

Do we know what they need to know?



EU Project GI-N2K, Wp1:
Demand for and Supply of
Geospatial Education and Training

06 Sept 2014, Frans Rip



Demand and Supply

...what **they** need to know...



■ **They** =

- GI-professionals: specialists, users, managers.
Objective: do their jobs. => **Demand side**
- GI-students: participants in GI teaching at EQF levels 4-8 (voc. - prof. - acad. - PhD). To get a job.

Are their learning needs met by the GI teaching on offer?

- **GI Teaching**: sequence of lessons + exercises, designed to develop GI competences. Offered by organisations and companies: **Supply side**



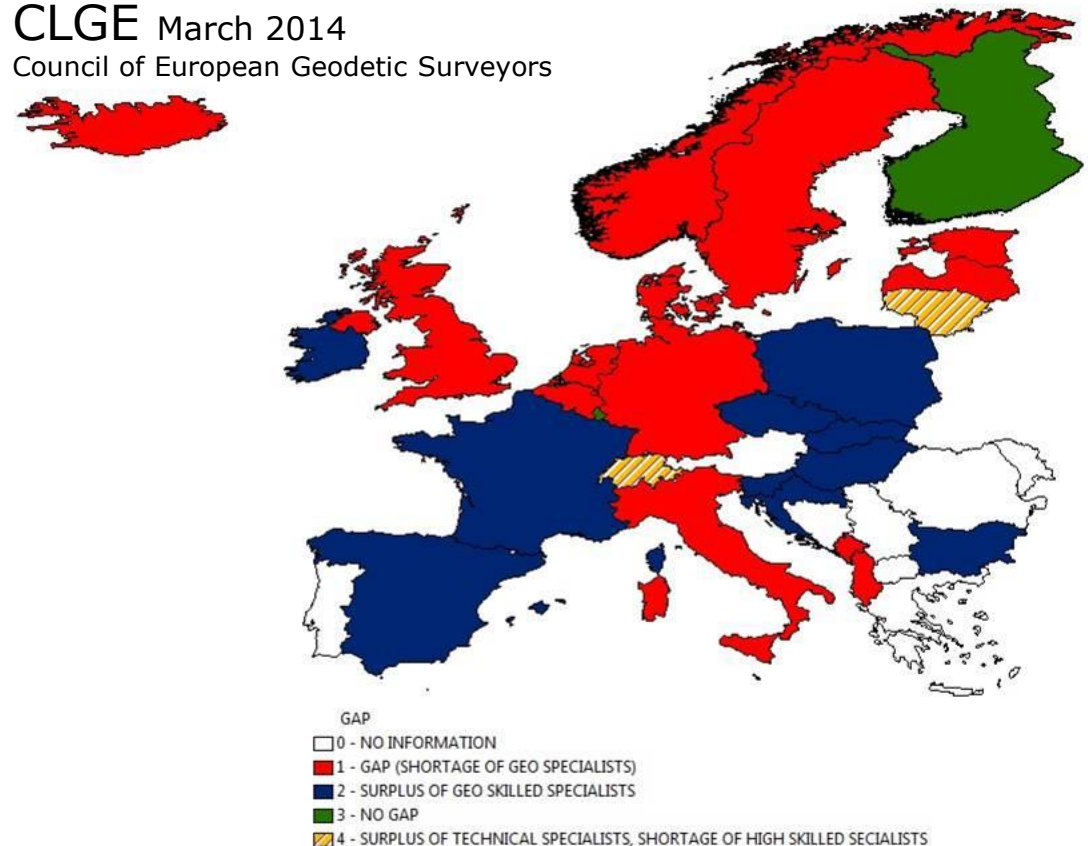
EU objective (Europe 2020 strategy):
improving skills and access to **education and training**,
focusing on market needs

Teaching is about
acquiring
competences

- GI-Problem:
finding people
with the right
ones

CLGE March 2014

Council of European Geodetic Surveyors



GI-N2K project (2013-2016)

Geographic Information: **N**eed to **K**now



- **Wp1**: Demand & Supply survey and analysis
 - State of awareness and use of GI-BoK?
 - Is there a teaching gap?
 - What is missing in GI-BoK
- Wp2: contents of GI-BoK next version (started)
- Wp3: construction of next version (started)
- Wp4: Test among partners (not yet started)

- Partners from 25 European countries; Lead: KU Leuven

<http://www.gi-n2k.eu/>

GI-N2K Wp1 results



- **Demand Survey** (University Salzburg, Austria)
 - Awareness and use of GI-BoK
 - Relevance of GI-BoK / Need for obtaining competences
 - Missing subjects in GI-BoK
- **Supply Survey** (Wageningen University, Netherlands)
 - Awareness and use of GI-BoK
 - Existing and Intended courses
 - Missing subjects in GI-BoK
- **Analysis of Demand vs Supply**



Demand vs. Supply

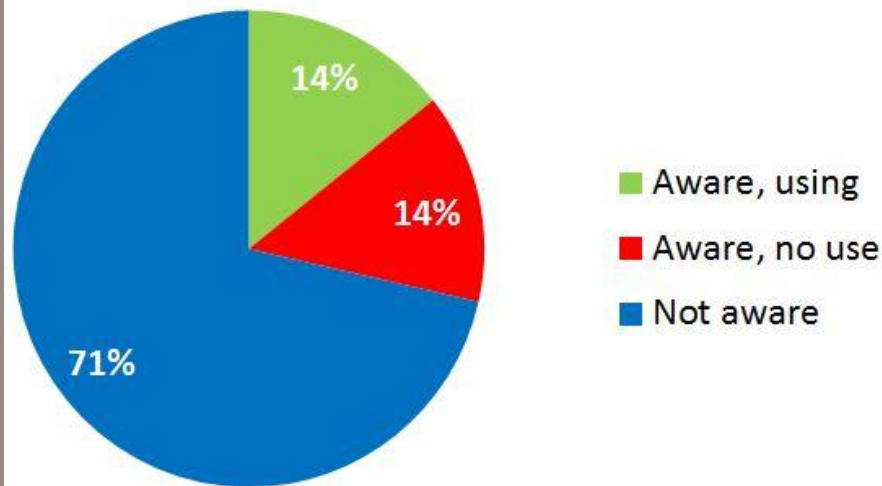
GI-BoK Awareness and use



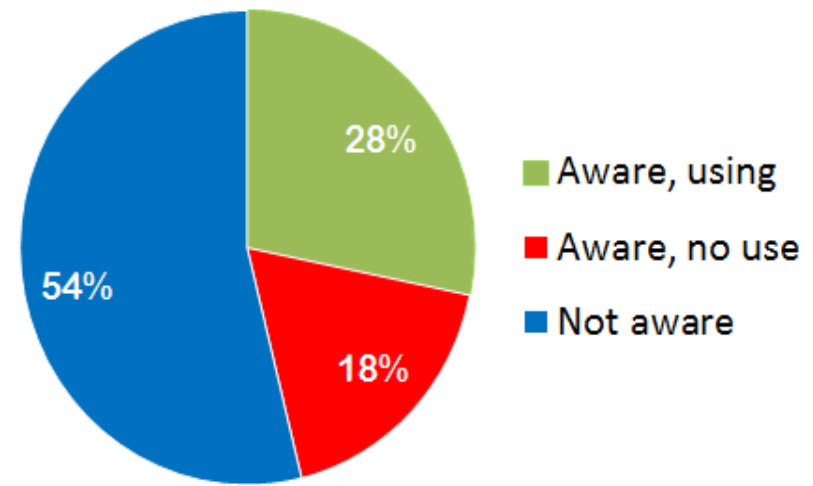
■ Conclusion:

Awareness and use of GI-BoK is limited.

It does not (yet) function as a common reference for GI-teachers and GI-employers



Awareness and use of GI-BoK among interview partners at the Demand side
(N=21)



Awareness and use of GI-BoK at the Supply side
(N=233)



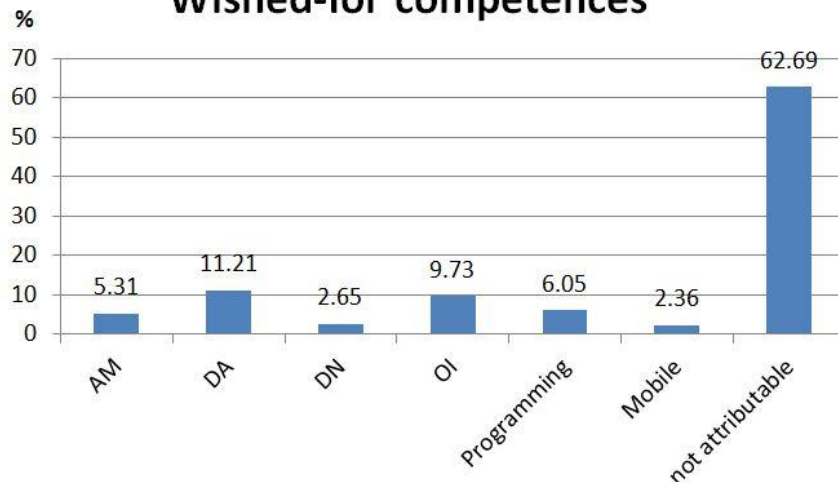
Demand vs. Supply: teaching gap?



Respondents rating

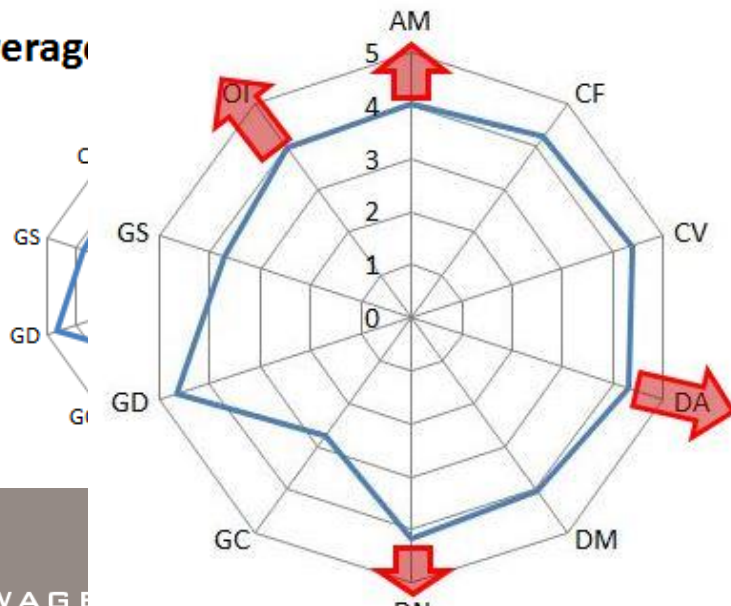
		Scale of 1-6
AM	Analytical Methods	4.0
CF	Conceptual Foundations	4.2
CV	Cartography and Visualization	4.4
DA	Design Aspects	4.3
DM	Data Manipulation	4.2
DN	Data Modeling	4.0
GC	Geocomputation	2.7
GD	Geospatial Data	4.7
GS	GIS&T and Society	3.7
OI	Organizational & Institutional Aspects	4.0

Wished-for competences



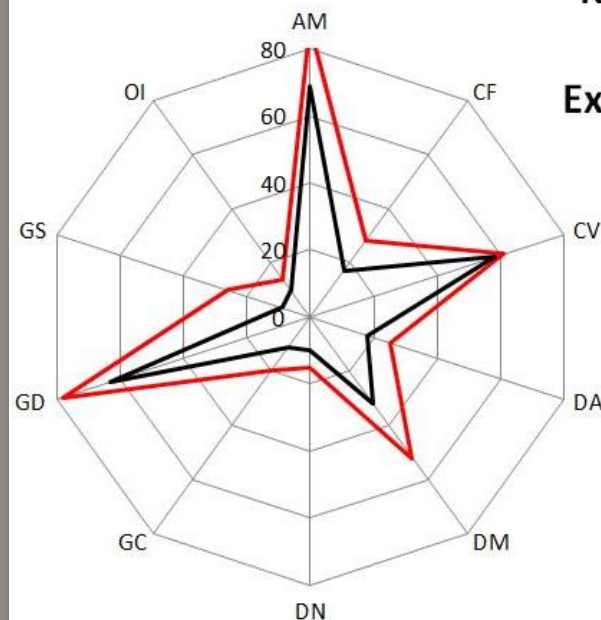
DEMAND

Average



KA-relevance + Competence Needs

Teaching on offer



Knowledge Areas
EQF levels 4-8
Existing + Intended
N=297+109

— Existing + Intended
— Existing



WAGB

Demand vs. Supply: teaching gap?



Conclusion from diagrams:
Competence needs and teaching
supply seem different.
Is there a Teaching gap in reality?

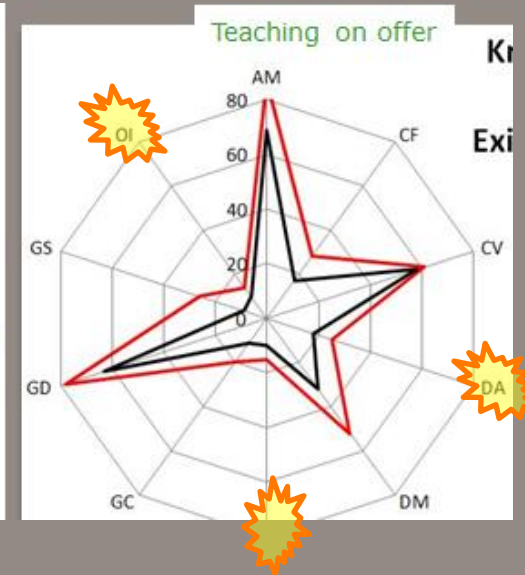
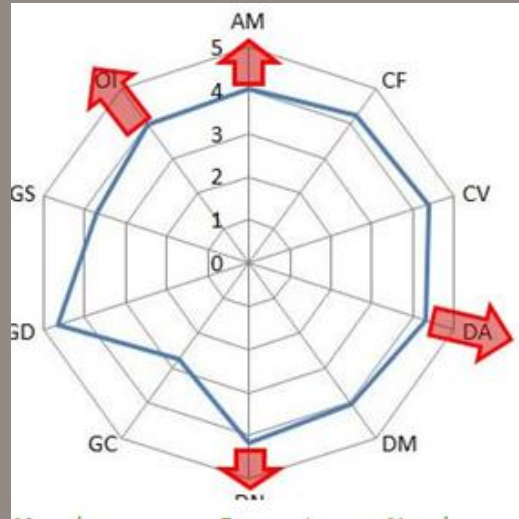
Possible causes of the difference:

- The questions asked
- The lacking awareness of GI-BoK as a shared frame of reference

So, the situation might be better than it seems

-> **No conclusive evidence for a teaching gap.**

But... If organisational aspects (scheduling, fees, language, location) were also taken into consideration, the situation might be worse, especially on a multi-country scale.



Demand vs. Supply Missing in GI-BoK



Progr.Dev.

Data archive
Frontend
API
Geojson
Python
Plugin
Javascript
Object or. Progr.
Java

Data acquisition

OSM
UAV, drone
GNSS
(Glob.Nav.SatSys)
Mass data
Open data
Crowd sourcing
VGI (vol.Geogr. Inf.)
Big data
Radar RS, SAR

Other 'hot topics'

Geomarketing
2D
Semantics
OBIA (object based im. anal.)
4D
BIM (building inf. model)
Data archive
Augmented reality
Indoor GML / City GML 4D

SUPPLY side

WebGIS

Web application
Geoprocessing
Html5
Smartp
GPRS
RESTfu
Semantic web

SDI

Inspire
Harmonization

Web Services

- Web platforms,
- System architecture

Data acquisition technology

- UAV
- LiDAR

Conclusion:

Dozens of possible subjects on various conceptual levels not present in GI-BoK.
GI-BoK is truly incomplete

DEMAND side

Point cloud analysis

Qualitative GIS

Open source software

Programming in Python

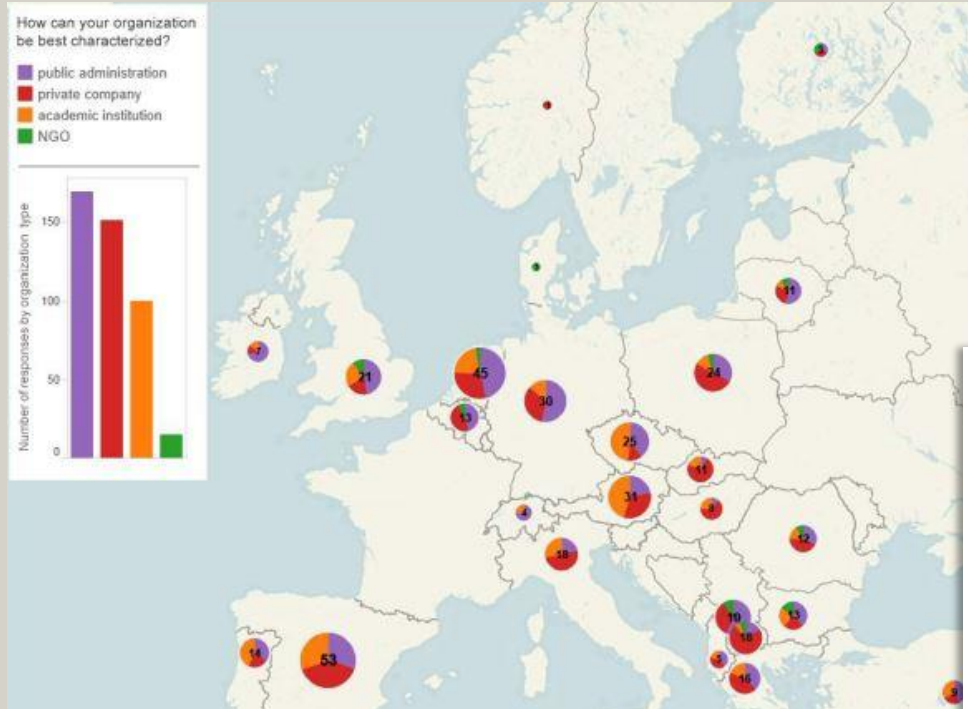
UML

XML



WAGENINGEN UR
For quality of life

GI-N2K Survey responses

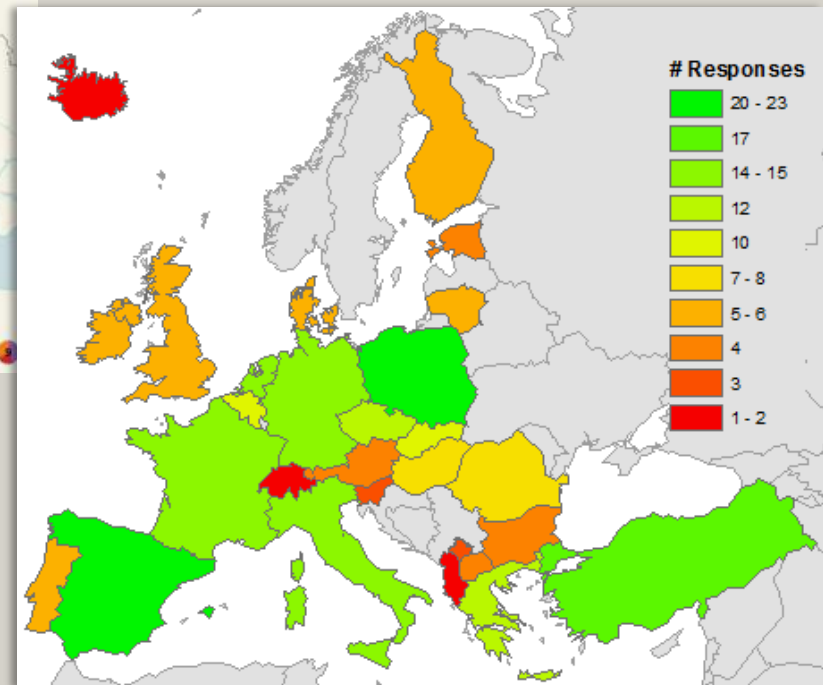


Demand side:

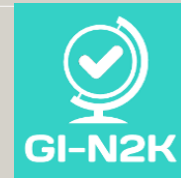
- Valid responses: 435 out of >1000
- From 28 countries

Supply side:

- Valid responses: 234 out of 264
- From 28 countries



Awareness and use of GI-BoK



Interviews

- 6 out of 21 interview partners are aware of GI-BoK
- Only 3 used it (all academics)

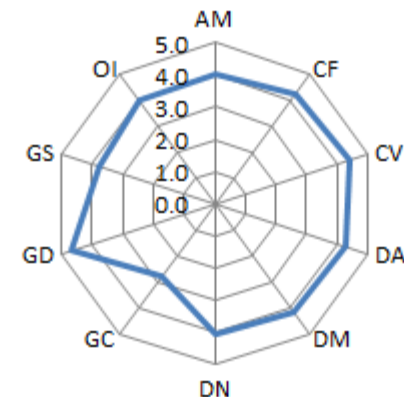
Comments about GI-BoK:

- *[if] 'it was more practical oriented'...*
- *'strongly academic'*
- *'way too theoretical'*
- private companies *'rather need an easy-to-use and more straightforward tool'.*
- use the BoK for student self-assessment.
- use the updated BoK as a foundation for the new competence-oriented salary system in the German public administration.

Regular respondents (465)		Scale of 1-6
AM	Analytical Methods	4.0
CF	Conceptual Foundations	4.2
CV	Cartography and Visualization	4.4
DA	Design Aspects	4.3
DM	Data Manipulation	4.2
DN	Data Modeling	4.0
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OI	Organizational & Institutional Aspects	4.0

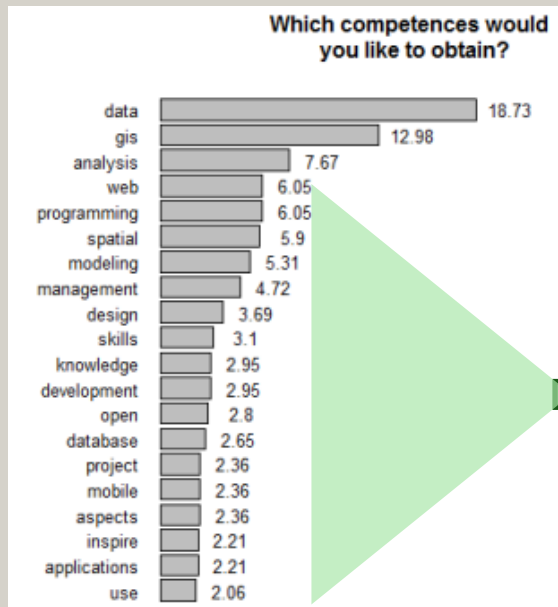
DEMAND

Average Relevance of KA's



Demand survey results

Need for competences

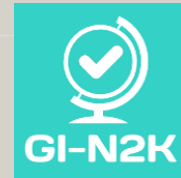


Free text response analysis

Word clouds of the 2% - 7% range

Demand Survey results

Missing in GI-BoK



Progr.Dev.

Data archive
Frontend
API
Geojson
Python
Plugin
Javascript
Object or. Progr.
Java

Data acquisition

OSM
UAV, drone
GNSS
(Glob.Nav.SatSys)
Mass data
Open data
Crowd sourcing
VGI (vol.Geogr. Inf.)
Big data
Radar RS, SAR

Other 'hot topics'

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4D
BIM (building inf. model)
Data archive
Augmented reality
Indoor GML / City GML 4D

WebGIS

Web application
Geoprocessing
Html5
Smartphone, mobile
GPRS
RESTful
Semantic web

SDI

Inspire
Harmonization
Geoportal
ISO standards
19107, 19109

Subjects mentioned in the
free text descriptions

Demand side summary



- **Awareness**

Little awareness of GI-BoK, almost no use

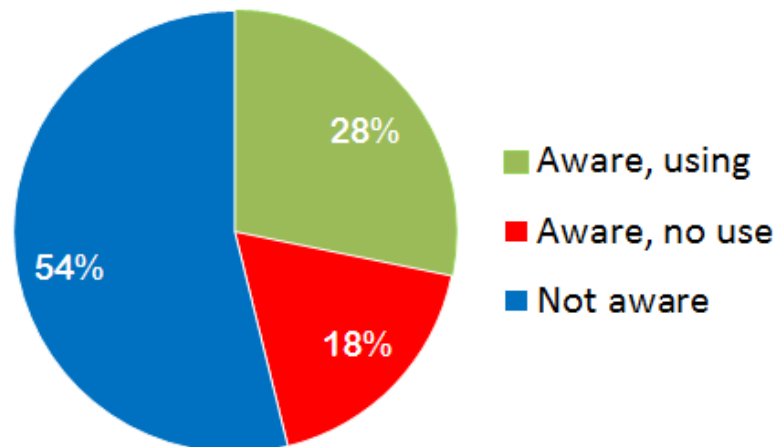
- **Demand**

Keywords indicate need for both GI competences (e.g. 'mapping') and non-GI competences (e.g. 'web')

- **Missing**

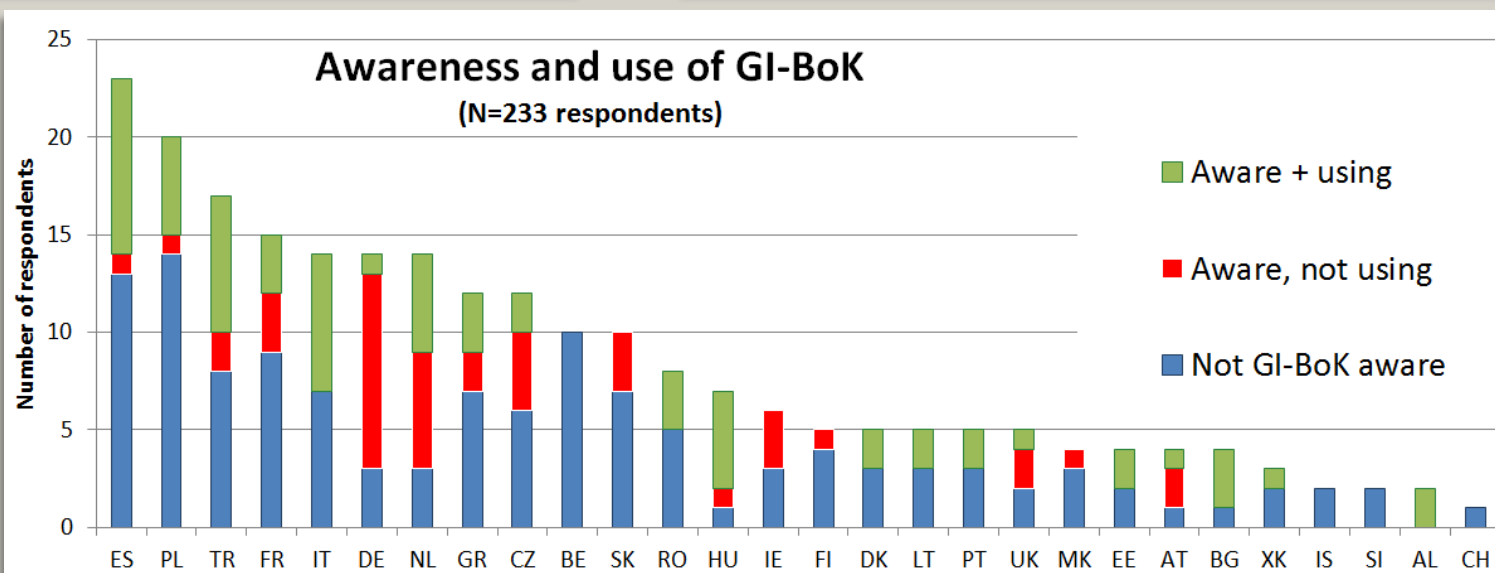
Large number of possible subjects, missing in first version of GI-BoK

GI-BoK Awareness and Use



Aware, but no use: why? – 44 answers

- No need, no wish (13/44)
- Organisational obstacles (11/44)
- BoK content not OK (8/44)
- No time (5/44)
- Usability aspects (2/44)

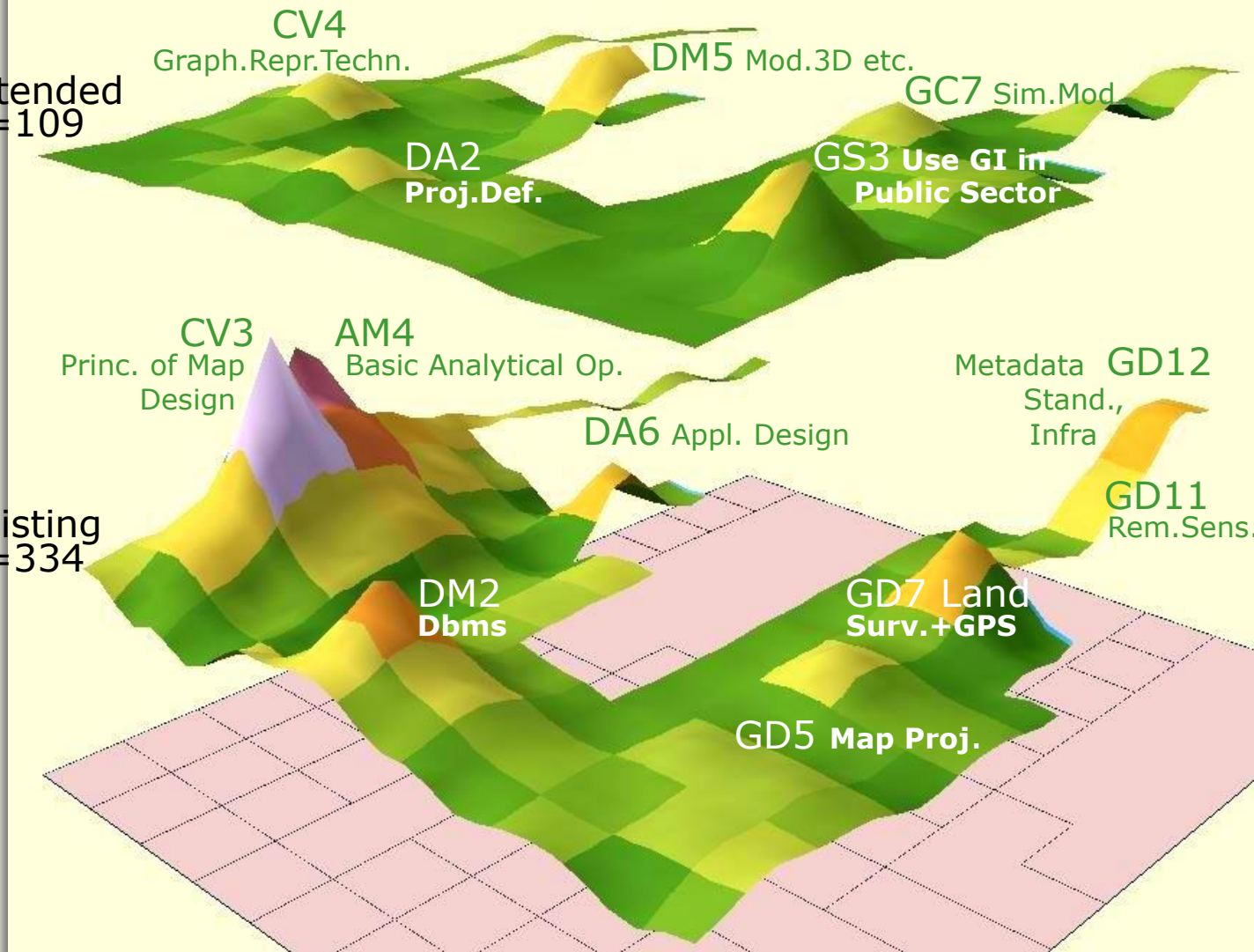


Teaching content landscape



Intended
N=109

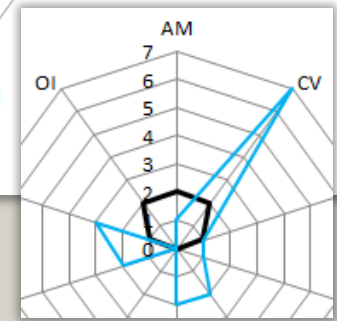
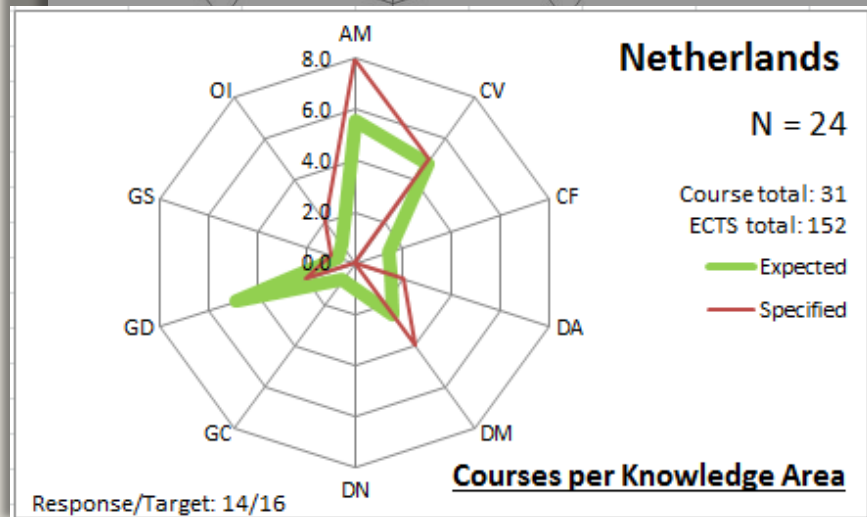
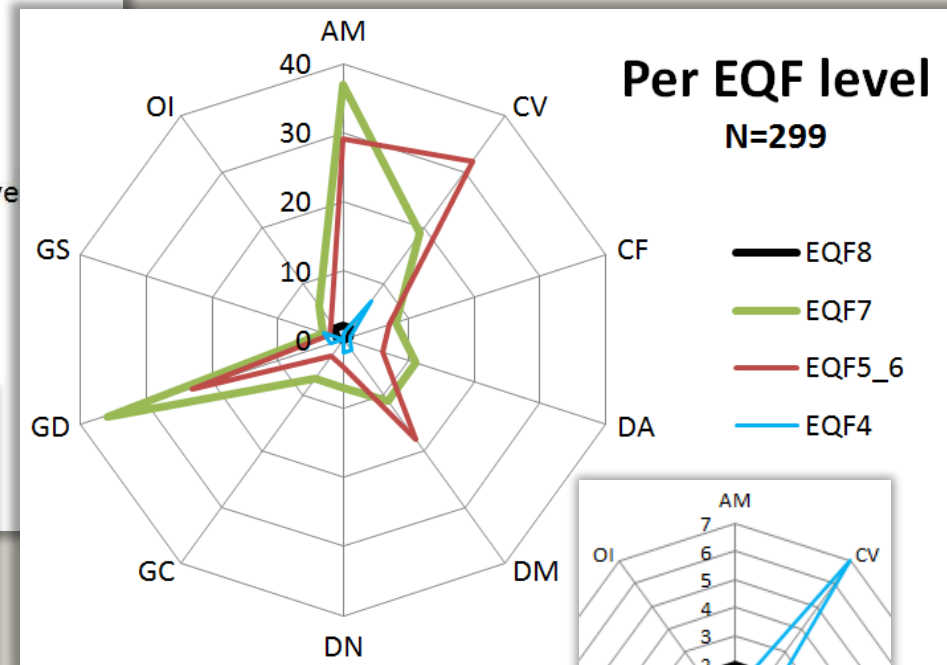
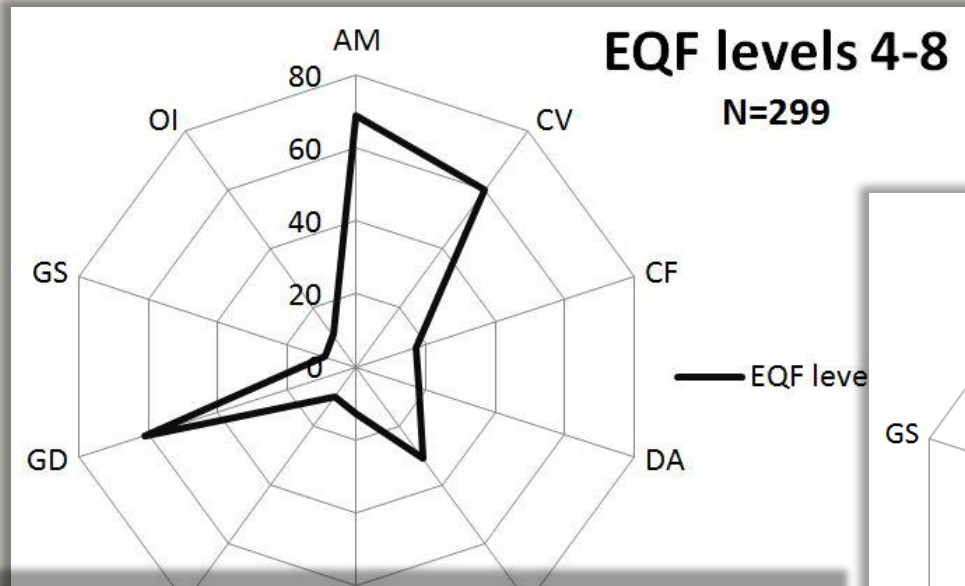
Existing
N=334



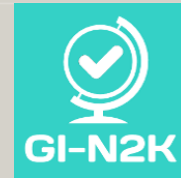
AM
Analysis Methods
CF
Conceptual Found.
CV
Cartography+ Vis.
DA
Design Aspects
DM
Data Modeling
DN
Data Manipulation
GC
Geocomputation
GD
Geospatial Data
GS
GI S+T & Society
OI
Org.+Inst.aspects

Teaching content profile

KA coverage per EQF level in # of courses



Missing in GI-BoK



Subjects mentioned in the free text descriptions of existing and intended teaching:

Web Services

- Web platforms,
- System architecture,
- OGC services,
- Web processing services
- SDI service components

Data acquisition technology

- UAV
- LiDAR
- Mobile GIS

Point cloud analysis

Qualitative GIS

Open source software

Programming in Python

UML

XML

Supply side summary



- Less than 50% awareness of GI-BoK, less than 25% use;
Half of the respondents aware of GI-BoK are not using it.
- Supply of teaching content: emphasis is on a) Analysis Methods, b) Cartography & Visualisation and c) Geospatial Data. Only small changes intended.
- number of possible subjects, missing in first version of GI-BoK



Do we know what they need to know?



- It is difficult to compare Demand for and Supply of competences because GI-BoK is not a common language
→ Not sure about a teaching gap
- Also, GI-BoK is incomplete
→ Yes, there is a content gap

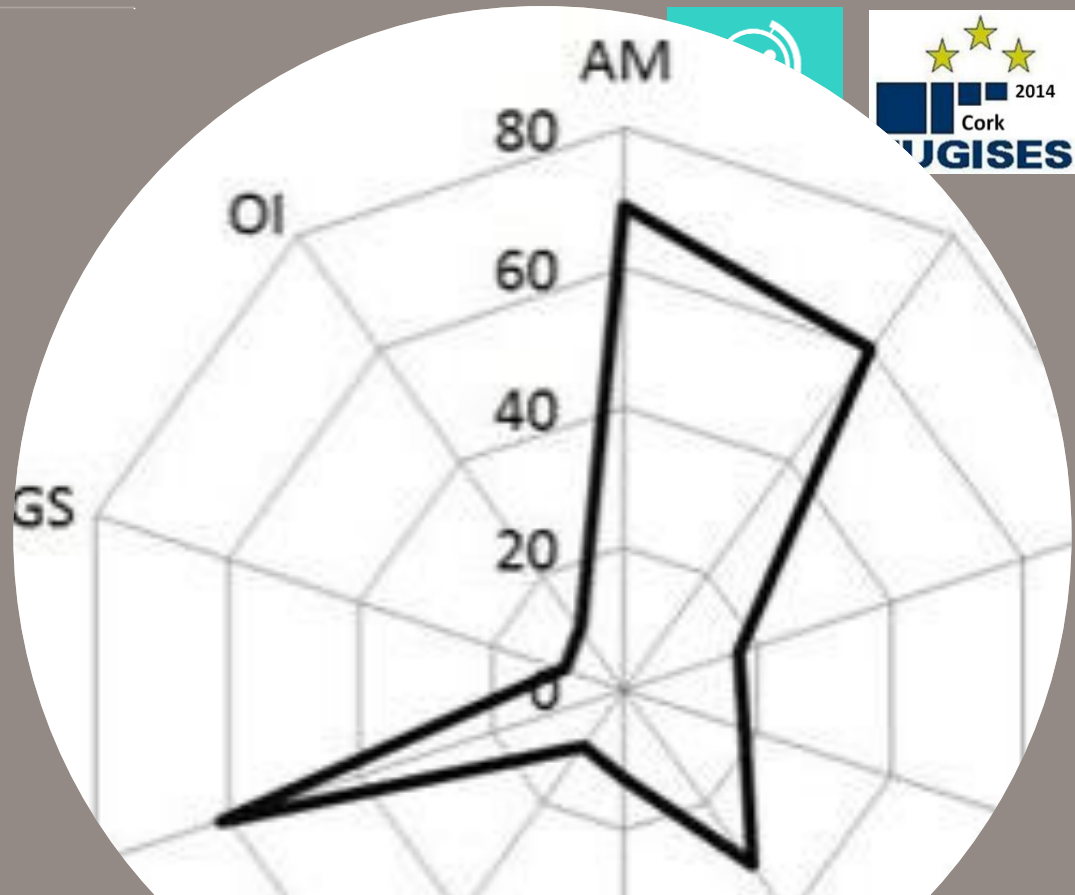
Outlook

GI-N2K will improve
GI-BoK:

- Interesting tools
- More up-to-date

If it becomes a
common language is
in the hands of the
users at Demand
and Supply side

<http://www.gi-n2k.eu/>



Suggestion for teachers:

- Add a GI-BoK diagram to the courses you offer to characterize their content
- Use the EduMapping kit:

<http://www.geo-informatie.nl/rip001/edumapping/EduMapping.html>





Competences

- Competences: abilities to apply knowledge in a context
 - Domain-specific competences
 - Description: Learning Outcomes. GI: GI-BoK
 - More general competences
 - Description for GI is in American Geospatial Technology Competence Model



GI-BoK, GTCM

Geographic Information Science & Technology Body of Knowledge

Edited by David Dibbern, Michael Behrer, Ann Johnson, Karen Kemp, Ann Taylor Luck, Brandon Pless, and Elizabeth Weiss
UNIVERSITY CONSORTIUM FOR GEOGRAPHIC INFORMATION SCIENCE

Analytical Methods

AM1 Academic and analytical origins

- 1.1 Academic foundations
- 1.2 Analytical approaches

AM2 Query operations and query languages

- 1.1 Query languages
- 1.2 Structured Query Language (SQL) and
spatial queries
- 1.3 Spatial queries

AM3 Geospatial measures

- 1.1 Distance and length
- 1.2 Direction
- 1.3 Slope
- 1.4 Area
- 1.5 Perimeter and distance decay
- 1.6 Adjacency and connectivity

AM4 Basic analytical operations

- 1.1 Buffering
- 1.2 Overlay
- 1.3 Topological analysis
- 1.4 Map algebra

AM5 Basic analytical methods

- 1.1 Point pattern analysis
- 1.2 Trends and density estimation
- 1.3 Spatial cluster analysis
- 1.4 Spatial interaction
- 1.5 Analyzing multidimensional attributes
- 1.6 Cartographic modeling
- 1.7 Multicriteria evaluation
- 1.8 Spatial process modeling

AM6 Analysis of surfaces

- 1.1 Locating surface distribution
- 1.2 Interpretation of surfaces
- 1.3 Surface features
- 1.4 Surface analysis
- 1.5 Surface modeling

Conceptual Foundations

CF1 Philosophical foundations

- 1.1 Geography's role in society
- 1.2 Technology
- 1.3 Philosophical perspectives

CF2 Cognitive and social foundations

- 1.1 Perception and cognition of geographic
phenomena
- 1.2 Human-environment interaction
- 1.3 Geography as a foundation for GIS
- 1.4 Place and landscape
- 1.5 Common sense geography
- 1.6 Cultural influences
- 1.7 Political influences

CF3 Domains of geographic information

- 1.1 Space
- 1.2 Time
- 1.3 Relationship between space and
time

AM7 Spatial statistics

- 1.1 Descriptive statistics
- 1.2 Inferential statistics
- 1.3 The spatial weights matrix
- 1.4 Global measures of spatial association
- 1.5 Local measures of spatial association
- 1.6 Outliers
- 1.7 Regression analysis

AM8 Geostatistics

- 1.1 Spatial sampling for statistical analysis
- 1.2 Principles of variogram analysis
- 1.3 Kriging
- 1.4 Principles of geostatistical modeling
- 1.5 Principles of geostatistical simulation
- 1.6 Principles of geostatistical simulation
- 1.7 Kriging variants

AM9 Spatial regression and econometrics

- 1.1 Principles of spatial econometrics
- 1.2 Spatial econometric models
- 1.3 Spatial modeling
- 1.4 Spatial econometrics and Geographic
Information Science (GIS)

AM10 Data Mining

- 1.1 Problems of large spatial databases
- 1.2 Data mining approaches
- 1.3 Knowledge discovery
- 1.4 Feature selection and reduction

AM11 Network analysis

- 1.1 Network definition
- 1.2 Graph-theoretic concepts (e.g., shortest
path, connectivity, etc.)
- 1.3 Network modeling
- 1.4 The Traveling Salesman Problem
- 1.5 Other classic network problems
- 1.6 Network analysis applications
- 1.7 Accessibility Modeling

AM12 Optimization and location-allocation modeling

- 1.1 Operations research modeling and
location-allocation problems
- 1.2 Location-allocation modeling
- 1.3 Location-allocation modeling and
problem solving

AM13 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM14 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM15 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM16 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM17 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM18 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM19 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM20 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

AM21 Elements of geographic information

- 1.1 Geographic information
- 1.2 Geographic information
- 1.3 Geographic information
- 1.4 Geographic information

Cartography and Visualization

CV1 History and trends

- 1.1 History of cartography
- 1.2 Technological transformations

CV2 Data considerations

- 1.1 Data considerations for map design
- 1.2 Data considerations for map design
- 1.3 Data considerations for map design
- 1.4 Data considerations for map design

CV3 Principles of map design

- 1.1 Map design fundamentals
- 1.2 Basic concepts of cartography
- 1.3 Color for cartography and visualization
- 1.4 Cartography for cartography and
visualization

CV4 Graphic representation techniques

- 1.1 Basic graphic representation techniques
- 1.2 Thematic representation techniques
- 1.3 Thematic representation techniques
- 1.4 Thematic representation techniques

CV5 Map production

- 1.1 Computer-aided map production
- 1.2 Map production
- 1.3 Map production
- 1.4 Map production

CV6 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV7 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV8 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV9 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV10 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV11 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV12 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV13 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV14 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV15 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV16 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

CV17 Map use and evaluation

- 1.1 The process of map use
- 1.2 Map use
- 1.3 Map use
- 1.4 Map use

Design Aspects

DA1 The scope of GIS/ET system design

- 1.1 The scope of GIS/ET system design
- 1.2 The scope of GIS/ET system design
- 1.3 The scope of GIS/ET system design
- 1.4 The scope of GIS/ET system design

DA2 Project definition

- 1.1 Project definition
- 1.2 Project definition
- 1.3 Project definition
- 1.4 Project definition

DA3 Resource planning

- 1.1 Resource planning
- 1.2 Resource planning
- 1.3 Resource planning
- 1.4 Resource planning

DA4 Database design

- 1.1 Database design
- 1.2 Database design
- 1.3 Database design
- 1.4 Database design

DA5 Analysis design

- 1.1 Analysis design
- 1.2 Analysis design
- 1.3 Analysis design
- 1.4 Analysis design

DA6 Application design

- 1.1 Application design
- 1.2 Application design
- 1.3 Application design
- 1.4 Application design

DA7 System implementation

- 1.1 System implementation
- 1.2 System implementation
- 1.3 System implementation
- 1.4 System implementation

DA8 Vector and object data models

- 1.1 Vector and object data models
- 1.2 Vector and object data models
- 1.3 Vector and object data models
- 1.4 Vector and object data models

DA9 Modeling 3D, networks, and temporal phenomena

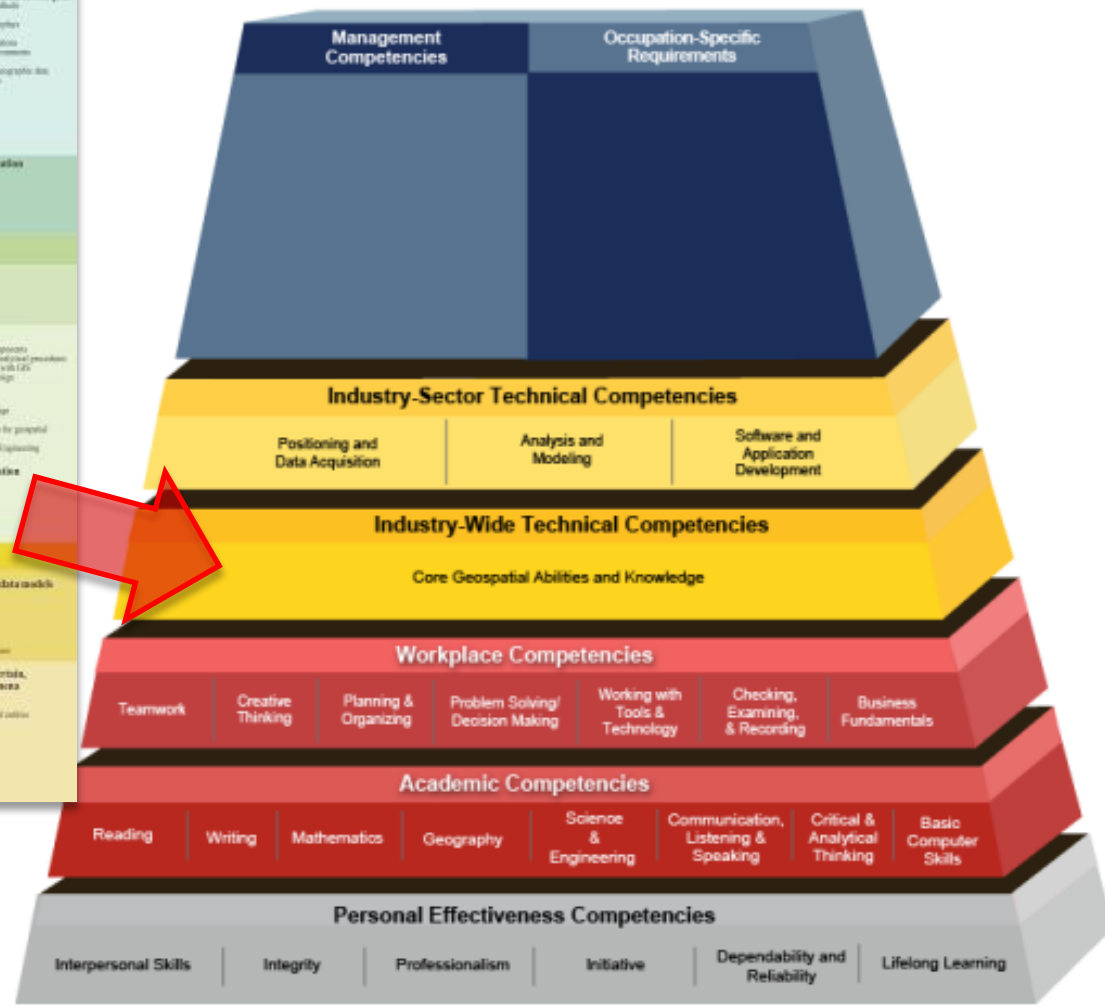
- 1.1 Modeling 3D, networks, and temporal phenomena
- 1.2 Modeling 3D, networks, and temporal phenomena
- 1.3 Modeling 3D, networks, and temporal phenomena
- 1.4 Modeling 3D, networks, and temporal phenomena

DA10 Modeling 3D, networks, and temporal phenomena

- 1.1 Modeling 3D, networks, and temporal phenomena
- 1.2 Modeling 3D, networks, and temporal phenomena
- 1.3 Modeling 3D, networks, and temporal phenomena
- 1.4 Modeling 3D, networks, and temporal phenomena

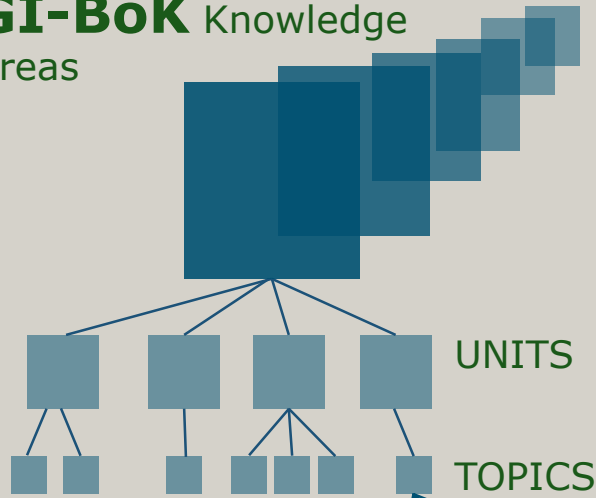
Geospatial Technology Competency Model

June 1, 2010



GI domain competences

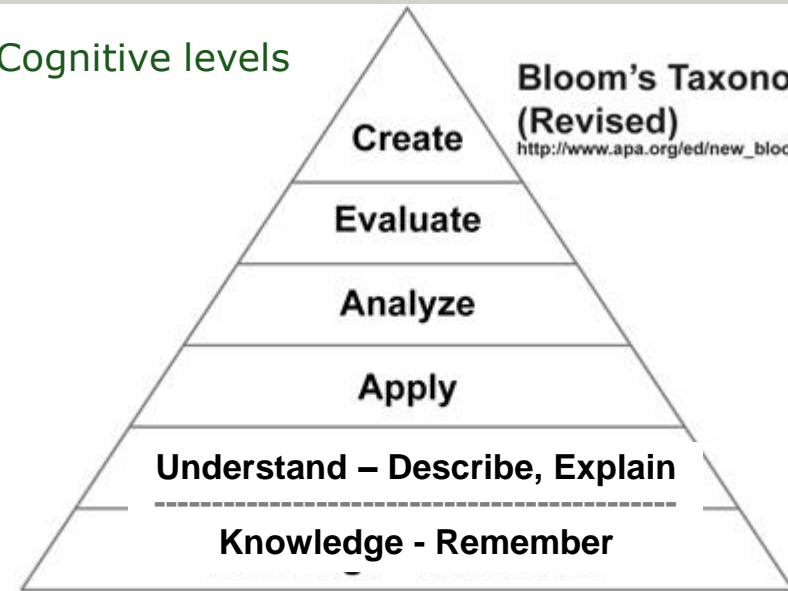
GI-BoK Knowledge Areas



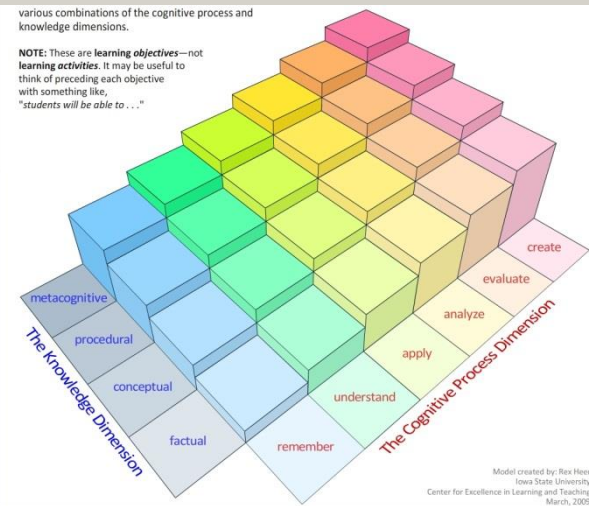
Learning Objectives in "Action-verb" format

e.g.: After this course, student is able to **evaluate tools for conversions between data formats** (from: TU-Delft Geomatics).

Cognitive levels



Based on an APA adaptation of Anderson, LW & Krathwohl, DR (Eds.) (2001)



The questions asked

Demand side:

What competences would you like to obtain?

Supply side:

The GI teaching in your organisation can be a single course, or a number of courses, organised in a programme.

Please specify up to 3 courses that best reflect the focus, or the core, of GI teaching in your organisation.

Specify ECTS-size, EQF-level, nearest GI-BoK Unit

