Academic and Research Strategies: Issues and Challenges

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Introduction

- Government policies and decisions are playing vital role in promoting education and research in various fields.
- The urban planning, environmental planning, industrialization, slum upgradation (mapping), land management are some of the areas where the geomatics has reached as baseline for decision making at national level.

Questions

- The question for research is when the IT sector of the country is on the high ground, the space technology has made up the forefront in an international sphere then why not the studies on outer space?
- Is this different than traditional space applications related research?
- Why this is treated as non-common of all above?

Adoptation

- There is an emergence need to adopt multi-specialisation approach to examine the issues and challenges of research in such a valued topic.
- The international space station is fully operational, it has good facility for science and technology research in multi-disciplinary areas.

Need for Training

- The emergence need is for training, education, research and dissemination.
- The most important dimension is global in nature.
- It suggests the inter-organisations, academia, industry, government and also international collaboration.

Global Competition

- The demand for skilled manpower is observed increasing every day with the advent of technology development.
- The corporate sector is experiencing changes, in the early 1990s, most the space science related companies relied on outsourced business from overseas market with US, UK, Europe and other developed nations which is now changed to national (Indian) projects.

Eduction

- ‘Education in Space Science’ is one of the important factors play a very important role here in bridging the gap between the demand and the market.
- A good education has direct and positive relations with the quality of the human resources generated.
- A measurement of the marginal productivity becomes meaningful. The marginal productivity of skilled manpower earns the higher GDP for the nation.

Situation

- The geomatics education offered by the universities is largely offer at post graduation level in India
- whereas it is offered from k-12 level to undergraduate and higher level in developed countries.

Standardisation

- A very important issue is to standardize the geomatics education worldwide, simultaneously it is essential to fill the gap through incorporating the newly developing fields in education syllabus, research agendas and outreach programmes to a grass root level.

Legal and policy Directives

- The technology is developing on fast rate, the implementation of the infrastructure and financial projects are also observed at fast rate, the emergence need is to give a legal (policy) recognition so as the availability of human resources become boundary-less.

Brain Storming

- It is important to discuss the issues and challenges against the academia, government and industry in regard to the development and growth takes place in this dimension and to explore and expand the scope.

3 important areas

- The emphasise must be given to the **education** system and the generation of **trained manpower**,
- Also important to address the issue of **standardization** of the education and research globally
- The attempt must be given towards the required **modifications in the policy** directives.

Why Need Geospatial Education

- The real world has lot of spatial data
  - Analysis, modeling, manipulation can be effective and efficiently carried out
    - the selection of neighborhood for purchase of house
    - the route for fire-fighting vehicles to the affected area
    - location of tourist sites to visit
    - the development of infrastructure
- The earth surface is a limited resource
    - rational decisions on space utilization
    - fast and quality information in decision making

Contd…..

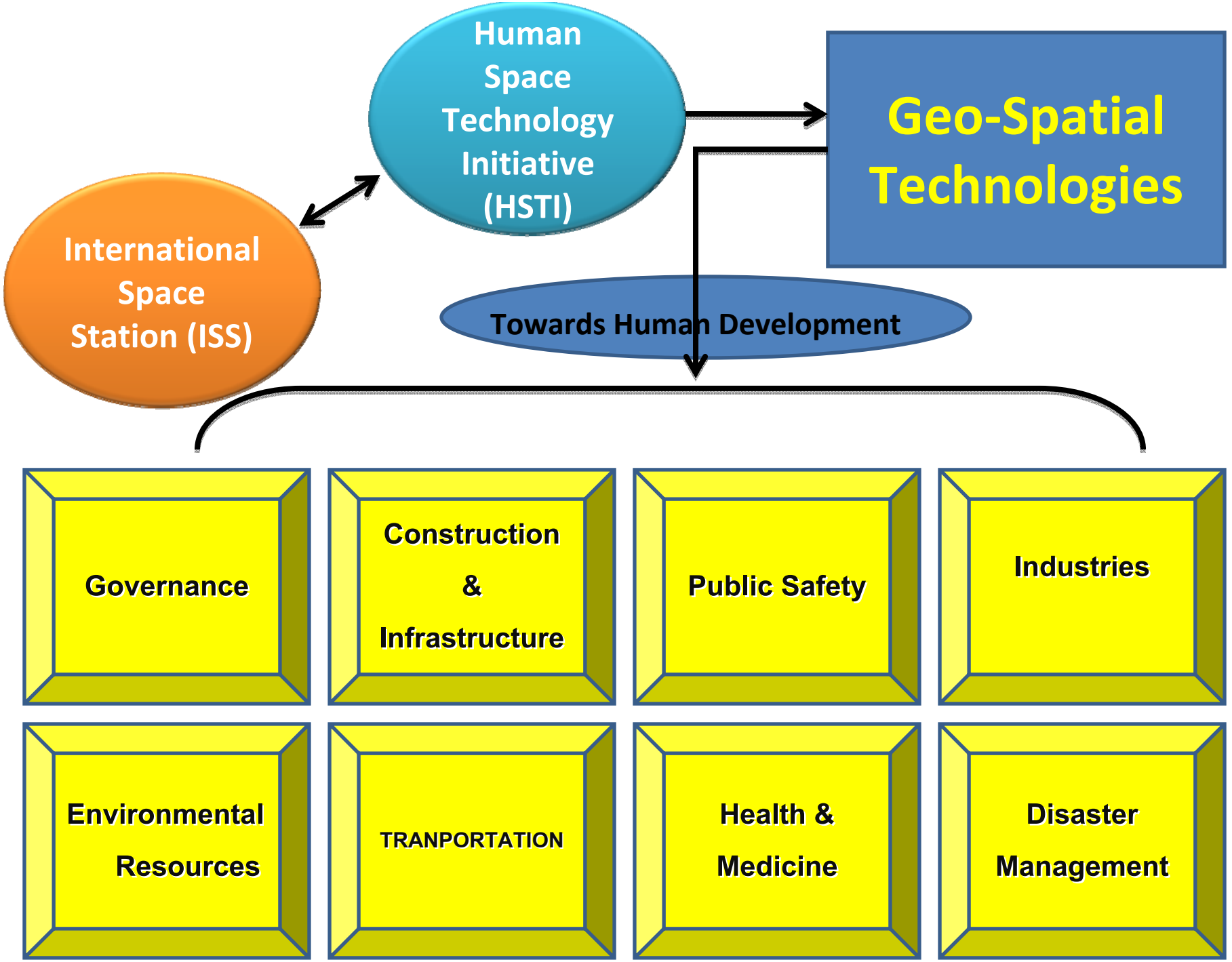
- Complexity of Management
  - Due to the need to combine and process many sets of data, in addition to judge as many as possible, situation that might happen.
- Intense Competition
  - The need to use technology in making decisions and strategy in the world of intense competition.

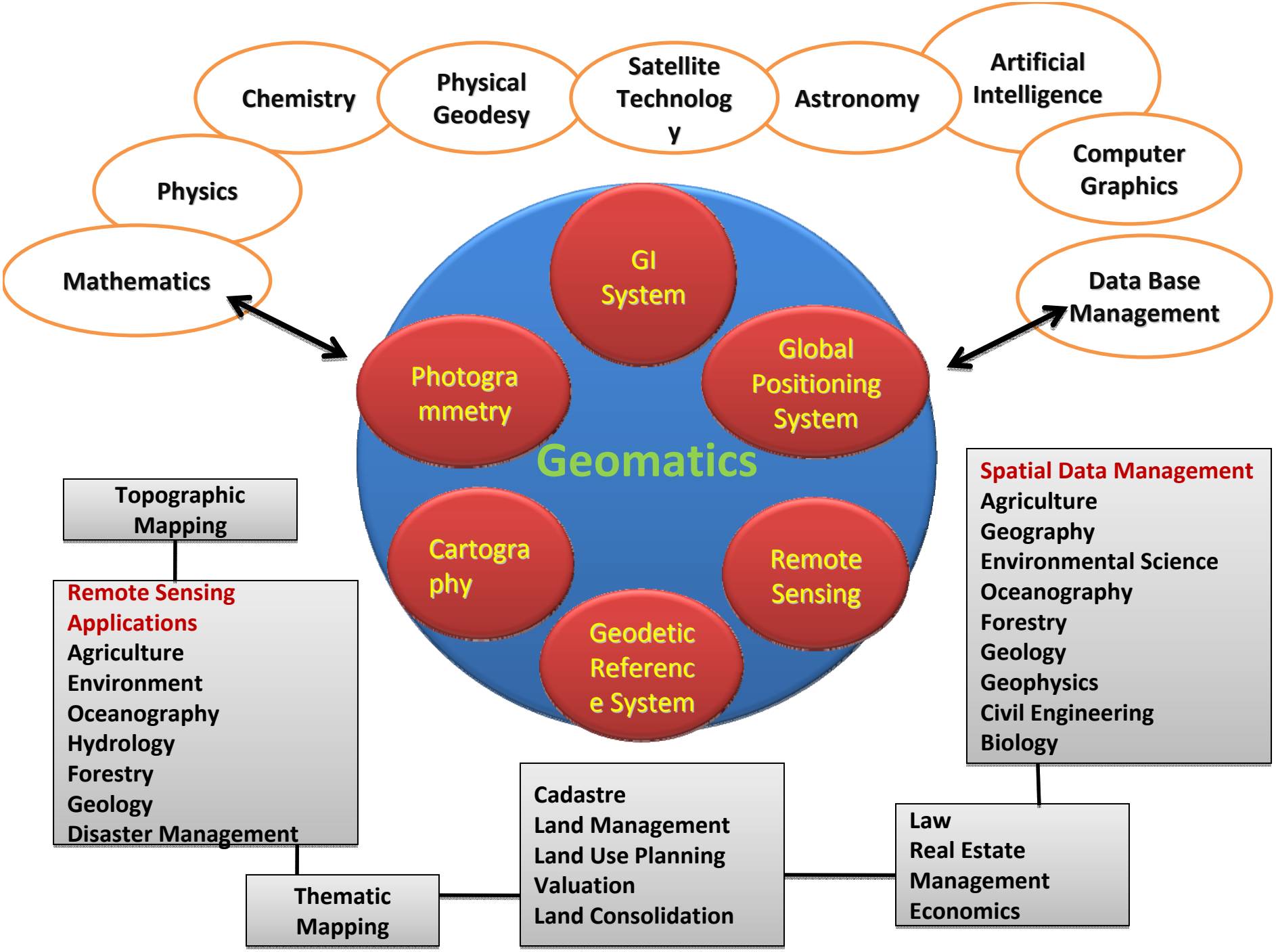
History of Geomatics

Decades	Milestones for computer-based GIS
1960's (Inventory and Development)	- Canada Geographic Information System (CGIS) developed: national land inventory, pioneered many aspects of GIS - Harvard Lab for Computer Graphics and Spatial Analysis: pioneered software for spatial data handling - US Bureau of Census developed DIME data format - ESRI founded
1970's (Launching of Satellites & Data Formats)	- CGIS fully operational (and still operational today) - First Landsat satellite launched (USA) - CARIS founded - USGS begins Geographical Information Retrieval and Analysis System (GIRAS) to manage and analyze large land resources databases and Digital Line Graph (DLG) data format - ERDAS founded - ODYSSEY GIS launched (first vector GIS)

Contd.....

Decade	Milestones for computer-based GIS
1980's (Private S/W Companies & Organisation of Data)	- ESRI launches ARC/INFO (vector GIS) - GPS became operational - US Army Corp of Engineers develop GRASS (raster GIS) - MapInfo founded - First SPOT satellite launched (Europe) - IDRISI Project started (GIS program) - SPANS GIS produced - National Center for Geographic Information and Analysis (NCGIA) established in USA - TIGER digital data
1990's (Industrialisation)	- MapInfo for Windows, Intergraph, Autodesk, others - ESRI produces ArcView and ARCGIS - $7+ billion industry
2000's (PPP)	-Expansion of Service Industries, -Private Public Partnership -Project/ Mission Mode


Human Space Technology Initiative (HSTI)
Geo-Spatial Technologies
International Space Station (ISS)
Towards Human Development
Governance
Construction & Infrastructure
Public Safety
Industries
Environmental Resources
TRANPORTATION
Health & Medicine
Disaster Management


Chemistry
Physical Geodesy
Satellite Technology
Astronomy
Artificial Intelligence
Computer Graphics
Physics
Mathematics
Data Base Management
GI System
Photogrammetry
Global Positioning System
Geomatics
Cartography
Remote Sensing
Geodetic Reference System
Topographic Mapping
Remote Sensing Applications
Agriculture
Environment
Oceanography
Hydrology
Forestry
Geology
Disaster Management
Thematic Mapping
Cadastre
Land Management
Land Use Planning
Valuation
Land Consolidation
Spatial Data Management
Agriculture
Geography
Environmental Science
Oceanography
Forestry
Geology
Geophysics
Civil Engineering
Biology
Law
Real Estate
Management
Economics

Market/ Industries require Geomatics?

Business
Defense and Intelligence
Education
Government
Health and Human Services
Mapping and Charting
Natural Resources
Public Safety
Transportation
Utilities And Communications
other

Academics and Professional Courses

Geomatics Applications Areas?

Environmental & Oceanographic Studies
Agriculture
Hydrology
Resource Mapping
Municipal GIS
Forestry
Town Planning and Urban Development
Disaster Management
Land Use/Land Cover studies
Transportation
Change Detection
Site Suitability Studies
Utilities & Facilities management
Network studies
etc.

The Boosters

- Modern Techniques of Data Acquisition
- The advent of the Graphical User Interfaces (GUIs) and increased speed and memory (all with decreased cost).
- Open Sourse GIS packages
- Demand from Industry

Limitations of Geomatics

- Data are expensive
- Learning curve on GIS software can be long
- Shows spatial relationships but does not provide absolute solutions
- Origins in the Earth sciences and computer science.
- Solutions may not be appropriate for humanities research

Geomatics user’s Scenario

(International)

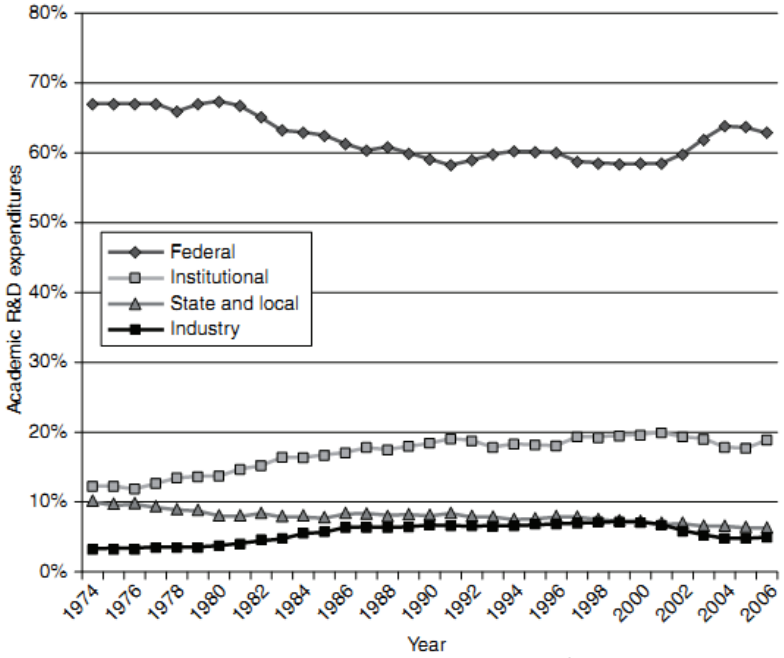
USA

GIS Education through Certificate Programs by Thomas A. Wikle

Last two decades GIS is taught in Higher education.

Currently, 4,165 public and private two-year and four-year colleges and universities in US uses GIS software for teaching.

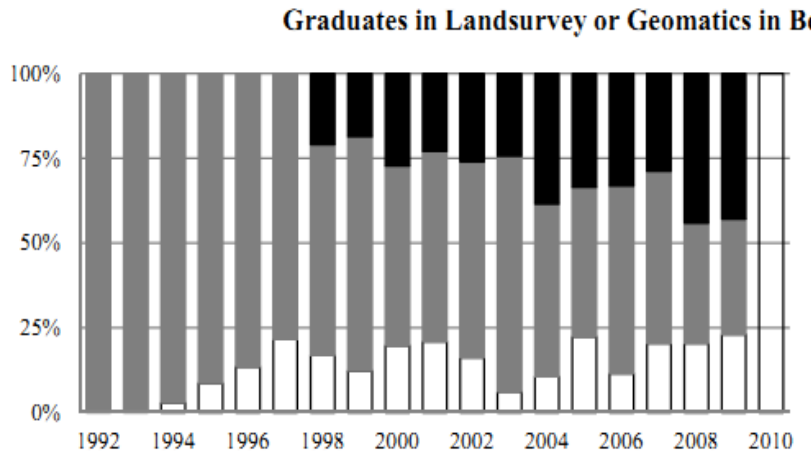
More than 445 of the nation's 1,184 community colleges offer instruction in GIS, including 145 certificate programs and 69 degree programs (GeoTech Center 2010, US).



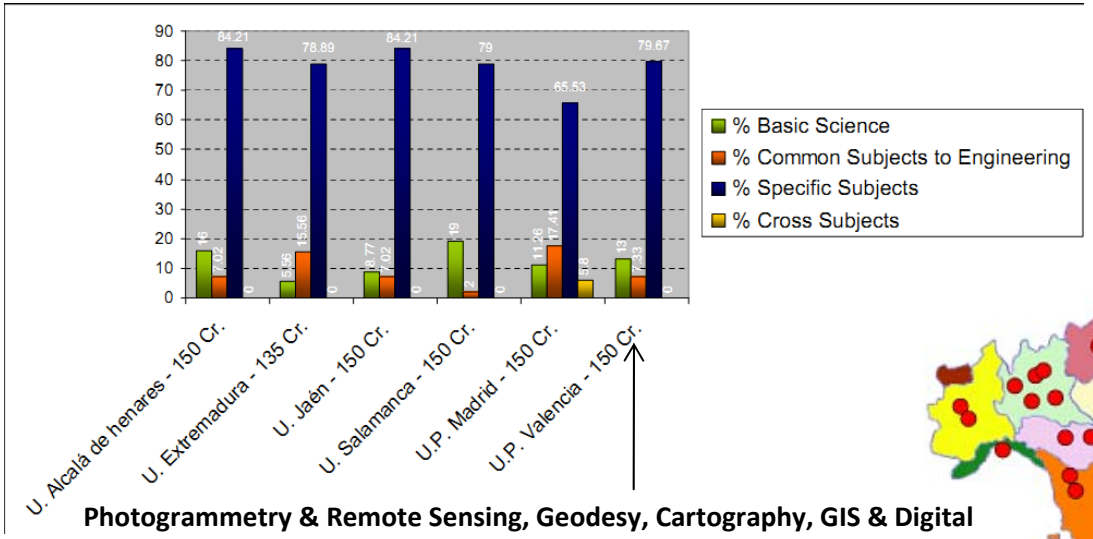
Source: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, WebCASPAR database, http://webcaspar.nsf.gov.

Description	Funds allocated (mn $)	Estimated cost (mn $)
Food and Farming	26,466	26,431
Defence	4,555	4,531
Energy and Environment	50,825	50,775
Government	6,858	6,707
Homeland Security		2,744
Transportation and Housing (T & H)	61,795	61,051
Health IT	17,559	17,559

Source: http://online.wsj.com/public/resources/documents/STIMULUS_FINAL_0217.html



BELGIUM



Photogrammetry & Remote Sensing, Geodesy, Cartography, GIS & Digital Cartography

SPAIN

ITALY

S-E Europe

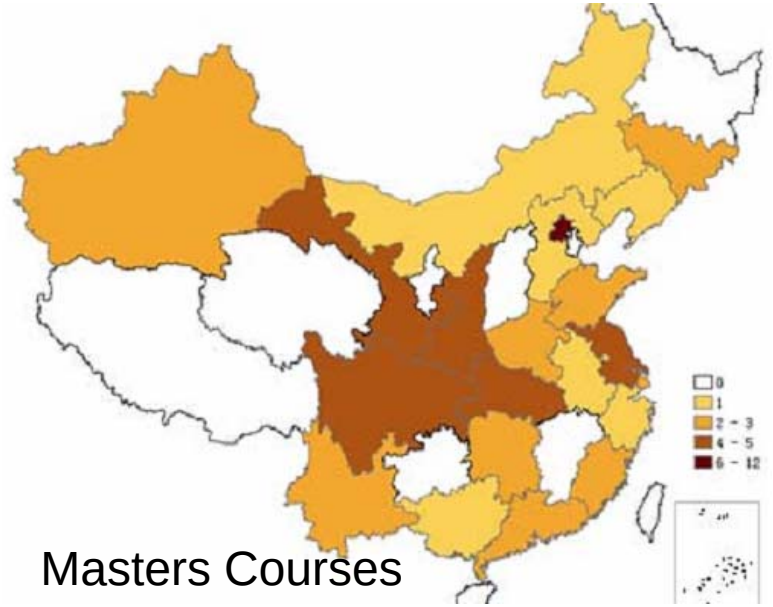
- Albania
- Bosnia and Herzegovina
- Kosovo
- FYR of Macedonia
- Montenegro
- Serbia
- Croatia
- *Slovenia*

40 Universities in Italy offer course in Geomatics in all the 20 Regions. Geomatics is involved in 12 different Bachelors and 16 Master curricula with a total number of 314 number of courses, 178 for Bachelors and 136 at Masters level.

Source: Teaching Geomatics in Italy F. Rinaudo

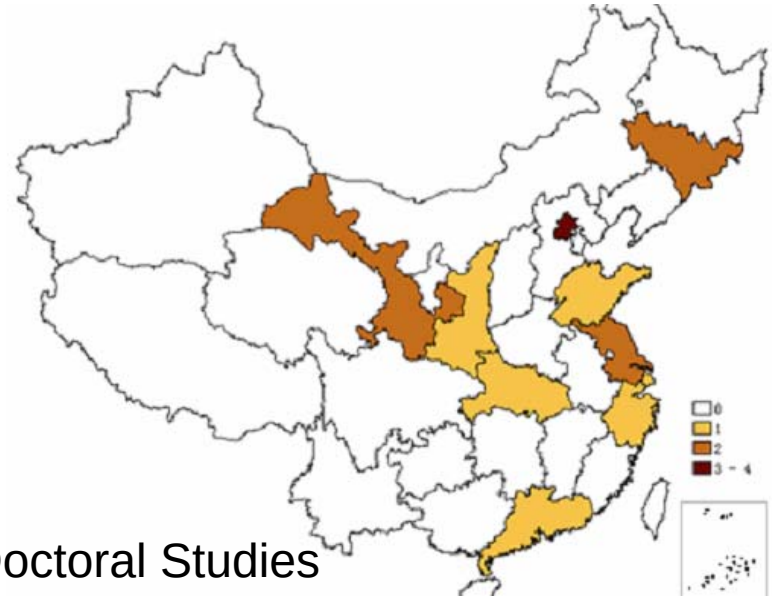
European Countries Participation in Geomatics Academics & Geospatial Industry Scenario

CHINA



Masters Courses

Number of colleges and universities offering masters course in GIS. (Source: GEOSPATIAL INFORMATION TECHNOLOGY EDUCATION IN CHINA,PRESENT AND FUTURE -TANG Guoana, DONG Youfua, JIA Yinia, GAO Yipinga)



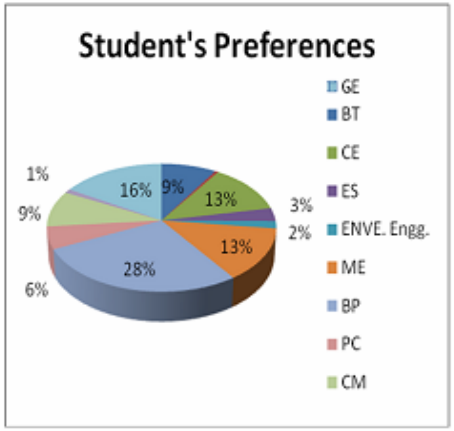
Doctoral Studies

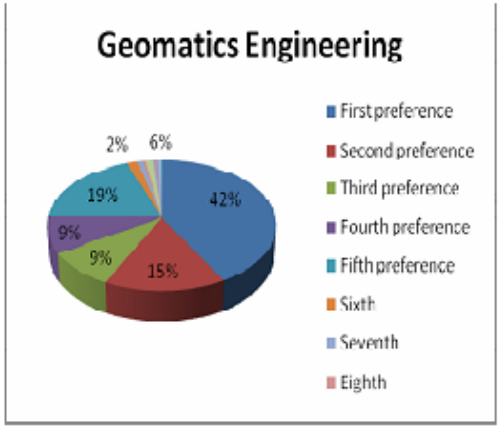
Number of departments offering doctoral studies in GIS(Source: GEOSPATIAL INFORMATION TECHNOLOGY EDUCATION IN CHINA,PRESENT AND FUTURE -TANG Guoana, DONG Youfua, JIA Yinia, GAO Yipinga)

- **Eastern and central province reveals more students pursuing higher education i.e. masters and doctoral studies compared to rest of the country.**
- **Focus of the education is on the applications of the software rather than Geomatics theories and processes. This limits the secondary development of GIS.**
- **Curriculum design needs more concreted efforts.**

Kathmandu-Nepal

STUDENT PREFERENCE SCENARIO OF THE GE COURSE IN 2008





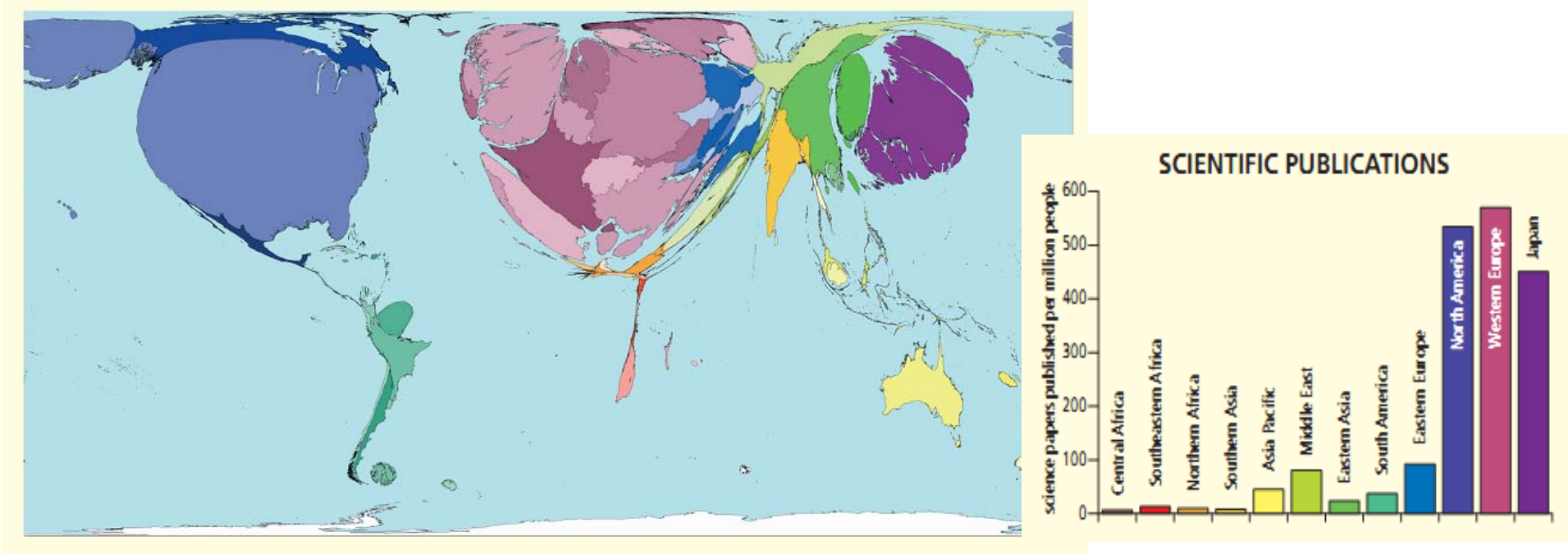
Africa

Universities Survey/Geomatics Departments in Sub-Saharan Africa

Qatar

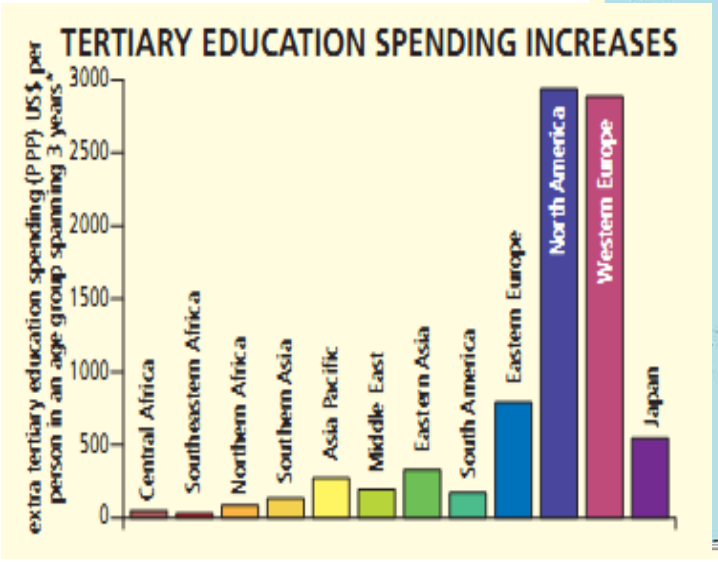
TABLE 1: Percentage use of geospatial technology in various verticals	
Verticals	Use of Geospatial Technology
Utilities	70%
Construction (including Infrastructure)	62%
Transport & Communication	77%
Financial Services	44%
Governance	85%
Environmental Management	65%
Defence & Security	70%

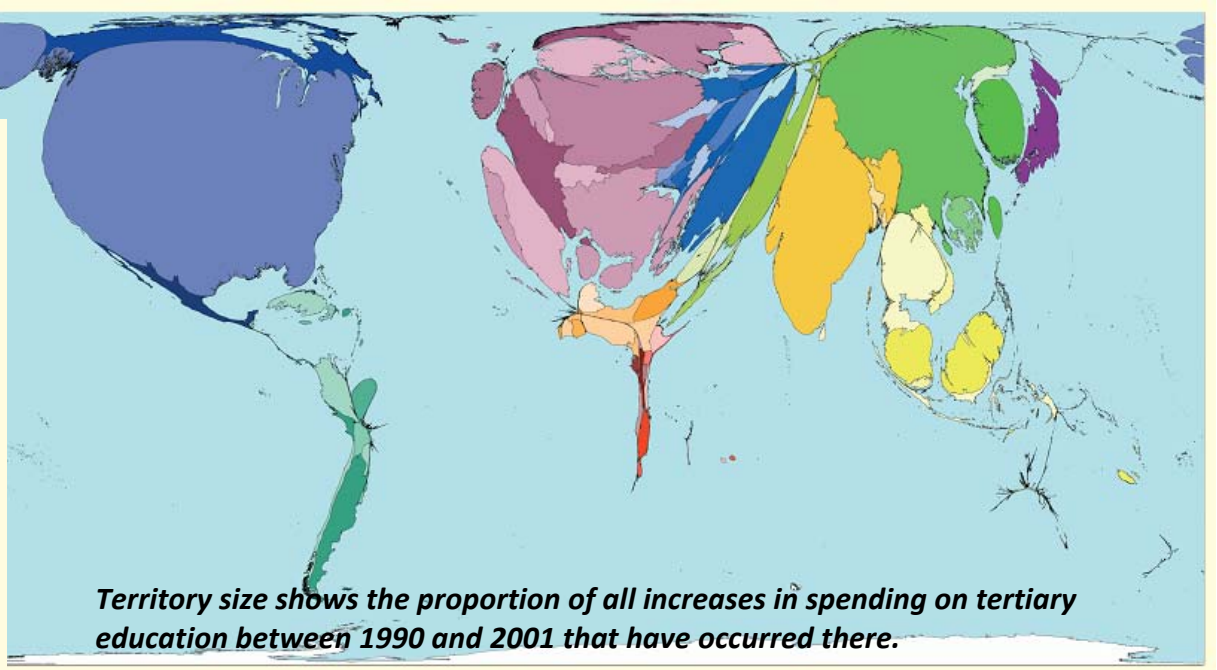
- Lack of a cohesive framework for effective coordination between institutions.
- Lack of research experience
- Lack of funds for research



Territory size shows the proportion of all scientific papers published in 2001 written by authors living there.

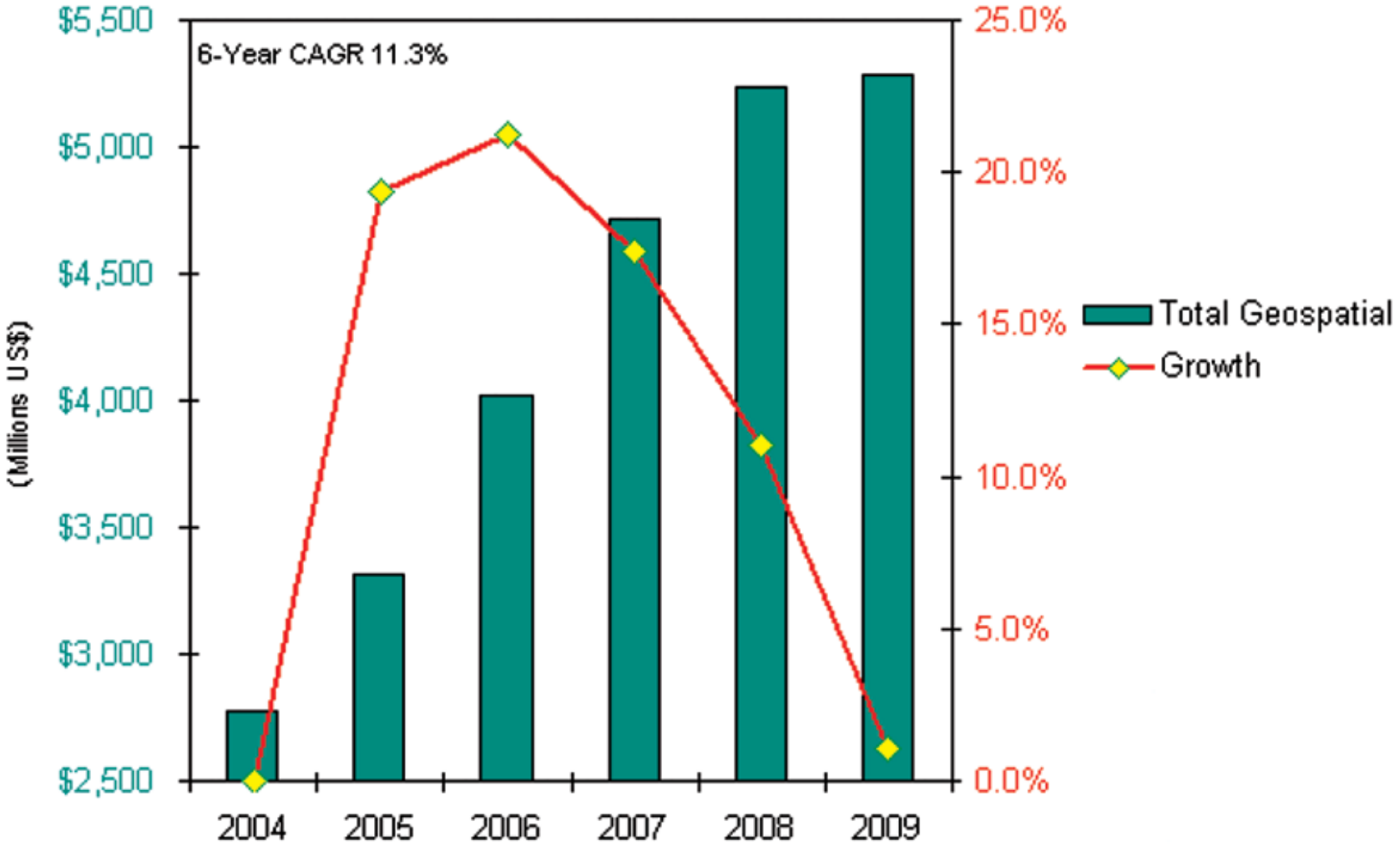
www.worldmapper.org





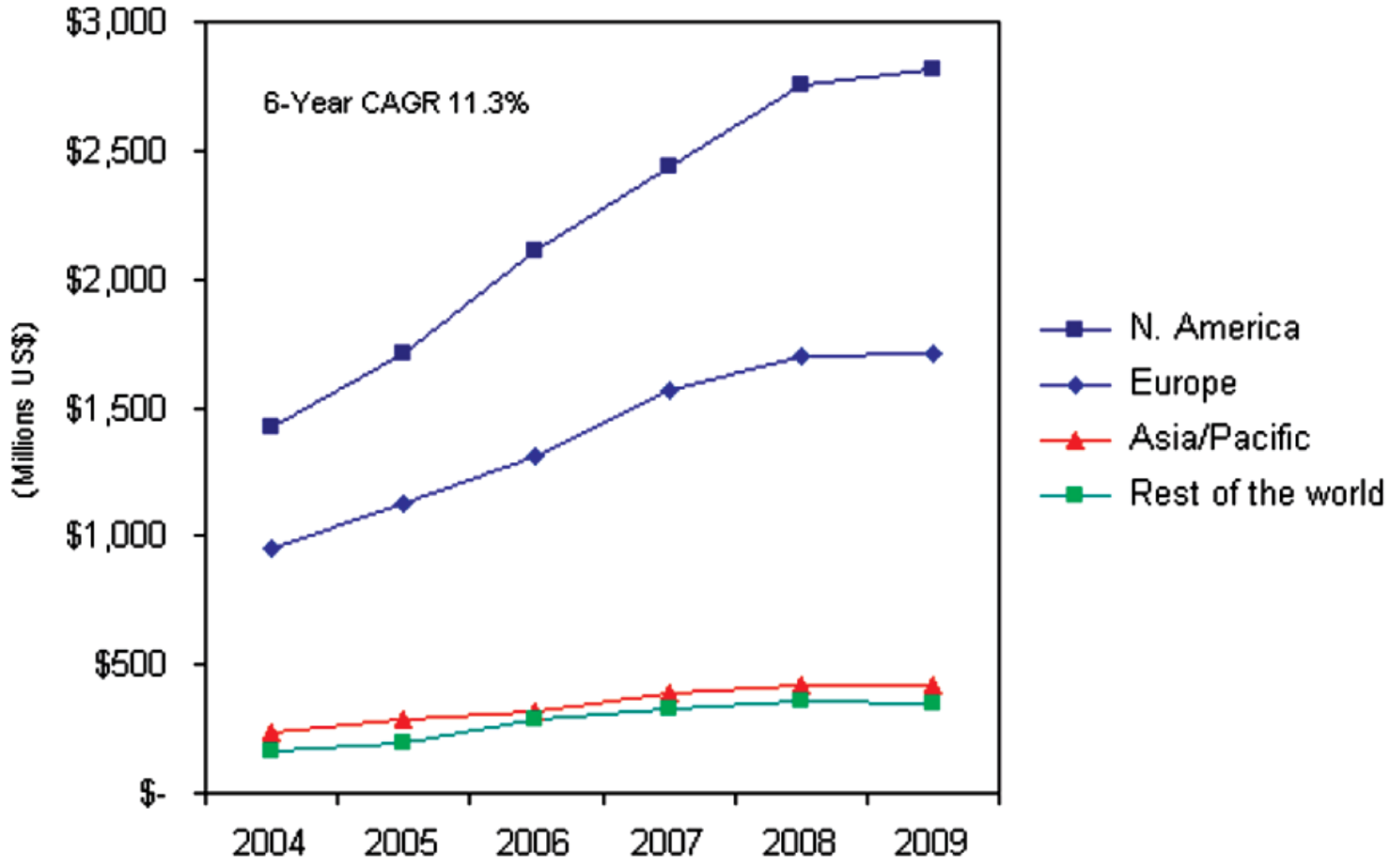
Territory size shows the proportion of all increases in spending on tertiary education between 1990 and 2001 that have occurred there.

World wide Geospatial Industry Growth, 2004-2009: Total Revenue (software, services, hardware, data)



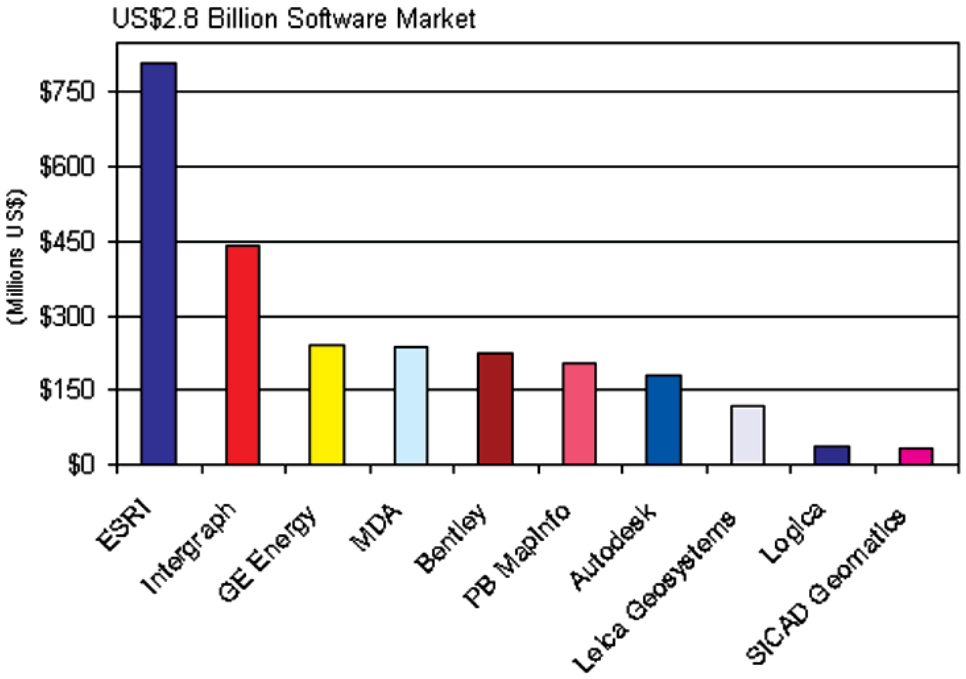
Source : http://www.webmazine.org/issues/bull242/documents/GISindustryForecast.pdf

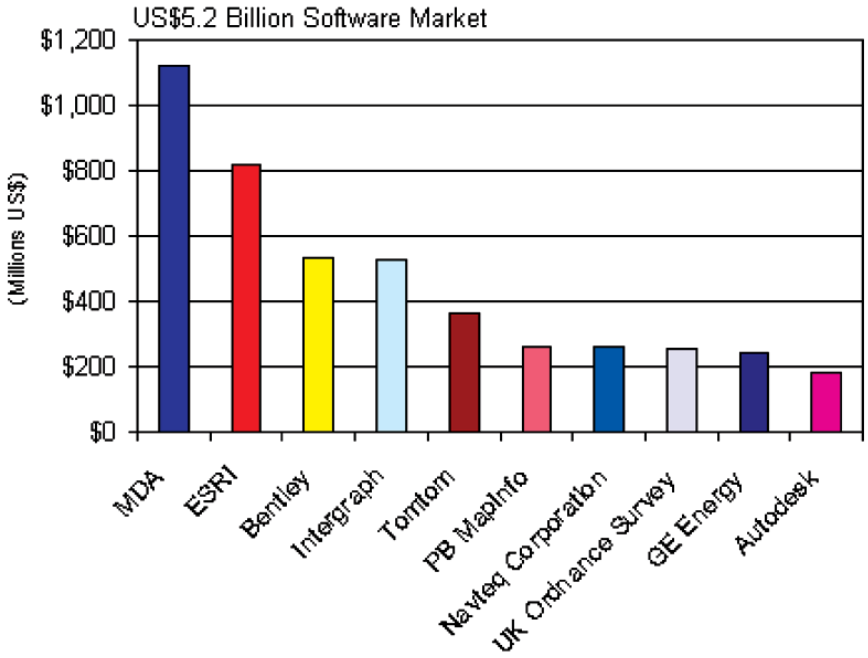
Geospatial Industry Growth, 2004-2009: Revenue growth for North America, Europe, and Asia / Pacific.



Source : http://www.webmazine.org/issues/bull242/documents/GISindustryForecast.pdf

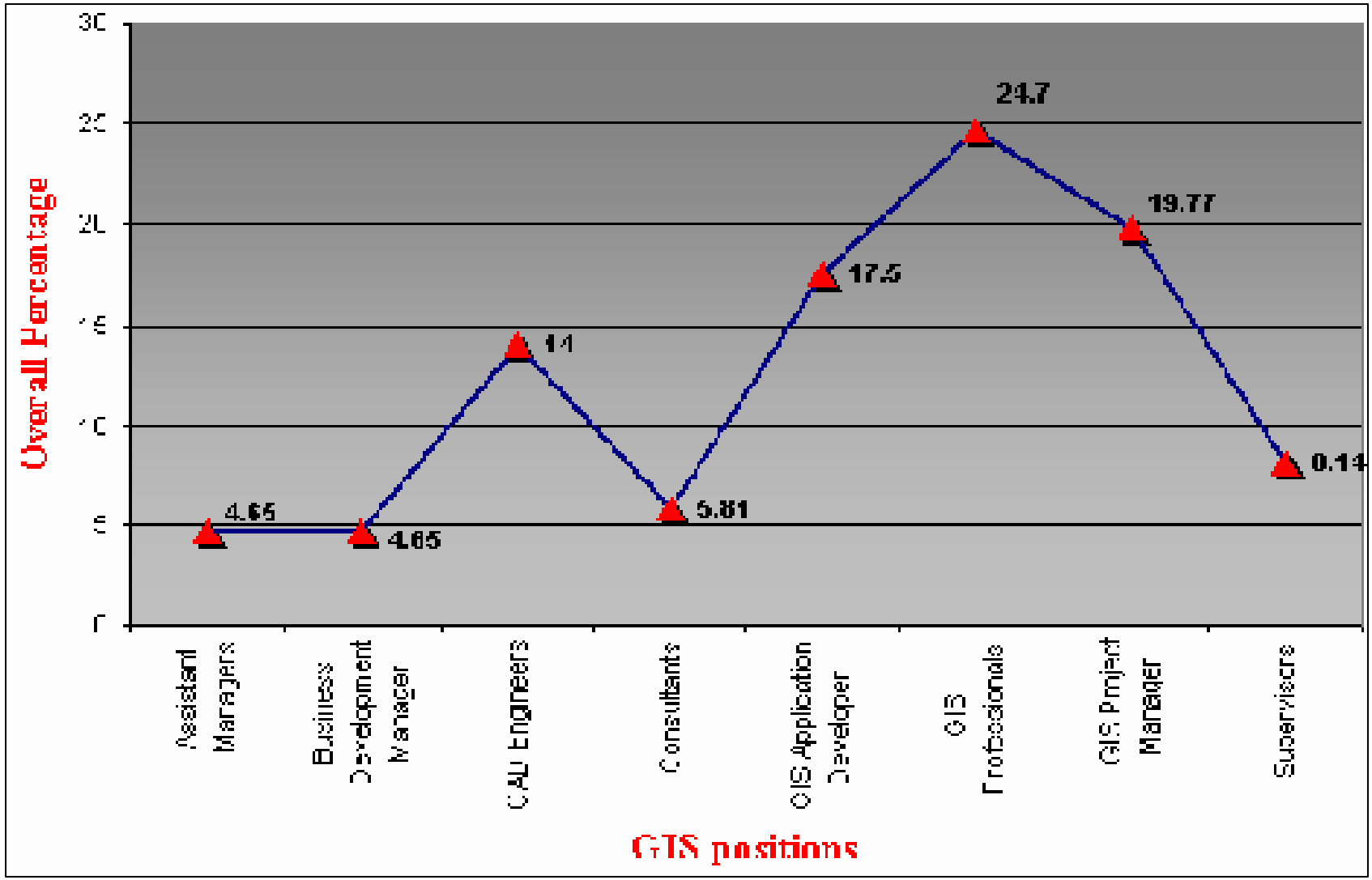
Worldwide Revenue for Leading Traditional Suppliers of GIS-based Software, Services, and Hardware, 2004 and 2009





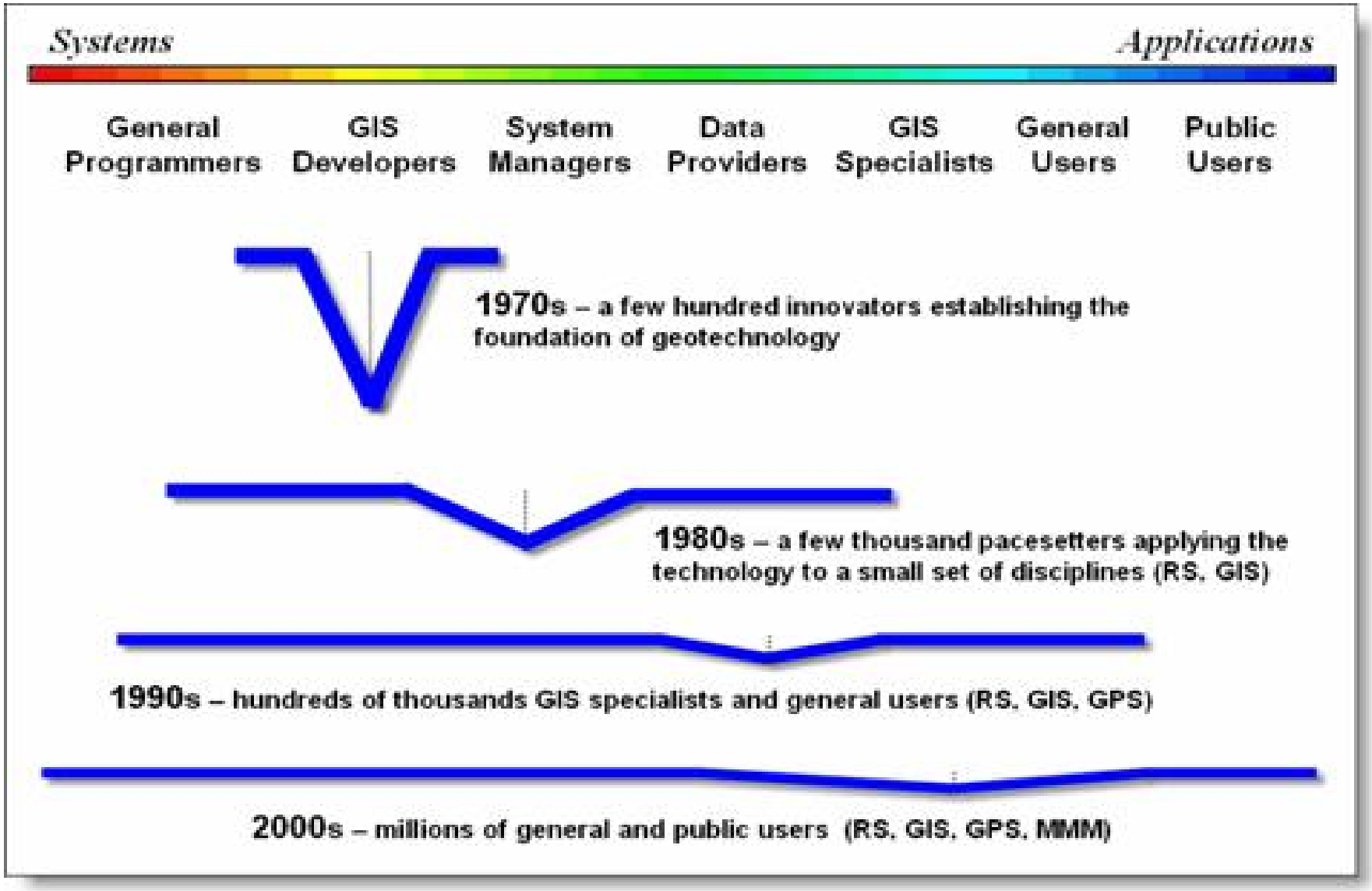
Source : http://www.webmazine.org/issues/bull242/documents/GISindustryForecast.pdf

As per the survey conducted by* GIS Development *during April 10, 2000, the existing percentage combination of GIS Analysts and GIS Engineers in India is much high than any other professionals.



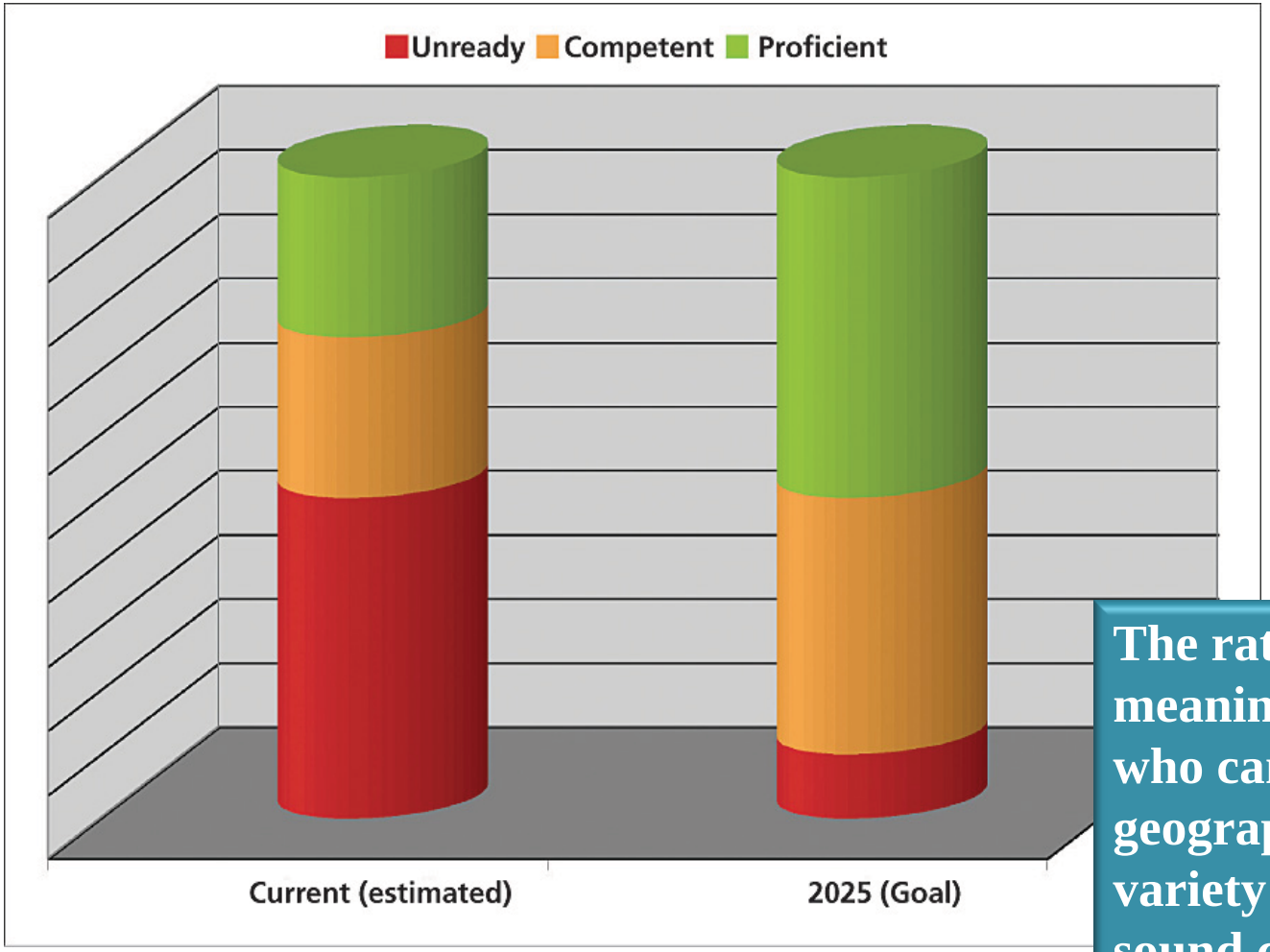
Source : http://gislounge.com/gis-developments-in-india-year-2000-analysis/

The evolution of the Geotechnology Community has broadened its membership in numbers, interests, backgrounds and depth of understanding.



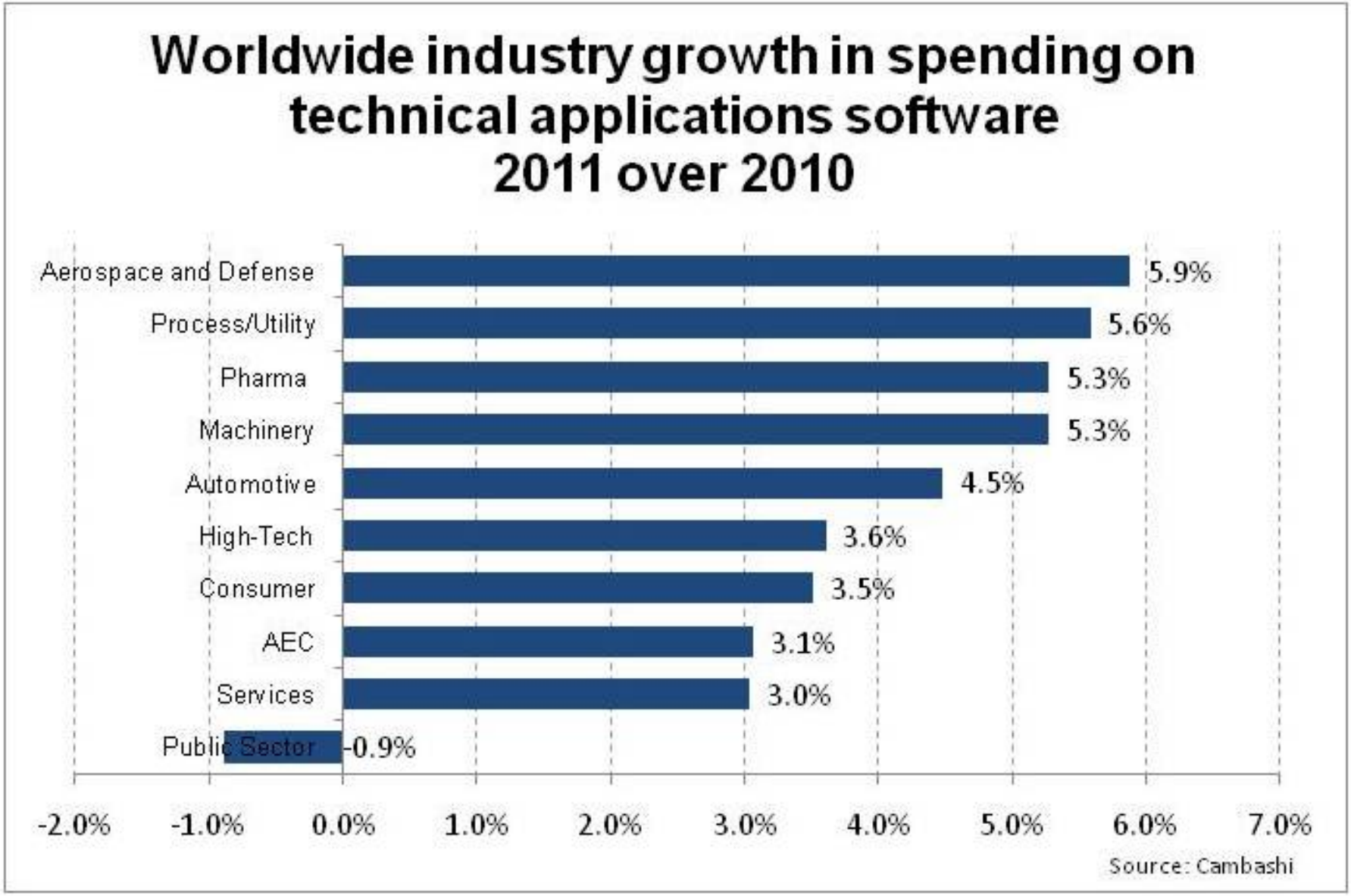
Source: http://innovativegis.com/basis/MapAnalysis/Topic27/Topic27.htm

A rough estimate of the distribution of geographic literacy among 18-year-olds in the U.S. today (left) and the distribution that National Geographic is committed to achieving by 2025 (right).

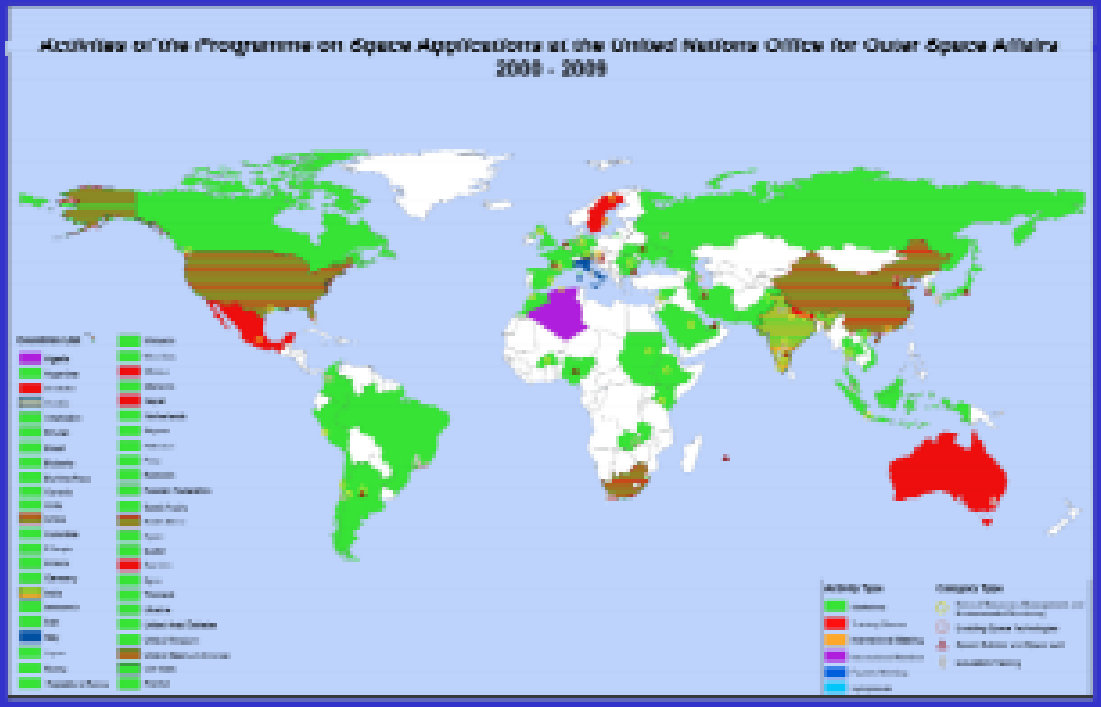


The rate of geographic literacy - meaning the number of people who can synthesize geographic information from a variety of sources and draw a sound conclusion

Source : www.esri.com


Worldwide industry growth in spending on technical applications software 2011 over 2010
Aerospace and Defense
Process/Utility
Pharma
Machinery
Automotive
High-Tech
Consumer
AEC
Services
Public Sector
5.9%
5.6%
5.3%
5.3%
4.5%
3.6%
3.5%
3.1%
3.0%
-0.9%
-2.0%
-1.0%
0.0%
1.0%
2.0%
3.0%
4.0%
5.0%
6.0%
7.0%
Source: Cambashi

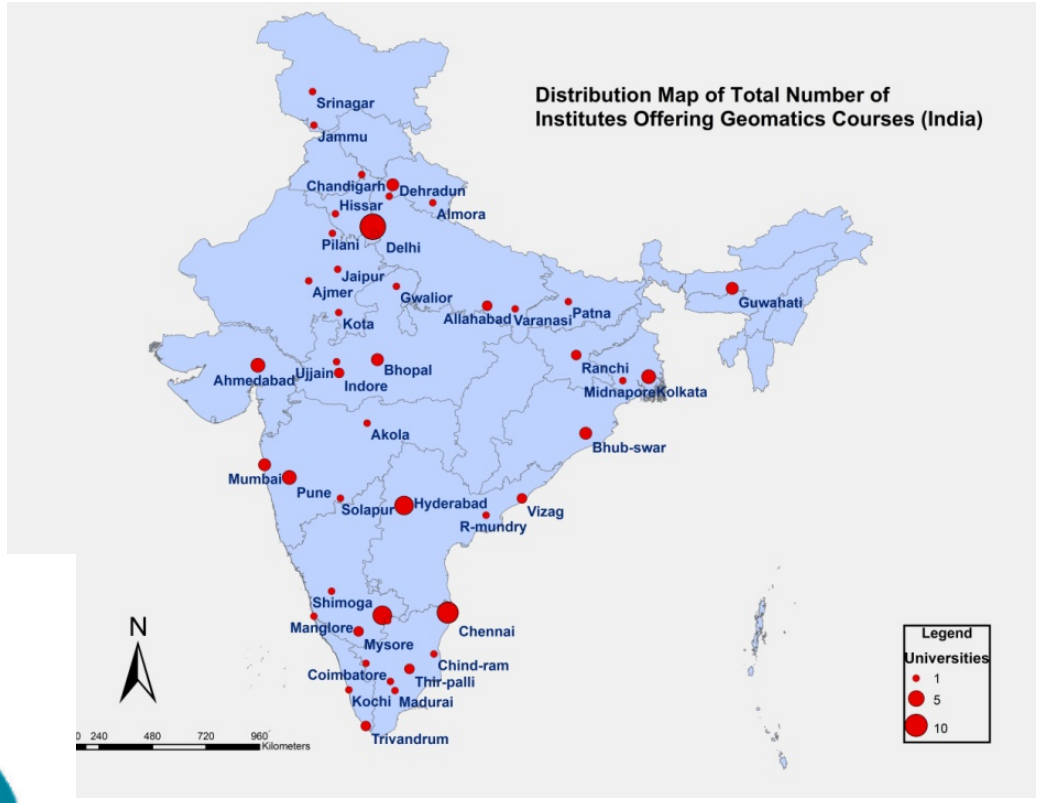
Workshops/Conferences/Seminars

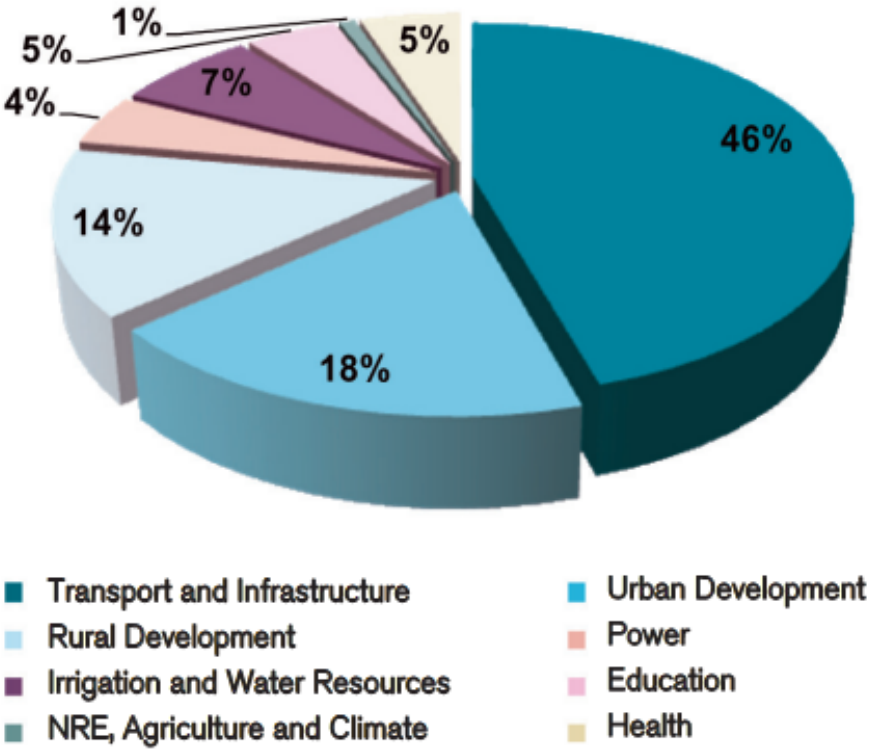


Workshops/Conferences/Seminars held in about 100 locations from 2000 to 2009

- Mountain Regions
- Tele-Health/Tele-Medicine
- Water Management
- Socio-Economic Benefit
- Global Navigation Satellite Systems
- Basic Space Technology Initiative (BSTI)
- International Space Weather Initiative (ISWI)
- Long Standing Partnership
  - COSPAS-SARSAT
  - UN/IAF Workshop

INDIAN SCENARIO





Range of Geomatics Education

Certificate course in Geomatics and K-12 Education

Training, Education and Outreach in Space Science

Educators who describe Geomatics as valuable for only map preparation will continue to be challenged, those need drastic change in their understanding.

Masters in Geomatics

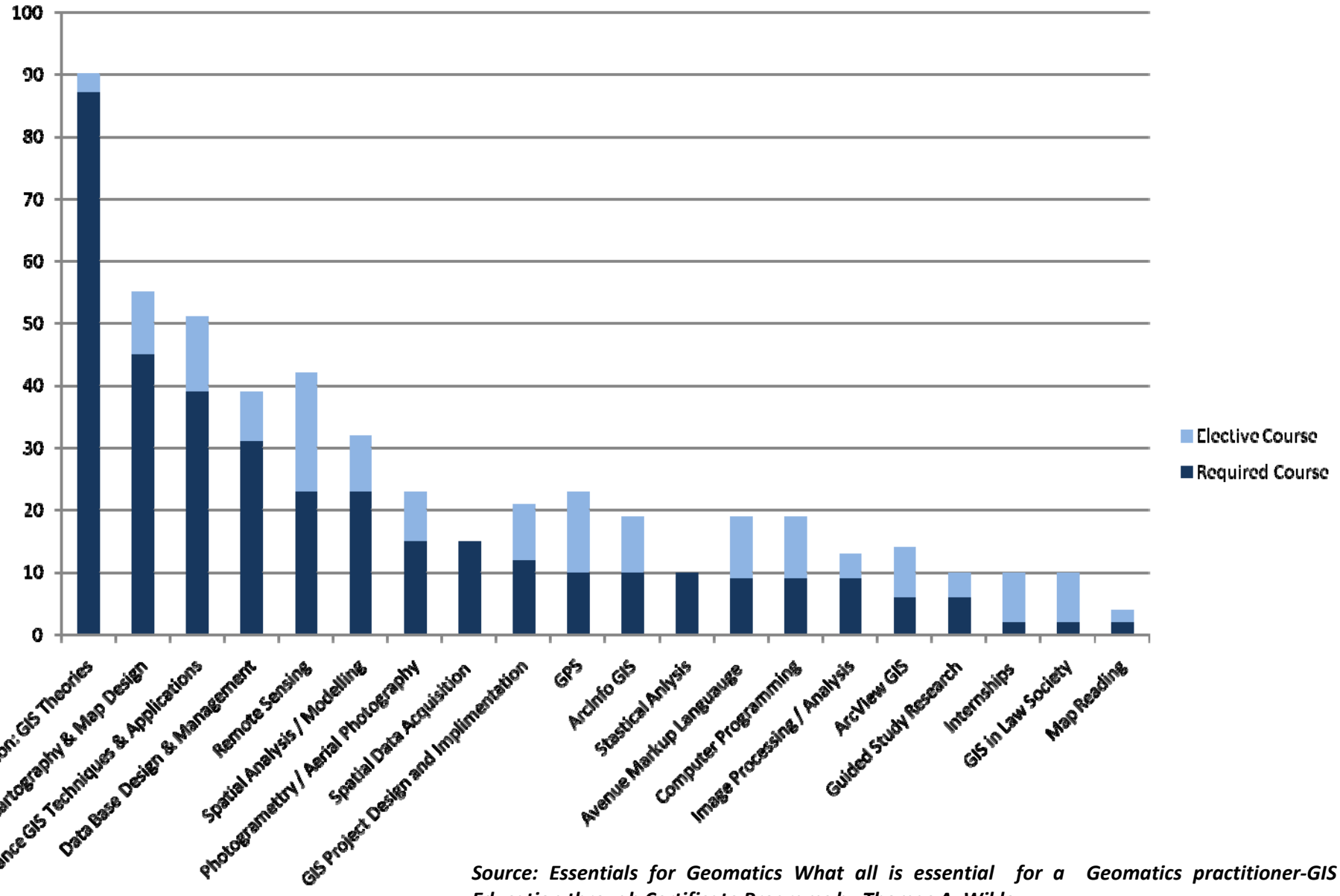
"Over the last two decades, higher education has made substantial investments in GEOMATICS education through equipment and software purchases, upgrades to teaching facilities, and the creation of innovative academic programs such as certificates and degrees.
However, comparatively less attention and fewer resources have been directed towards what might be called the **"instructor element"** of GEOMATICS instruction. "

Todd D. Fagin, Thomas A. Wikle

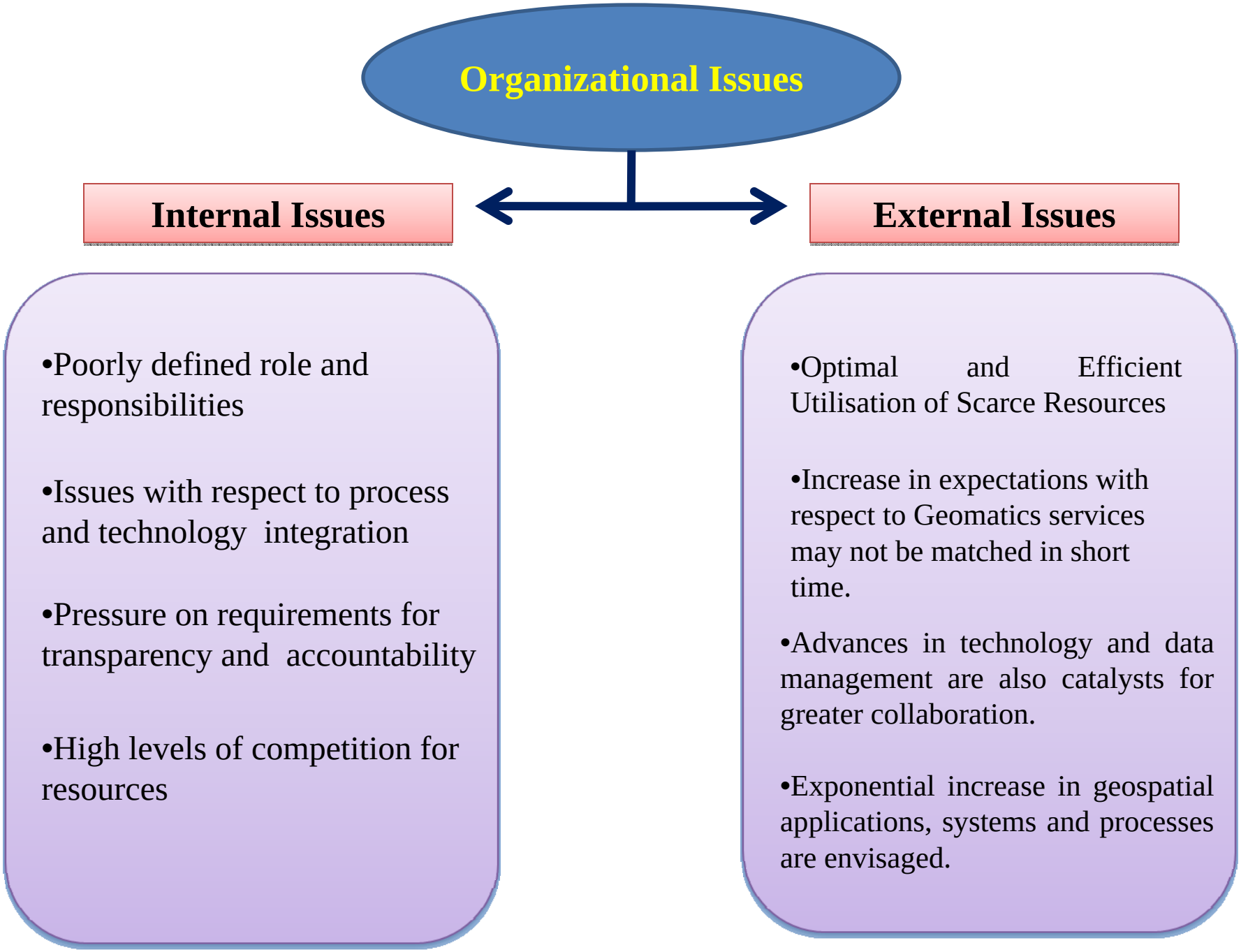
Wings of Geomatics

Surveying	Cartography
•Survey Law •Legal Surveys Procedure, Traditional Survey Equipment •Computerized Land Information Systems •Global Positioning Systems (GPS) •Computer Aided Drafting Systems (CAD) •Computer Hardware and Software •Construction surveying, Pre-engineering surveying •Property Rights Systems, Land Planning and Management •Understanding/Interpretation of data	•Specialized Equipment viz. stereo plotters, airborne survey cameras, sensors and scanners •Computer Graphic Systems, Image Processing Software •Image Interpretation, Geographic Information Systems (GIS) •Computer Aided Drafting Systems (CAD), Desktop Publishing •Computer hardware and software •File management metadata and file transfer
Earth Observation (Remote Sensing)	**Geographic Information System (GIS)**
•Hyperspectral/Ultraspectral/Radar/Lidar Techniques •Algorithm Development, Spectral Data Exploitation, Specialized Equipment •Large Volume Data Mining, Data Visualization •Data format conversion and GIS/RS Integration •Field Campaign Design and Implementation •Insitu remote sensing validation techniques •GIS/RS Integration, Electromagnetic Spectrum •Analytical Principles and Procedures, Image Acquisition, processing and Interpretation	•Principles of Geodesy •Control Survey Networks •Spatial Referencing Systems and Positioning •Computer Aided Drafting Systems (CAD) •Engineering Surveying, Coordinate Geometry, Photogrammetry •Computer Hardware and Software- external databases •Surveying, Earth observation and Cartography •Database/information structures, algorithms, design and systems •Geospatial data analysis, modeling and display •Spatial statistics
Navigation and Positioning	
•Electronic Navigation Systems for Positioning, Navigation, guiding, and controlling air, land, and sea vehicles •Custom software to integrate hardware systems •User Interfaces for Navigation and guidance systems •Position related information organized in databases •Use of integrated inertial measurement units and GPS •Understanding of ellipsoids, datums, map projections •Application of navigation, and positioning into other geomatics area, Geometrical geodesy	

Content wise



Source: Essentials for Geomatics What all is essential for a Geomatics practitioner-GIS Education through Certificate Programs by Thomas A. Wikle


Organizational Issues
Internal Issues
External Issues
•Poorly defined role and responsibilities
•Issues with respect to process and technology integration
•Pressure on requirements for transparency and accountability
•High levels of competition for resources
•Optimal and Efficient Utilisation of Scarce Resources
•Increase in expectations with respect to Geomatics services may not be matched in short time.
•Advances in technology and data management are also catalysts for greater collaboration.
•Exponential increase in geospatial applications, systems and processes are envisaged.

Next to Set the Steps of Curriculum Development

National needs/ National Policy

Structuring of Curriculum

Teaching at various Scales: Graduation, etc

Standardisation of Evaluation and Assessment

Feed back from Industry and Analysis & Revise the Curricula

Academic and Research Questions

- What are the **national policies** to balance the pursuit of academics and research in the field of Space Science /Technologies/ Geomatics.

- What are the main **financial aspects** related Geomatics Education?

- Why there is comparatively **low number of students register** for the Degree in Geomatics?

- How **to standardise** the syllabus and the faculty in-take?

Policy Considerations:

❖**How to increase the number of students** in the stream of science and technology and check the quality of the teachers.

❖**How to overcome the constraints of traditional to scientific education** in the larger scale.

❖**Curriculum and Syllabus design** of decisions about learning in science and technology education in consideration to the content, pedagogy, and assessment.

❖**“Text-based’ to “Context-based’: towards a real world** syllabus

❖**Precisely defined scientific knowledge and scientific abilities**

❖**Review of the assessment procedures** from traditional base to scientific based.

Geomatics Education In India

Degree courses on Geoinformatics - offered in 40 universities across India as part of Geography, Geology, Urban Planning, Civil Engineering etc.

Governmental support - By grants under various schemes and trainings

University Grants Commission (UGS)
Department of Science and Technology under FIST,
SAP & other innovative programmes.
Department of Space - offers trainings in RS-GIS to university teachers
Offer fellowships/scholarships to the needy students

Emerging GIS Technologies

Some of the technologies that most spatial advocates agree are driving innovation in our applications are:

- Database Technologies
- Mobile Computing
- Sensors
- Standards and Data Sharing

Challenges Ahead of the Development in Indian Industry

- Privacy Issues
- Sustained Growth
- Storage and Depository
- Open Minded
- Policy
- Open Source

How to increase curiosity in GIS

- Personal
- Trainings and campaigns
- Educational
- Political
- Financial

Thank You

References

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