

MAPPS Census White Paper

Executive Summary

The recent Presidential Executive Order on a Comprehensive Plan for Reorganizing the Executive Branch seeks input on improving “efficiency, effectiveness and accountability.” This white paper addresses a multi-billion-dollar opportunity for reducing costs and eliminating redundancy in Federal government: geospatial mapping and processing programs. In the short term, millions of dollars could be saved at the U.S. Bureau of the Census (USBoC) alone. Longer term, the savings within the USBoC could exceed \$1B, and rise to multiple billions when implemented across all agencies. These savings can be realized by reducing duplication of activities and programs and by leveraging private sector geospatial data capabilities, which have advanced significantly over the last 30 years.

In this document, we will specifically focus on the opportunities at the USBoC. Thirty years ago, the USBoC did have a significant need to develop a reliable map. The USBoC, however, has remained in the mapping business even though it is not a core competency or a constitutionally-mandated obligation. USBoC mapping has evolved into a growing expenditure which now needs to be reviewed when addressing redundancy within the federal government.

This document outlines the history of inefficiencies within the USBoC in the collection and use of geospatial map data and tools over the last three census cycles, including the billions wasted on solutions that were ultimately ineffective in reducing costs. These redundant investments and other inefficiencies have resulted in the budget increasing over 600 percent since the late 1960s, while the population has only increased by a fraction of that amount. These increases, which most recently culminated in a \$12.5B price tag for the 2010 Census, have escalated so dramatically that Congress mandated a census budget cap, directing the USBoC to ensure that the 2020 Census costs no more than the 2010 total.

A key issue in the USBoC approach appears to be the lack of attention paid to the commercial mapping industry. This industry emerged in the late 80's and is now the foundation for a \$75B global market which supports a broad array of industries and is integrated into daily life for consumers and government users. The companies in this industry spend billions of dollars annually creating and maintaining the most accurate, comprehensive and timely maps, as well as continuously innovating new, more efficient, technology systems and support to deliver the maps and associated products and services. Rather than leveraging this capability, USBoC continues to attempt to duplicate these functions.

As the gap between public and private sector mapping capabilities continues to widen, there is clearly a growing opportunity to benefit by taking advantage of the newer, more efficient commercial solutions and increasingly high quality commercial data. A fresh look at the capabilities of the commercial mapping industry is also particularly relevant in light of the issues faced by the 2020 Census program, which the GAO has placed on its “High Risk” list for 2017.

It is recommended that the government review the opportunity to partner with the private sector in its mapping and related maintenance programs, including options such as buying commercial maps, partnering with the private sector to improve processes and to verify data, and fully outsourcing the

mapping process. This approach would both lower costs and allow the USBoC to focus its staff resources on meeting its primary Constitutional mission: a successful 2020 population count.

Inefficiencies

According to the U.S. Constitution, it is necessary to enumerate the “whole Number of free Persons” in the United States every ten years, in order to apportion Representatives to the House and direct tax distribution. This enumeration responsibility was assigned to the Secretary of Commerce in Title 13 of the United States Code, and delegated by the Secretary to the U.S. Bureau of the Census.

When the Census first began, there were no commercial maps available to assist with the task of counting the population. The USBoC therefore began developing maps to support its mission, which eventually led to the development of the TIGER map program in the 1980’s.

The original Constitutional mandate does not, however, actually require Federal development of a national map, and more recent guidance from OMB Circular A-16 requires that “all agencies that collect, use, or disseminate geographic information and/or carry out related spatial data activities will, both internally and through their activities involving partners, grants, and contracts...

Search all sources... to determine if existing federal, state, local or private data meets agency needs before expending funds for data collection.”¹

While “searching all sources” for map data would not have yielded much thirty years ago, it is a very different story today. We now have a thriving commercial geospatial services industry which produces annual revenues of \$75B and employs 500,000.² This industry began growing in the 1990s, driven by consumer demand for high quality maps to support mobility. Initially delivering simple routes for AAA travelers, the industry rapidly expanded, providing increasingly detailed maps for in-vehicle navigation systems, online mapping tools and a host of commercial sectors such as telecommunications and information technology.

Major companies such as Apple, Google, HERE Technologies, and TomTom are now actively engaged in developing and selling geospatial data, which serves as a fundamental underpinning for dozens of industries, including insurance, banking, utilities, retail and advertising, telecom, transport and logistics, web/internet and connected driving. Amazon, Facebook, Microsoft, IBM, FedEx, Garmin and every major automotive manufacturer use this data to power their operations every day. In addition, there has recently been a significant increase in commercial mapping investment in this area, as new advances in automated vehicle technology have triggered major activity in the field. Recent headlines include \$32M in new capital for DeepMap, a \$500M spend planned by Uber, and \$3.1 billion to acquire HERE Technologies.³

Multiple providers have high quality nationwide coverage, and routinely deliver this data in a variety of standard and customized formats tailored to their customers’ needs, simplifying the need for validation.

¹ https://obamawhitehouse.archives.gov/omb/circulars_a016_rev/#8)

² Boston Consulting Group, 2012.

³ <https://www.forbes.com/sites/dougnewcomb/2016/06/27/inside-audi-bmw-and-daimlers-3-billion-bet-on-heres-mapping-business/#1fe7500b6343>.

In a USBoC study, the agency acknowledged that data available from commercial sources is of higher quality and lower cost than that developed by the USBoC currently.⁴ Similarly, the commercial sector currently uses internationally certified quality assurance processes and standards which “provide a model for the Census Bureau to follow.”⁵

Against this backdrop, USBoC mapping efforts appear redundant. Unlike the USBoC, which builds up mapping capability as needed for each decennial population count, private sector firms already maintain the personnel and infrastructure to process billions of inputs and provide geospatial data of a guaranteed quality to major customers world-wide on a daily basis. At least one firm spends approximately \$400M a year on map maintenance, an investment which increases annually.⁶ This maintenance cost is distributed among the wide array of companies and industries which buy the commercial map, making overall costs lower for everyone. In the future, these efficiencies can be expected to increase, potentially providing additional savings to government users.

The redundancy in public and private sector mapping is particularly evident when the data collection process is examined. Private sector firms have spent decades building up relationships with local authorities in order to stay abreast of data changes. In addition, these firms employ a broad array of increasingly sophisticated tools and process to capture and deliver map data in near real-time, including specialized vehicles equipped with the latest sensors capture real-world data with centimeter accuracy and major cloud-based services which “close the loop” with consumer vehicles, a solution which will eventually allow every connected car on the road to serve as a sensor.

In contrast, the USBoC has continued to invest in manual data collection processes and in establishing links with the same local authorities. In 2000, the USBoC strategy for validating its map was to send field agents out with pen and paper to walk a percentage of residential streets. In the following Census, 140,000 temporary agents were sent out to walk every street.⁷ This was not a sustainable strategy, so a program was begun to collect data from local government authorities in an attempt to reduce the amount of fieldwork. Challenges arose here too, as inconsistencies in reporting and data formats created the need for significant data validation and reformatting efforts. More recent initiatives center around a combination of field agent canvassing, local government data, in-office review of satellite imagery, and the use of administrative data from other agencies. Future research also calls for research on the use of drones.

The simple fact is that the private sector has already successfully and efficiently deployed technologies which are just now making their way into the USBoC’s preliminary research program.

This is a clear and expensive disconnect. As shown in Figure 1, the ongoing USBoC effort to develop geospatial tools, and to collect and manage data, has increased over time.⁸ It is estimated that USBoC spent \$1.4B over 10 years to develop address data for the 2010 Census alone.⁹ The current Geographic Support System Initiative (GSS-I) initiative calls for \$674M over 10 years to improve address coverage,

⁴ *Census Bureau Market Research Project with Nokia*, July 2013

⁵ *Ibid.*

⁶ HERE source.

⁷ GAO-15-546T, p. 8.

⁸ Chart data from OIG-16-029-A.

⁹ GAO-15-193, p. 59.

updating of spatial features, and enhancement of quality assessments, as well as to deliver a reengineering of the address canvassing operation.¹⁰

		In-office address canvassing
		Launched GSS-I
	Launched CAUS	CAUS
DSF City Address updating	DSF	DSF
Launched LUCA	LUCA	LUCA
Partial address canvassing and listing	Complete address canvassing	Re-engineered address canvassing
2000	2010	2020

Figure 1 Census Bureau Mapping and Addressing activities

These numbers contribute to the ongoing trend of substantial increases in overall Census costs – **costs which escalated by more than 600 percent** between 1960 and 2010, after inflation and housing unit costs are taken into account.¹¹ The GAO estimates that “the 2010 Census was the costliest U.S. Census in history at about \$12.3 billion, and was about 31 percent more costly than the \$9.4 billion 2000 Census (in 2020 dollars).”¹²

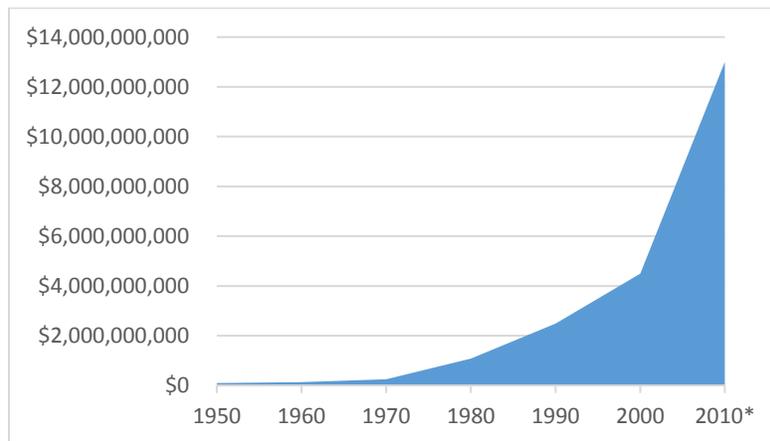


Figure 2 Census Cost Escalation over Time

This trend looks set to continue, as preparations for the 2020 Census already appear to be running into significant difficulties. GAO report 17-312 puts it on the “high risk” list for 2017, noting that:

¹⁰ Ibid, p. 62.

¹¹ https://www.nap.edu/read/12865/chapter/5#39_2-C.4

¹² http://www.gao.gov/highrisk/2020_decennial_census/why_did_study

“The Bureau is planning many previously unused innovations for the 2020 Census, including making greater use of local data, imagery, and other office procedures to build its address list; ... using administrative records to reduce field work; and reengineering field operations using technology to reduce manual effort and improve productivity.” All of these items relate to its geospatial data program. “For example, although the Bureau has no control over the accuracy of data provided to it by other agencies, it is responsible for ensuring that data it uses for 2020 Census are of sufficient quality for their planned uses.”

Ineffectiveness

The USBoC focus on building rather than buying geospatial technology and data, coupled with significant challenges in implementing new tools, is an additional cost escalator. For example: at his July 9, 2013, Senate HSGAC nomination hearing, Census Director John Thompson committed to using the private sector to avoid “recreating the wheel” in mapping and to instead engage with the private sector to reduce costs. Census did competitively bid and award the opportunity to supply map data. However, the current budget indicates that the USBoC plans to collect (again) map data that they have already acquired. This is particularly inefficient in light of the significant private sector advances in this area as described above. The USBoC also continues discussions with other Federal agencies to share the cost of developing additional national map databases, e.g., the All Road Network of Linear Referenced Data (ARNOLD).

This situation is exacerbated by USBoC challenges in developing and deploying homegrown solutions: the GAO states that “the Bureau’s past efforts to implement new approaches and IT systems have not always gone well... [F]undamental weaknesses in key IT management practices... increased the cost of [the 2010] Census by up to \$3 billion.”¹³ An unfortunate pattern of incorrect cost estimation and emergency appropriations has been the result. For example, the USBoC attempted to develop a custom portable handheld device for data collection under the Field Data Collection Automation (FDCA) program. The GAO raised issues around procurement, management, and operational risks related to this program on multiple occasions throughout the 2010 census preparation process. In the end, the project not only had cost overruns for development, but failed to deliver the expected billions in efficiencies. This project was also a significant distraction in the implementation of the final Census deployment. An additional example is the USBoC effort to build its own highly instrumented spatial data collection vehicles. This effort was also part of the 2010 Census program, but failed to deliver a deployable data collection fleet.

The GAO, OMB, and Congress have all repeatedly expressed concern about the USBoC approach to mapping, addressing, and managing associated costs over the last thirty years, most recently including:

- 2/2017 – *High Risk Series: Progress on Many High Risk Areas, While Substantial Efforts Needed on Others* (GAO 17-312). “Over the past 3 years, we have made 30 recommendations to help the Bureau design and implement a more cost-effective census for 2020; however, only 6 of them had been fully implemented as of January 2017.”¹⁴
- 4/2016 – *Census Scientific Advisory Committee Recommendations from Spring 2016 Meeting* “CSAC recommends that Census extend agency expertise in automated image processing,

¹³ GAO – 15 -546T

¹⁴ http://www.gao.gov/highrisk/2020_decennial_census/why_did_study

change detection, use of ancillary data and feature extraction... The Census should seek assistance in integrating automated processes with the currently (mostly manual) workflow.”

- 4/2015 – *2020 Census: Recommended Actions Need to be Implemented Before Potential Cost Savings Can Be Realized* (GAO-15-546T)
- 2/2015 – *Geospatial Data: Progress Needed on Identifying Expenditures, Building and Utilizing a Data Infrastructure, and Reducing Duplicative Efforts* (GAO-15-193)

Accountability

The GAO states that total Federal geospatial investment is likely under-reported by about half.¹⁵ In the same report, **USBoC is noted as unable “to provide an estimate for over half of its geospatial data costs.”** Other recent examples include:

- 5/2016 – *The U.S. Census Bureau Geography Division Lacks Complete Information for Project Costs and Has Not Fully Monitored GSS-I Goals* (OIG-16-029-A) Report notes that the Census appears to have approved new projects without cost estimates, failed to track contractor costs to specific projects, and failed to monitor progress of GSS-I goals.
- 10/2014 – *2020 Census: Census Bureau Can Improve Use of Leading Practices When Choosing Address and Mapping Sources* (GAO-15-21) “the Bureau has inconsistently documented cost and quality support for decisions already made to use address and mapping data from state, tribal, and local governments, other federal agencies, and a commercial vendor... the Bureau lacks accountability and transparency for future sourcing decisions.”

Looking ahead to the 2020 Census, the same pattern appears to be continuing. The 2016 Strategic Plan has not yet been formally presented, but the latest budget already requests more money than originally planned. That budget also includes increasing the number of staff dedicated to map development.

In addition, the GAO reports that:¹⁶

- “Key IT decisions need to be prioritized and made in time for full end-to-end testing in 2017: In October 2016, Bureau officials stated that they had 16 IT-related and 32 partially IT-related decisions left to make...
- Information security risks and challenges need to be addressed to secure the Bureau's systems and data...
- 2020 Cost Estimation does not conform to best practices... the Bureau carried out its risk and uncertainty analysis only for about \$4.6 billion (37 percent) of the \$12.5 billion total estimated life-cycle cost.”

Clear Opportunity to Save \$Billions

The above discussion focuses on the USBoC. However, duplication and redundancy in mapping cuts across many Federal agencies, as noted by GAO-15-193 and many related reports. It is recommended

¹⁵ GAO 15-193, pg. 37. “...Census officials could not provide an estimate for over half of its geospatial data costs...”

¹⁶ http://www.gao.gov/highrisk/2020_decennial_census/why_did_study

that the government review the current “build vs buy” strategy and more strongly consider the alternatives which would allow the public sector to participate in the efficiencies established by the private sector. These include: simply buying commercial maps, partnering with the private sector to improve processes and verify data, and fully outsourcing the mapping process.

Benefits would include:

- Eliminate collection efforts
- Provide the capability to deal with thousands of different sources
- Eliminate the need to validate currency of data
- Avoid costs of new collection programs
- Utilize commercial change detection capability
- Take advantage of technology updates from the private sector
- Share costs and expense with industry
- Expense of converting data from different formats and sources is no longer necessary

It is estimated that savings could be up to \$1.5B for USBoC alone, depending on which options are chosen. These savings could substantially mitigate key budget and program issues faced by the USBoC.

This is an opportunity to remove long-standing inefficiencies created by cyclical public sector development and maintenance of geospatial assets. Such action would not only help resolve 2020 Census budget and implementation challenges but will also positively impact future Censuses as well.