

Adoption of New GIS Technology for Developing World National Statistical Offices

Tom Fitzwater

International Programs

Population Division

U.S. Census Bureau

Background:

International Programs

U.S. Census Bureau

International Data Products

The U.S. Census Bureau conducts **applied research and analysis on international topics.**

- Demographic, economic, geographic, health, and aging issues.
- Expert staff with exceptional access** to international data.
- Data products include the **International Data Base (IDB)** and **HIV/AIDS Surveillance Data Base.**

Country	Geographic	Reference	Population Subgroup	Sex	Age	Prevalence	SA
AA	Not specified	2005	Blood donors - volunteer	B	ALL	0.11	
AC	Not specified	2004	Blood donors - volunteer	B	ALL	0.20	
AC	Not specified	2004-2005	Prisoners	M	ALL	3.00	
AC	Not specified	1986-1990	Prostitutes	F	ALL	1.70	
AC	National	2002	Pregnant women	F	ALL	0.48	
AC	National	2005	Pregnant women	F	ALL	0.66	
AC	National	2000	Pregnant women	F	ALL	0.94	
AC	National	2003	Pregnant women	F	ALL	0.00	
AC	National	2001	Pregnant women	F	ALL	0.44	
AC	National	2004	Pregnant women	F	ALL	0.75	
AC	Not specified	1986-1990	Prostitutes	F	ALL	1.70	

Comments for Selected Record: # of Records: 102153
Only the prevalence rate was given.

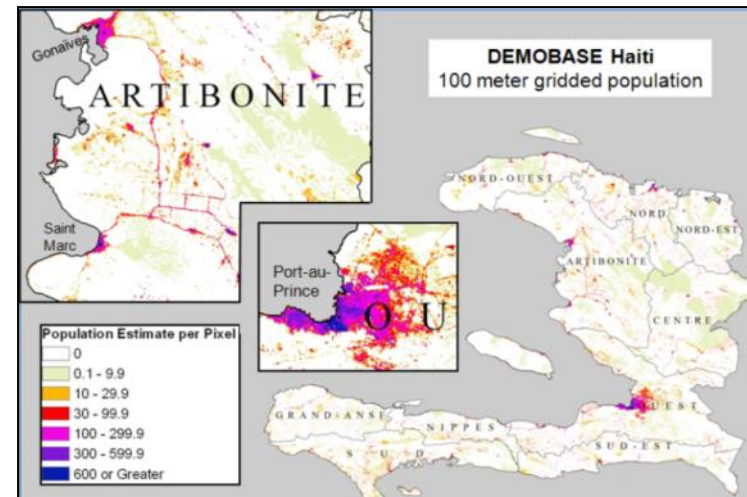
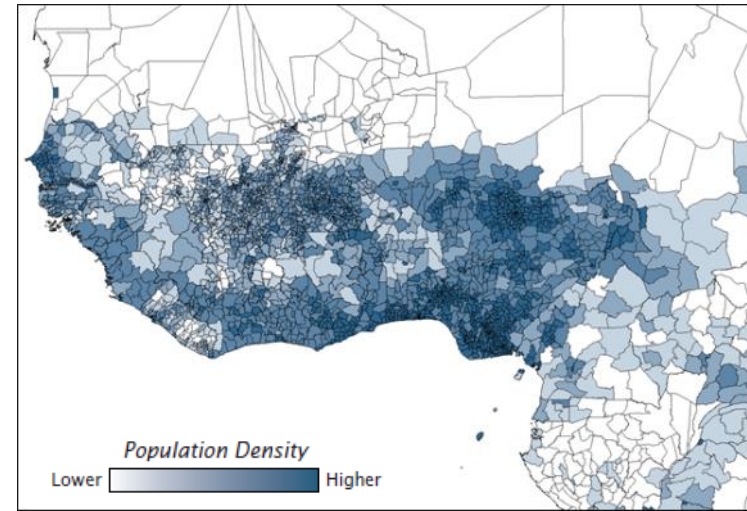
Source Information for Selected Record:

Source ID	Author	Year	Title	Publication Information
A0547	Alonso, M., R. Mazin, R. Manchado, et al.	2009	Preventing Transfusion-Transmitted HIV Infection in Latin America and the Caribbean: Issues Associated with Blood Donor...	Journal of Acquired Immune Deficiency Syndromes, vol...

International Data Products

We also produce **subnational** population estimates.

- **Global Population Data:** vector-based subnational population estimates.
- **Demobase:** raster population estimates.
 - Pilot datasets for Haiti, Pakistan, and Rwanda available online.

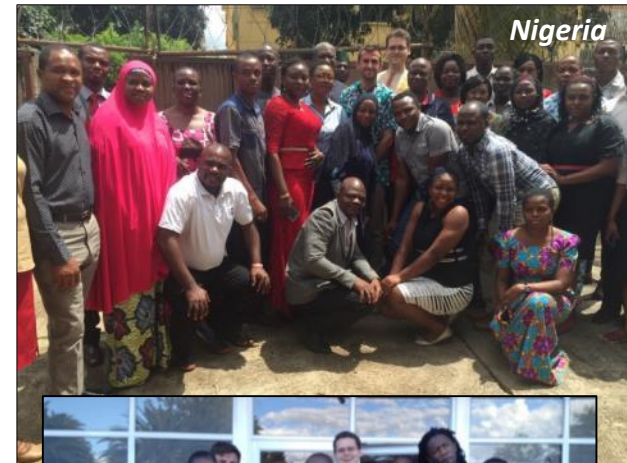


International Assistance

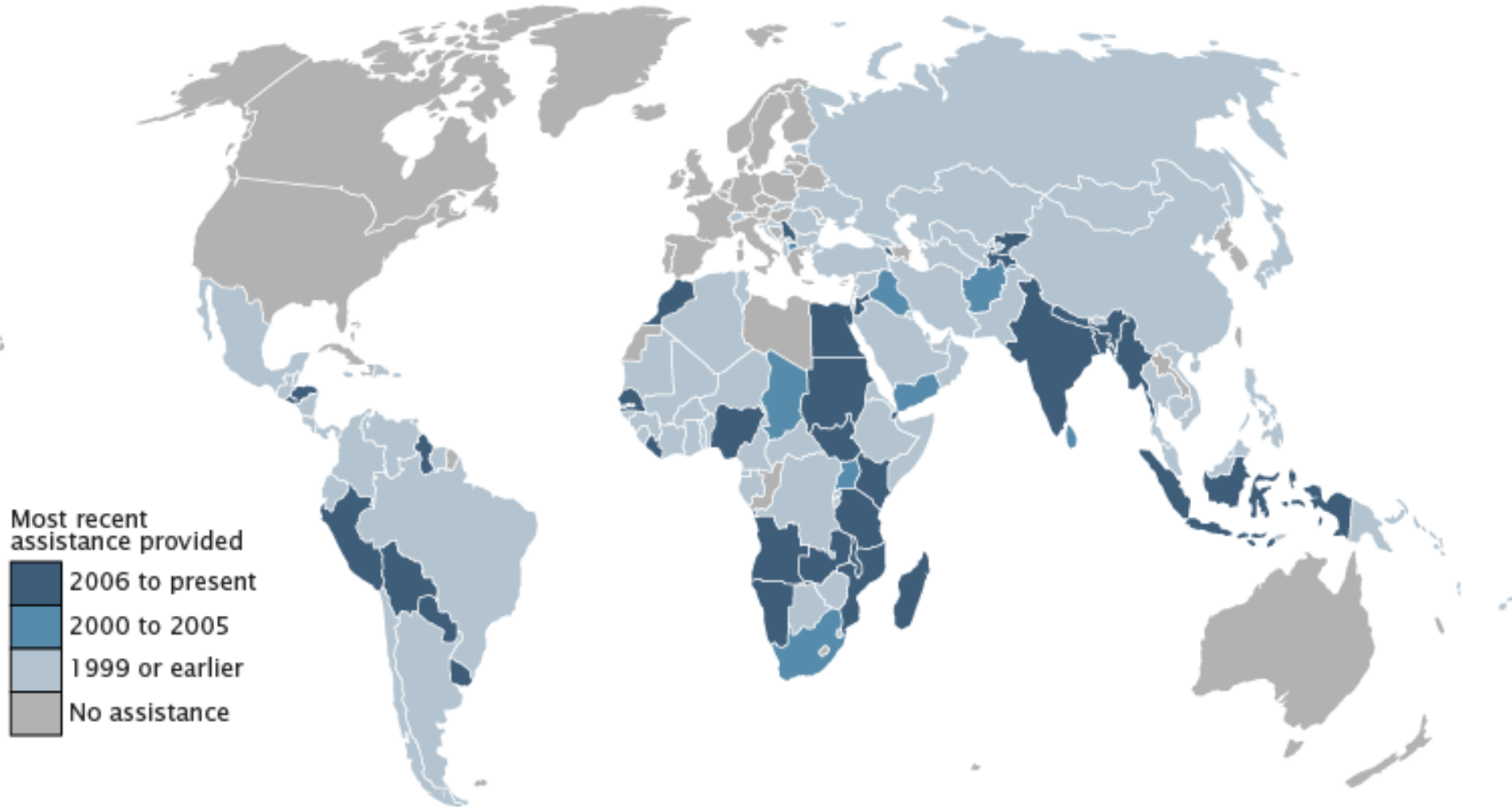
We help **build the capacity** of other national statistical offices.

- In-country & regional workshops.
- Technical assistance & consulting.
- **GIS** training frequently provided.

Our **International Assistance** program has been active for over **65 years**.



Where We Work



Headquarters Workshops

In 2012, we re-established our Washington, D.C. **workshop program**.

Since then, we have trained **117 professionals** from **40 countries**.

Topics:

- Census and survey data processing.
- Demographic analysis.
- Gender statistics.
- Data analysis and dissemination.
- Spatial data management.

Schedule of classes available online.



E-Learning

- **Online courses:**
 - 1-2 hours web-based training modules.
 - Covers entire survey lifecycle.
- **Select Topics in International Censuses (STICs):**
 - Series of technical notes on emerging population census challenges.
 - Complements UN standards.

Introduction to Census Cartography

Select a session:

- Introduction to the Course
- Session 1: Concepts and Terminology
- Session 2: Administrative and Census Geography
- Session 3: Maintaining a Cartographic System
- Conclusion and Final Assessment

This course has been developed by the US Census Bureau's international programs center for technical assistance.

Glossary Resources

This course is made possible by the generous support of the American people through the United States Agency for International Development (USAID).

United States Census Bureau

New Technologies in Census Geographic Listing
Select Topics in International Censuses¹

Released December 2015

INTRODUCTION

This Select Topics in International Censuses brief will provide national statistical offices (NSOs) with focused information about technologies for census geographic listing operations that have matured in the past ten years. Geographic listing strongly affects subsequent census operations. During the listing operation, census workers identify dwelling units and list households within the census area, which is usually the entire country. Traditionally, when census workers performed this count using pencil and paper, they created cartographic sketch maps for use during the full population and housing enumeration. Leading into the 2000 census round, Geographic Information Systems (GIS) software became widely available on desktop computers with user-friendly graphical interfaces. However, it was during the 2010 census round (2005–2014) that many NSOs transitioned from paper maps to digital. The transition from paper to digital maps involves the digitization of enumeration area boundaries as represented on sketch maps. These sketch maps must also portray physical boundaries for proper digitization. Physical features in digital format that correspond to those represented in the sketch maps are then used to rebuild enumeration area boundaries. During the 2010 census round, many NSOs also began researching and implementing solutions using enterprise GIS, satellite imagery analysis, and Global Positioning System (GPS)-enabled handheld devices. However, cost and complexity formed significant barriers to widespread adoption. For the 2020 census round, NSOs will increasingly adopt these technologies for census operations.

Geographic Definitions Used in This Brief

Each NSO may have its own understanding of the terms used when describing listing operations. These definitions are intended to provide clarity for the purposes of this brief, not to supplant existing NSO definitions or suggest the need for complete uniformity. There are further distinctions between dwellings based on assets and services available. For more information on these definitions, refer to pages 152–157 of Principles and Recommendations for Population and Housing Censuses (UNSD, 2015).

Building points—A complete listing of the point locations of structures within the enumeration area—usually the complete area of a country—that may or may not contain one or more living quarters.

Living quarter—Any inhabited structure that is not wholly used for nonresidential purposes at the time of the census.

Dwelling unit—A room or group of rooms (place of abode) within a permanent structure constructed specifically for occupation by one household with access to a street or common space.

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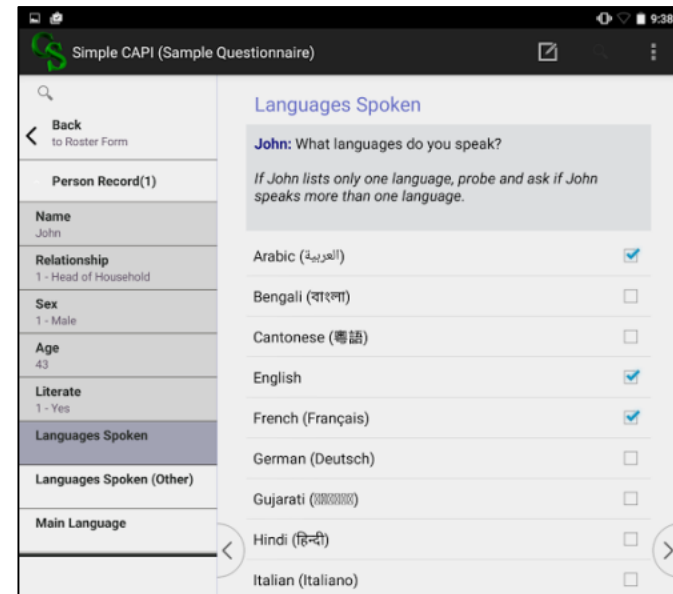
¹ This technical note is one in a series of "Select Topics in International Censuses" exploring matters of interest to the international statistical community. The U.S. Census Bureau helps countries improve their national statistical systems by engaging in capacity building to enhance statistical competence in reasonable ways.

United States Census Bureau | U.S. Department of Commerce
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Software: CSPro

- **Census and Survey Processing System (CSPro).**
- Used by hundreds of organizations and 160+ countries for **entering, editing, tabulating, and disseminating** census and survey data.
- Data entry app for **Android** now available.



The screenshot shows the CSPro app interface for a 'Simple CAPI (Sample Questionnaire)'. The user is 'John', a 43-year-old male, head of household, who is literate. The current question is 'Languages Spoken'. The interface lists several languages with checkboxes: Arabic (العربية) [checked], Bengali (বাংলা) [unchecked], Cantonese (粵語) [unchecked], English [checked], French (Français) [checked], German (Deutsch) [unchecked], Gujarati (ગુજરાતી) [unchecked], Hindi (हिन्दी) [unchecked], and Italian (Italiano) [unchecked]. A note indicates that if only one language is listed, the user should be probed for more.



Other Software

- **Demographic Analysis and Population Projection System (DAPPS):**
 - Analyzing and creating cohort-component population projections.
- **Population Analysis System (PAS):**
 - Analyzing age structure, fertility, mortality, migration, population distribution, and urbanization.
- **Rural and Urban Projection (RUP):**
 - Projecting age and sex cohorts over time.
- **Subnational Projections Toolkit (SPToolkit):**
 - Support preparation of subnational population projections.

National statistical offices (NSOs):
Rapid vs. gradual
adoption of new technology

Rapid Adoption

leapfrog

verb \ 'lēp- frōg, - fräg \

to move ahead of or beyond (someone or something) in a very quick and sudden way

Merriam-Webster.com

- Developed world NSOs **gradually** incorporated new electronic technologies into the census process over the course of 100+ years.
- Developing world NSOs have the opportunity to **leapfrog** this gradual approach and **rapidly** adopt new technology in just a few years...
 - ... and most are taking advantage of this opportunity!

New Geospatial Tech

- ***New Technologies in Census Geographic Listing (2015):***
 - Satellite image analysis
 - Handheld devices
 - Enterprise databases
 - Training & outsourcing considerations
- Audience: NSOs in low & middle income countries.

New Technologies in Census Geographic Listing
Select Topics in International Censuses¹

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Gradual Adoption

- U.S. Census Bureau:
 - **Pre-1950s:** Heavily paper driven, door-to-door enumeration; early computerization (e.g. UNIVAC).
 - **1970s/80s:** Increased mechanization; mail-out/mail-back questionnaires; small spatial databases.
 - **1990s/2000s:** Master Address File/TIGER development and integration (advanced spatial database); laptop questionnaires (some surveys).
 - **2010s:** Internet response; tablet/smartphone questionnaires; optimized field workforce management; more extensive geospatial data management.

Source: <https://www.census.gov/history/>

Rapid ~~Gradual~~ Adoption

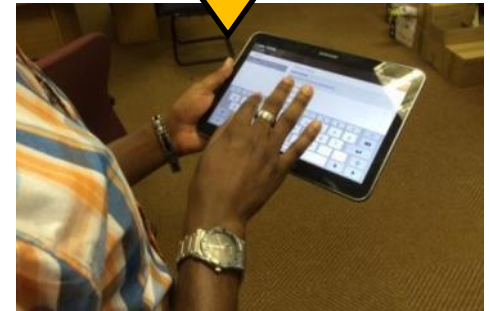
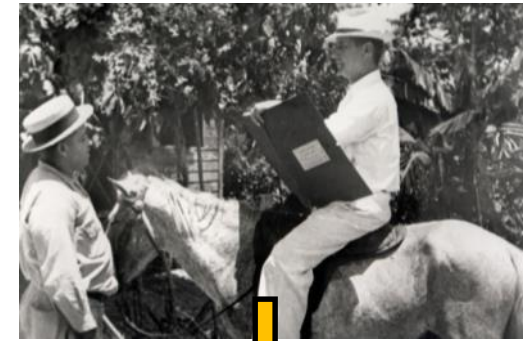
■ ~~U.S. Census Bureau:~~ **Developing World NSOs**

- **2000s** **Pre-1950s:** Heavily paper driven, door-to-door enumeration; early computerization (e.g. ~~UNIVAC~~). **Desktop + CSPro**
- ~~1970s/80s:~~ Increased mechanization; mail out/mail-back questionnaires; small spatial databases.
- ~~1990s/2000s:~~ Master Address File/TIGER development and integration (advanced spatial database); laptop questionnaires (some surveys).
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Paperless Censuses and Surveys

- Strong push to adopt new technology for **global 2020 census round**.
 - National statistical offices are migrating rapidly to paperless workflows.
 - This trend includes the developing world.
- **Encouragement** from multiple sources:
 - Peers (other national statistical offices).
 - International development community.
 - Ministerial level.



Paperless Censuses and Surveys

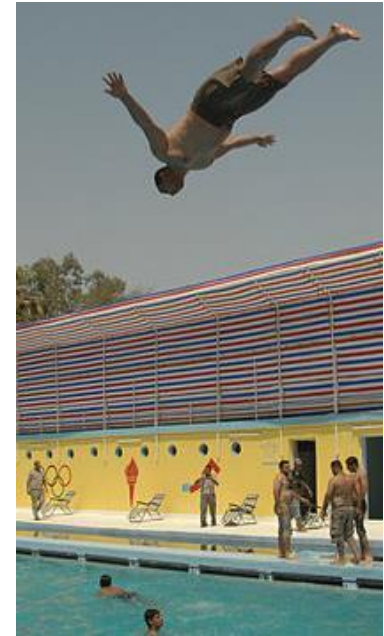
- **Geospatial/GIS** are especially popular in terms of new tech:
 - In-office address canvassing with satellite imagery.
 - Affordable handheld GPS devices.
 - More sophisticated enterprise workflows & databases.



14:29:46	38.96	33.44	30.55	31.50	36.95
14:29:59	3.596	1.762	2.046	1.212	0.814
14:30:15	9.617	7.845	4.262	1.992	1.188
14:30:25	4.145	2.519	1.305	1.009	0.721
14:30:35	38.38	32.86	30.37	31.34	36.63
14:30:44	10.54	4.650	2.757	1.714	0.962
14:30:53	11.48	3.843	2.899	1.937	1.185
14:31:04	3.957	3.203	2.258	1.373	0.794
14:31:10	37.90	32.33	30.01	31.36	36.81
14:31:18	2.669	3.368	2.368	1.601	0.883
14:31:26	4.130	3.835	2.176	1.319	0.669
14:31:36	2.748	3.698	1.283	1.229	0.738

Challenges with Rapid Adoption

- Many organizations are “diving in”.
 - Rapid adoption is **high risk**.
 - Trade-off between **fast, good, and cheap**.
- Minimal **testing** before adoption.
 - Assuming tech will succeed, with no **backup plan**.
 - No experience with major operational failure while using new tech.
- Minimal **information security**.
 - No major data breach that compromised integrity of the statistical office.



You can only pick two...



Hardware & Infrastructure Challenges

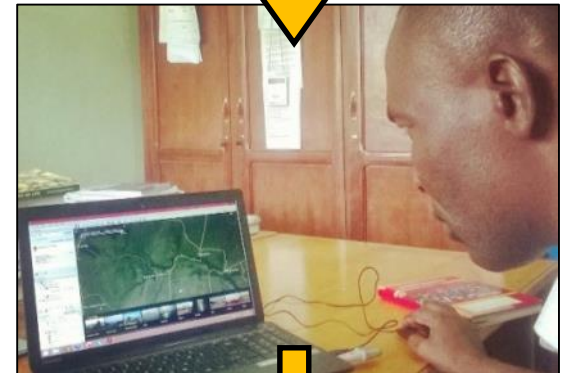
- Most smartphones, tablets, servers, and PCs are designed for consumers in **developed** countries.
- Assumptions:
 - **Infrastructure:** Reliable electricity & Internet connections.
 - **Affordability:** Cost structure based on developed world consumers.
 - Cheaper devices of lower quality, e.g., GPS accuracy of 15-30m+ for basic tablets.



So... is it **wise** to leapfrog?

Leapfrogging Successfully

- Developing world NSOs **can leapfrog** with **rapid adoption**.
 - However, the process is **high risk**.
- To minimize possibility of failure:
 - Balance fast vs. good vs. cheap.
 - Manage expectations.
 - Practice good project management (risk, oversight).
 - Have fallback options (“Plan B”).

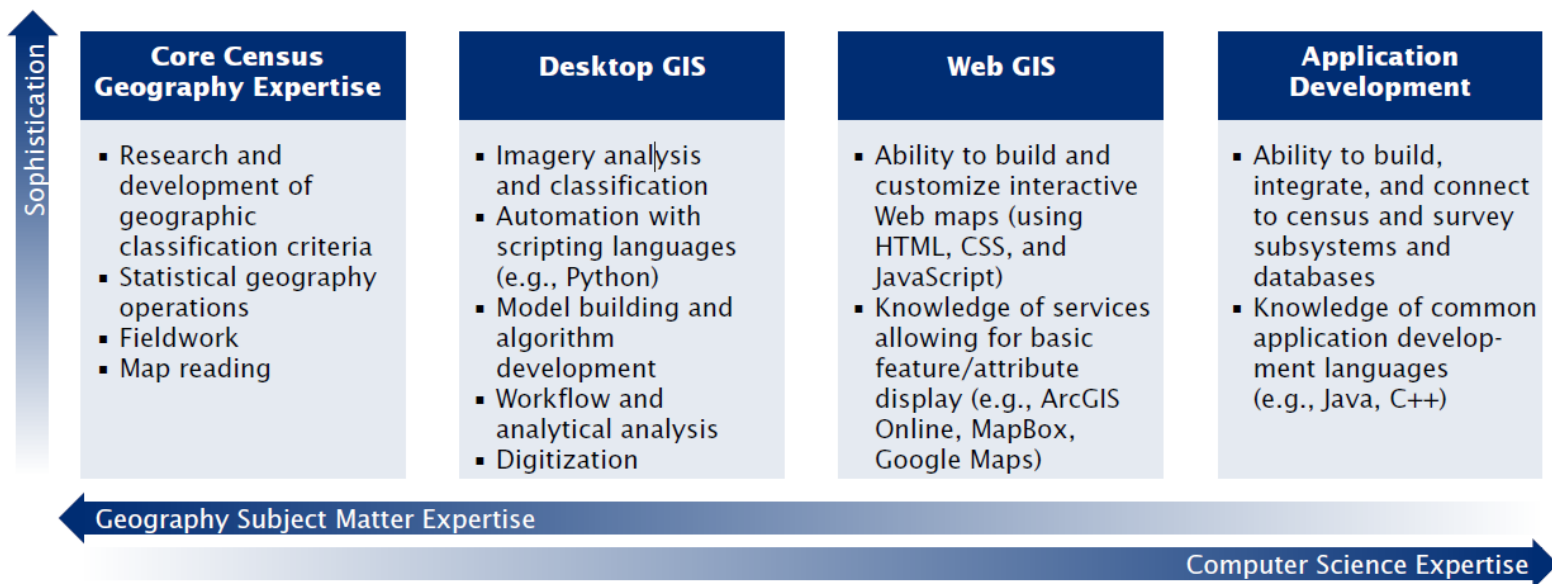


Training for Rapid Adoption

- A broad spectrum of skills are required for new geospatial technology.

Figure 6.

Areas of Expertise Required for Successful Implementation of New GIS Technology



Source: U.S. Census Bureau.

Training for Rapid Adoption

- Sufficient training opportunities should be provided to ensure staff and managers **understand** new technology.
 - Not necessarily becoming an expert.
 - Focus on high-level tech concepts and project management.
- Opposite problem: **training fatigue**.
 - Staff are continually attending trainings and workshops, limiting their ability to conduct business.
 - Misaligned training incentives and lack of training strategy can exacerbate this situation.

Rapid Adoption: Train or Contract?

- May be preferable to **contract** with private vendors to implement tech projects.
 - New geospatial technology heavily reliant on **web development** and **programming** ability.
 - Staff *cannot* become experts in every programming language, platform, or framework.
 - Staff *can* focus on core census and survey expertise.
- However, important to train staff on fundamental concepts so they can provide **effective vendor oversight**.

Rapid Adoption: Training Strategy

- NSO managers and development partners must also strategize cooperatively:
 - Ensure training is **complementary**, not competing.
 - **Balance** staff training time with actual work time.
 - Consider whether training incentives are more harmful than helpful.
- **Manage expectations:**
 - A survey expert **will not** become a web developer after one training workshop.
 - Focus resources on attainable expertise.

Thank You

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