK 2.0
- UCGIS initiative

- Geospatial Technology Competency Model
- US Department of Labor

- GI-N2K

Timeline:
- 1990
- 1995
- 2000
- 2005
- 2010

Academia vs. Industry
Why BoK 2.0?

Easy to use

Higher Education
- curriculum design, accreditation

GIS&T professional
- professional certification

Workforce
- human resources professionals

Demand-driven

platform to manage and query GIS&T domain knowledge
# GI-N2K project

<table>
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<tr>
<th>Milestones</th>
<th>Lead partner</th>
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<tr>
<td><strong>1</strong> Analysis of demand and supply</td>
<td><strong>Danny Vandenbroucke, Univ. Leuven (BE)</strong></td>
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<td><strong>2</strong> Content-revision of the BoK</td>
<td><strong>AGILE</strong></td>
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<td>Sept 2015</td>
<td>Univ. of Muenster (DE)</td>
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<td><strong>3</strong> The Virtual Lab for the bok: VirLaBok</td>
<td>Nova Univ. of Lisbon (PT)</td>
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<td>Sept 2015</td>
<td>Univ. of the Bundeswehr (DE)</td>
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<td><strong>4</strong> Testing &amp; Validation</td>
<td><strong>Univ. West-Hungary (HU)</strong></td>
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<td>Sept 2016</td>
<td>Univ. of Girona (ES)</td>
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Assessment of Workforce Demand
Survey participation throughout Europe

Survey (questionnaire)
435 questionnaires
33 countries

In-depth interviews
21 leading experts
6 European regions
Do you know the GIS&T BoK?

- 72% not aware
- 14% aware & use
- 14% aware

n=21
Rate the importance of..
Cartography and Visualisation

- preparing data for map production (e.g. classification, generalisation, map projection)
- designing maps (e.g. symbology, typography, colour schemes)
- choosing adequate graphic representations (e.g. thematic maps, interactivity, web mapping)
- producing maps (e.g. map reproduction, colour separation)
- using and evaluating maps (e.g. map interpretation, usability evaluation)
Geospatial Data

working with land partitioning systems (e.g. cadastre)
using georeferencing systems (e.g. geographic coordinate systems, linear referencing)
specify geodetic datums (e.g. WGS84, vertical datums, NAP)
understand map projections (e.g. projection classes, properties and parameters)
assess data quality (e.g. geometric or thematic accuracy and resolution)
land surveying and GPS
digitising (e.g. with tablet, on-screen or automated vectorisation)
collecting field data (e.g. select sample size, field data technologies)
aerial imaging and photogrammetry (e.g. image interpretation, feature extraction)
remote sensing (e.g. applying algorithms and processing, accuracy assessment)
metadata, standards and infrastructures (e.g. SDI, INSPIRE)
Analytical methods

- apply query operations (e.g. SQL)
- measure geometric properties (e.g. distance, area, connectivity)
- use basic analytical operations (e.g. buffer, overlay, map algebra)
- analyse spatial data (e.g. point pattern analysis, multi-criteria evaluation)
- analyse surfaces (e.g. viewsheds, cost surfaces, calculate slope)
- use spatial statistics (e.g. Morans I, spatial weights matrix)
- use geostatistics (e.g. Kriging, semivariogram modelling)
- use geostatistics (e.g. Kriging, semivariogram modelling)
- apply spatial regression (e.g. geographically weighted regression)
- data mining (e.g. BigData handling, knowledge discovery)
- analyse networks (e.g. graph theory, routing, utility networks)
- mathematical optimisation (e.g. operations research, linear programming, location-allocation)
Geocomputation

- using advanced computational methods (e.g. neural networks, grid computing)
- using cellular automata (e.g. define transition and neighbourhood rules, apply CA)
- using heuristics (e.g. simulated annealing)
- apply genetic algorithms (e.g. location optimisation)
- developing agent based models (e.g. model specification, calibration, encoding)
- simulation modelling (e.g. Monte Carlo simulation)
- assessing uncertainty (e.g. error propagation, MAUP)
- using fuzzy sets (e.g. fuzzify spatial decision making)
Rating by educational level

Mean Rating of Relevance on a scale from 1 (not important) to 6 (extremely important)

What is your highest level of education regarding GIS&T?
- GIS&T user (n=36)
- Competent GIS&T user (self-trained) (n=51)
- Competent GIS&T user (extensively trained) (n=63)
- Bachelor (GIS&T) (n=44)
- Master (GIS&T) (n=157)
- PhD / Doctorate (GIS&T) (n=72)
Current and Future Tasks

Which competences would you like to obtain?

GIS
data
spatial

Which competences will gain importance in the future?

mapping
applications
knowledge
inspire
management
modeling
programming
web
mobile
development
project
use
information
systems
database

open
integration
mining
information
systems
big
gist
web
cloud
programming
mobile

applications
use
management
database
development

ESRI User Conference 2015, San Diego
Diversity between sectors

Which tasks do you frequently perform?

academia
- project
- services
- cartography
- visualization
- teaching
- research
- gist
- maps
- modeling
- students
- software

public administration
- implementation
- analyze
- create
- project
- maps
- management
- development
- web
- planning
- information
- applications
- land
- support

private companies
- business
- different
- analysis
- design
- develop
- creating
- geotools
- geographic
- projects
- maps
- geographic
- development
- applications
- software
- database
## Gaps in the BoK

<table>
<thead>
<tr>
<th>Application development</th>
<th>Java, python, API</th>
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<tr>
<td>WebGIS</td>
<td>html5, semantic web, restful, smartphone</td>
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<tr>
<td>SDI</td>
<td>INSPIRE, harmonization, 19109</td>
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<tr>
<td>data acquisition</td>
<td>open data, big, data, VGI, UAV, Radar RS</td>
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<tr>
<td>other ‘hot’ topics</td>
<td>augmented reality, City GML, OBIA</td>
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Complementary: Qualitative Interviews

Three major deficits repeatedly mentioned:

- IT skills
- applying theoretical knowledge to real-world problems
- soft skills: (English) language and team working.

Variation in the GIS&T job market

- ‘no problem to find employees’
- ‘slight oversupply features the market’
- ‘industry needs more good graduates’
- ‘it is difficult to find GIS&T experts’
Is there a European GIS&T?

![Relevancy of GIS&T BoK Knowledge Areas](chart.jpg)
Future Trends Identified

Câmara et al. 2009 – Geographical Information Engineering in the 21st Century:

Technology side:
- Sensor networks
- Mobile devices
- Remote sensing

Concepts side:
- Semantics
- Time
- Cognition
Conclusions and open questions

- GIS&T trends towards IT

- Variety between sectors >> between continents

- Where are disciplinary boundaries of GIS&T?

- Should workforce demands drive higher education?