2020 CENSUS LIFE-CYCLE COST ESTIMATE EXECUTIVE SUMMARY

Version 2.0

June 10, 2019

2020 CENSUS
LIFE-CYCLE COST ESTIMATE (LCCE)

VERSION 2.0

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1. INTRODUCTION

1.1 Executive Summary Purpose

This executive summary of the 2020 Decennial Census Life-cycle Cost Estimate (LCCE) provides a high-level overview of the June 2019 version of 2020 Census LCCE and the supporting 2020 Decennial Census LCCE Basis of Estimate (BoE). The executive summary constitutes Version 2.0 of the 2020 Decennial Census LCCE. It incorporates updates to the Version 1.0 Executive Summary issued December 21, 2017. These updates primarily include realigning cost data within the Work Breakdown Structure (WBS) to more accurately reflect how activities are managed and planned, updating the estimate to reflect actual costs through FY 2018, integrating FY 2018 End-to-End Census Test results, and incorporating final definitive scope details for major contracts and field operations

The executive summary is prepared for public release and does not include details of the technical approach, program design, assumptions, model calculations, cost breakouts, etc. Detailed documentation of the 2020 Census LCCE is contained in the BoE. The BoE is the detailed formal documentation of the cost estimate that is not published for the general public, but rather is intended for official government use, including by auditors and oversight bodies.

1.2 The Role of the LCCE

The LCCE is the estimated cost of developing, producing, deploying, maintaining, operating and disposing of a program or system over its entire lifespan. The LCCE is prepared in order to support and inform program change decisions, major program reviews, resource allocation trade-off analyses, budget requirements, and source selections. The LCCE provides the basis for the official projected cost for a program or system that is communicated to the Department of Commerce (DOC), the Office of Management and Budget (OMB), Congress, the Government Accountability Office (GAO), and others.

As the basis for the official projected cost of the program, the LCCE provides Census Bureau and DOC leadership with critical information for making program decisions, monitoring resource allocations, establishing executable budgets, and proactively addressing financial issues.

1.3 Improving the LCCE

The Census Bureau has demonstrably improved the quality of the 2020 Census LCCE. The results from the Census Bureau's significant efforts have been recognized in GAO's August 2018 assessment of the 2020 Census LCCE, as reported in the 2017 Version 1.0 Executive Summary. In this assessment, the GAO found that "…the Census Bureau has made significant progress in improving its ability to develop a reliable cost estimate".

Figure 1: Comparison of 2015 and 2017 GAO Assessments

(shown below), taken from the August 2018 GAO assessment document[1], illustrates the extent and scale of improvement between their assessments of the 2015 and 2017 LCCE versions.

Characteristic	2015 Assessment	2017 Assessment
Well-Documented	◔ Minimally Met	◑ Partially Met
Accurate	◑ Partially Met	◕ Substantially Met
Credible	◔ Minimally Met	◕ Substantially Met
Comprehensive	◑ Partially Met	● Met

● Met ◕ Substantially Met ◑ Partially Met ◔ Minimally Met ○ Not Met

Source: GAO analysis of U.S. Census Bureau data. | GAO-18-635

Figure 1: Comparison of 2015 and 2017 GAO Assessments[2]

The GAO did not make any new recommendations in their August 2018 assessment (see the 2017 assessment column referenced in Figure 1 above). Accordingly, the Census Bureau continues to work on recommendations contained in the June 2016, GAO report[3] on their assessment of the 2015 version of the 2020 Census LCCE. These recommendations are listed below.

1. To help ensure the Bureau produces a reliable cost estimate for the 2020 Census, take the following steps to meet the characteristics of a high-quality estimate:
   a. Comprehensive—among other practices, ensure the estimate includes all life-cycle costs and documents all cost-influencing assumptions.
   b. Well-documented—among other practices, ensure that its planned documentation plan captures the source data used; contains the calculations performed and the

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[1] 2020 CENSUS Census Bureau Improved the Quality of Its Cost Estimation but Additional Steps Are Needed to Ensure Reliability, August 2018, GAO-18-635, page 2.
[2] The dates of the assessments in the figure below refer to the date of the LCCE assessed rather than the release date of the GAO assessment report (which is 2016 and 2018, respectively).
[3] 2020 Census: Census Bureau Needs to Improve Its Life-Cycle Cost Estimating Process, June 30, 2016, GAO-16-628

       estimating methodologies used for each element; and describes step by step how the estimate was developed.

    c. Accurate—among other practices, ensure the estimating technique for each cost element is used appropriately and that variances between planned and actual cost are documented, explained, and reviewed.

    d. Credible—among other practices, ensure the estimate includes a sensitivity analysis, major cost elements are cross-checked to see whether results are similar, and an independent cost estimate is conducted to determine whether other estimating methods produce similar results.

2. To further ensure the credibility of data used in cost estimation, establish clear guidance on when information for cost assumptions can and should be changed as well as the procedures for documenting such changes and traceable sources for information being used.

3. To ensure Bureau and congressional confidence that the Bureau's budgeted contingencies are at appropriate levels, improve control over how risk and uncertainty are accounted for and communicated with the Bureau's decennial cost estimation process, such as by implementing and institutionalizing processes or methods for doing so with clear guidance.

The Census Bureau has improved across all of these recommendations and intends to continue building upon the success that it has achieved in maturing the 2020 Census LCCE. Table 1: Examples of Ongoing LCCE Enhancements below describes examples of ongoing improvement efforts by the Decennial Program.

Table 1: Examples of Ongoing LCCE Enhancements

Enhancement	Description
Increase Understanding of Information Technology and Major Contracts	• Developing an application to manage major contract expenses • Deeper involvement of contracts management subject matter experts and decennial leadership
Improve Program Inputs / Assumptions	• Working with programs to reflect operational refinements and 2018 End-to-End Test results • Deeper involvement of operational subject matter experts and decennial leadership
Improve Basis for Cost Management and Integration	• Developing Cost Estimation and Analysis Process and related governance artifacts • Using the LCCE as a management tool to inform operational decisions

1.4   High Level Comparison to Previous Version of the 2020 Census LCCE

The current 2020 Census LCCE, as reported in the June 2019 Executive Summary Version 2.0, is $15.6 billion. This is unchanged from the total LCCE cost reported in the December 2017 Executive Summary Version 1.0. Table 2 below shows a comparison between October 2017 and May 2019 LCCE. There have been changes among different elements of the WBS (see Section

2.2 below) and risk within the same total cost. Additionally, the confidence level in the total cost has risen since the previous version as illustrated in a greater risk and contingency reserve within the same overall total.

Table 2: LCCE Cost Comparison of October 2017 vs. June 2019 (in Millions)

Element	LCCE Oct 2017	LCCE June 2019	% Change
1 - Program Management	$625	$681	9%
2 Census/Survey Engineering	$1,822	$2,009	10%
3 - Frame	$732	$690	-6%
4 - Response Data	$5,375	$4,988	-7%
5 - Published Data	$219	$220	0%
6 - Test, Evaluation, Special Censuses	$791	$777	-2%
7 - Infrastructure	$3,454	$3,376	-2%
Point Estimate Subtotal	**$13,018**	**$12,740**	**-2%**
Risk-Based Contingency	$1,056	$1,403	33%
Point Estimate Subtotal, with Risk-Based Contingency	**$14,074**	**$14,143**	**0.5%**
Additional Sensitivity Analysis	$369	$300	-19%
Secretarial Contingency	$1,182	$1,182	0%
Risk-adjusted Total	**$15,625**	**$15,625**	**0%**

2. BACKGROUND & SCOPE

2.1   Program Background and Characteristics

The goal of the 2020 Census is to count everyone once, only once, and in the right place. As the cost of completing this goal has significantly increased each decade since 1970 as the population becomes more challenging to count, the Census Bureau undertook a challenge this decade to design the 2020 Census to control cost growth, while continuing to maintain high quality results. The actual cost of the 2010 Census in 2020 inflation-adjusted dollars was $92 per housing unit, while Congress appropriated $106 per housing unit.[4] Comparatively, the 2020 Census, as

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[4] In FY 2010-2011 the Census Bureau returned nearly $1.9 billion in unused appropriations from the 2010 Census.

currently designed, is expected to cost $108 per housing unit in 2020 inflation-adjusted dollars including usage of all estimated contingency and $87 per housing unit without estimated contingency. The level of contingency funds ultimately required to conduct a 2020 Census of the highest quality will determine whether the actual inflation-adjusted cost per housing of the 2020 Census is higher or lower than that of the 2010 Census. To optimize operational efficiency while maintaining quality, the Census Bureau will conduct the most automated, modern, and dynamic decennial census in history.

The goal this decade is to design the 2020 Census for the 21st Century in a way that embraces technology to ensure a high quality 2020 Census that will lay the framework for future censuses for decades to come. This will be the first decennial census to update the Census Bureau's address frame using geographic information systems and aerial imagery instead of sending census employees to walk and physically check all 11 million census blocks; the first to encourage the population to respond to the 2020 Census using the Internet and over the telephone, reducing the need for expensive paper data capture; the first to use data the public has already provided to the government and data available from commercial sources to enable focusing of additional visits in areas that have traditionally been hard to enumerate; and the first to use sophisticated operational control systems to send Census Bureau employees to followup with nonresponding housing units and to track daily progress.

The 2020 Census

The purpose of the 2020 Census is to conduct an accurate count of the population and housing to disseminate the results to the President, the States, and the American people. To accomplish this, the Census Bureau must count everyone once, only once, and in the right place. The challenge this decade has been to do so at a lower cost per household (adjusted for inflation) than the 2010 Census. As the 2020 Census draws near, the Census Bureau has designed a 2020 Census that ensures the coverage of the population and housing is as complete as possible. The design will serve to minimize the undercounting or overcounting of the population, particularly as related to the differential impact on subgroups of the population.[5] The Census Bureau is fully committed to designing and conducting a 2020 Census that fairly represents every person in America.

The primary requirement served by the decennial census is the apportionment of seats allocated to the states for the House of Representatives. This requirement is mandated in the U.S. Constitution:

> Article I, Section 2, "The actual enumeration shall be made within three years after the first meeting of the Congress of the United States, and within every subsequent Term of ten Years"

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[5] A detailed discussion of the quality implications of the 2020 Census design can be found in Chapter 7 of the *2020 Census Operational Plan Version 4.0*.

Fourteenth Amendment, Section 2, "Representatives shall be apportioned among the several States according to their respective numbers, counting the whole number of persons in each State"

Uses of Decennial Census Data

As discussed above, decennial data are used to apportion the number of seats in Congress among the states. At the census block level, the data informs governmental entities for redistricting, (i.e., defining the representative boundaries for congressional districts, state legislative districts, school districts, and voting precincts). Additionally, decennial data help enforce voting rights and civil rights.

The Census Bureau also uses the decennial census results to determine the statistical sampling frames for the American Community Survey (ACS), which replaced the long form in the decennial census, and the dozens of current surveys conducted by the Census Bureau. The results of these surveys are used to support important functions, such as appropriating federal funds to local communities (an estimated $675 billion annually[6]); calculating monthly unemployment, crime, and poverty rates; and publishing health and education data.

Finally, decennial data play an increasingly important role in United States commerce and the economy. As people expand their use of data to make decisions at the local and national levels, they increasingly depend on data from the Census Bureau to make these decisions. Today, local businesses look at data provided by the Census Bureau on topics like population growth and income levels to make decisions about whether or where to locate their restaurants or stores. Similarly, a real estate investor, who is considering investing significant funds to develop a piece of land in the community, relies on Census Bureau data to measure the demand for housing, predict future need, and review aggregate trends. Big businesses also rely heavily on Census Bureau data to make critical decisions that impact their success and shape the economy at the national level. As noted above, the decennial census is the foundation for the Census Bureau's demographic survey data.

The decennial data must meet high quality standards to ensure good decision-making and to continue building confidence in the government, society, and the economy. Studying the balance between cost and quality is an important focus of the census design.

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[6] Marisa Hotchkiss and Jessica Phelan, *Uses of Census Bureau Data in Federal Funds Distribution: A New Design for the 21st Century*, Census Working Papers, 2017 (Washington, DC: U.S. Census Bureau, September 2017), p. 3.

Challenging Environmental Factors

The 2020 Census challenge is exacerbated by multiple environmental factors that have the potential to impact its success. The Census Bureau is committed to proactively addressing the challenges outlined below in Figure 2.
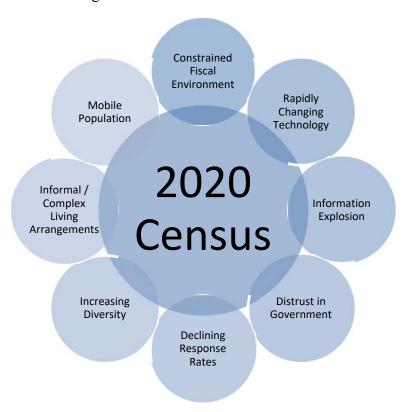

Figure 2: 2020 Census Environment

- **Constrained fiscal environment:** Federal budget constraints placed significant pressure on funding available for research, testing, design, and development work for successful innovation.[7]

- **Rapidly changing use of technology:** Stakeholders expect the decennial census to use technology innovation, yet the rapid pace of change makes it challenging to plan for and adequately test the use of these technologies because they become obsolete.

- **Information explosion:** Rapid changes in information technology create stakeholder expectations for how the Census Bureau interacts with the public to obtain and disseminate data products.

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[7] A detailed discussion of the major program risks can be found in Chapter 6 of the *2020 Census Operational Plan Version 4.0*.

- **Distrust in government**: The public's concerns about information security and privacy, the confidentiality of information given to the government, and how government programs will use the information they collect continue to grow. This impacts response rates and could make it more difficult for government agencies to collect important demographic information.

- **Declining response rates:** Response rates for Census Bureau surveys, and for surveys and censuses in general, have declined as citizens are overloaded with requests for information and become increasingly concerned about sharing information.

- **Increasingly diverse population:** The demographic and cultural make-up of the United States continues to increase in complexity, including a growing number of households and individuals with limited English proficiency; who may experience language barriers to enumeration and who may have varying levels of comfort with government involvement.

- **Informal, complex living arrangements:** Households are becoming more diverse and dynamic, making it a challenge to associate an identified person with a single location. For example, blended families may include children who have two primary residences. Additionally, some households include multiple relationships and generations.

- **A mobile population:** The United States continues to be a highly mobile nation as about 14.3 percent of the population moves in a given year, based on results from the American Community Survey conducted in 2017. Continued growth in cellular telephone technology and an associated reduction in landline telephones tied to physical locations may also complicate enumeration.

A New Design for the 21st Century

Several of the societal, demographic, and technological trends listed above can result in a population that is harder and more expensive to enumerate. As it becomes more challenging to locate individuals and solicit their participation through traditional methods, the Census Bureau must, decade after decade, spend more money simply to maintain the same level of accuracy as previous censuses. With the innovations described in the 2020 Census Operational Plan Version 4, the Census Bureau estimates that billions of dollars can be saved relative to replicating a design similar to that of the 2010 Census.

Field costs associated with Address Canvassing and Nonresponse Followup operations comprise the most expensive aspects of the 2020 Census. Four innovation areas are aimed at reducing the costs of fieldwork. A reengineered Address Canvassing operation is expected to reduce the field workload for address updating by 60 to 65 percent. Self-response innovations, which are aimed

at generating the largest possible self-response rate, coupled with the use of administrative records and third-party data, are intended to reduce the field workload associated with Nonresponse Followup. Finally, the reengineered field operations are intended to increase the efficiency of those operations, allowing managers and fieldworkers to be more productive and effective.

Figure 3: The 2020 Census - A New Design for the 21st Century describes at a high-level how the 2020 Census will be conducted. This design reflects a flexible approach that takes advantage of new technologies and data sources while minimizing risk.
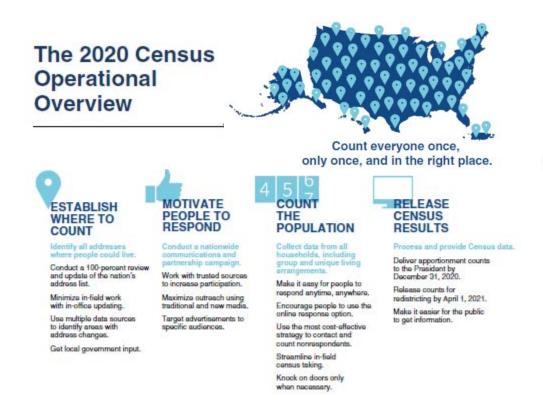
The 2020 Census Operational Overview

Count everyone once, only once, and in the right place.

ESTABLISH WHERE TO COUNT

Identify all addresses where people could live.

Conduct a 100-percent review and update of the nation's address list.

Minimize in-field work with in-office updating.

Use multiple data sources to identify areas with address changes.

Get local government input.

MOTIVATE PEOPLE TO RESPOND

Conduct a nationwide communications and partnership campaign.

Work with trusted sources to increase participation.

Maximize outreach using traditional and new media.

Target advertisements to specific audiences.

COUNT THE POPULATION

Collect data from all households, including group and unique living arrangements.

Make it easy for people to respond anytime, anywhere.

Encourage people to use the online response option.

Use the most cost-effective strategy to contact and count nonrespondents.

Streamline in-field census taking.

Knock on doors only when necessary.

RELEASE CENSUS RESULTS

Process and provide Census data.

Deliver apportionment counts to the President by December 31, 2020.

Release counts for redistricting by April 1, 2021.

Make it easier for the public to get information.

Figure 3: The 2020 Census - A New Design for the 21st Century

The first step in conducting the 2020 Census is to identify all of the addresses where people could live, or **Establish Where to Count**. An accurate address list helps ensure that everyone is counted. For the 2020 Census, the Census Bureau began an in-office review of 100 percent of the nation's addresses in September 2015 and is continually updating the address list based on data from multiple sources, including the U.S. Postal Service, tribal, state, and local governments, satellite imagery, and third-party data providers. The Census Bureau has completed multiple passes of the entire nation with the in-office address canvassing operation. This office work determines which parts of the country require fieldwork to verify address information. In-Field Address Canvassing will begin in 2019 and is anticipated to cover approximately 35 to 40 percent of all addresses where in-office address canvassing methods do not work well, like

where tree cover interferes with the use of imagery or in cities where high rise construction makes address change difficult to detect using aerial imagery.

As discussed earlier, response rates to surveys and censuses have been declining. To **Motivate People to Respond**, the 2020 Census will include a nation-wide communications and partnership campaign. This campaign is focused on getting people to respond on their own (self-respond). It costs significantly less to process a response provided via the Internet or through a paper form than it does to send a fieldworker to someone's home to collect their response. Advertising will make heavy use of digital media, tailoring the message to the audience. The partnership program will use trusted voices in the community to explain the importance of the Census and encourage wide participation.

The Census Bureau **Counts the Population** by collecting information from all households, including those residing in group or unique living arrangements. The Census Bureau wants to make it easy for people to respond anytime and anywhere. To this end, the 2020 Census will offer the opportunity and encourage people to respond via the Internet and will encourage, but not require, people to enter a unique Census Identification with their response. Online responses will be accurate, secure, and convenient.

For those who do not respond, the Census Bureau will use the most cost-effective strategy for contacting and counting people. The goal for the 2020 Census is to reduce the average number of visits to nonresponding households by using available data from government administrative records and third-party sources. These data will be used to identify vacant households, to determine the best time of day to visit a particular household, and to count the people and fill in the responses with existing high-quality data from trusted sources. These uses of government administrative records and third-party sources have shown promise during our testing throughout the decade and were tested again in the 2018 End-to-End Census Test. Deploying our resources in the field in the most cost-effective ways allows the Census Bureau to focus time and manpower to maximize response rates across geographic areas and demographic groups.

In addition, the majority of fieldworkers will use mobile devices for collecting the data. Operations such as recruiting, training, and payroll will be automated, reducing the time required for these activities. New operational control centers will rely on automation to manage most of the fieldwork, enabling more efficient case assignment, automatic determination of optimal travel routes, and reduction of the number of physical offices. In general, a streamlined operation and management structure is expected to increase productivity and save costs.

The last step in the 2020 Census is to **Release the 2020 Census Results**. The 2020 Census data will be processed and sent to the President (for apportionment) by December 31, 2020, to the states for redistricting by April 1, 2021, and to the public beginning in December 2021.

2.2   Scope of the Estimate

The time frame covered by the 2020 Census LCCE is a 12-year period from 2012 to 2023. The scope of the 2020 Census includes 35 operations.[8] The 2020 Census operations are organized into eight major areas that correspond with the Census Bureau standard Work Breakdown Structure (WBS) as shown in Figure 4: 2020 Census LCCE WBS Top-level WBS Elements below.
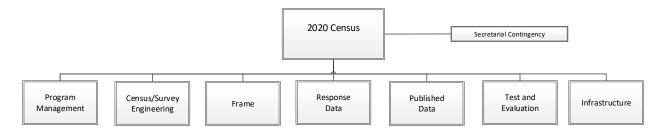

Figure 4: 2020 Census LCCE WBS Top-level WBS Elements

The 35 operations needed to conduct the 2020 Census are shown in Figure 5: 2020 Census Operations below. The graphic is organized into the major areas that correspond with the 2020 Census Program WBS shown above. Program Management, Census/Survey Engineering, and Infrastructure are combined into one general group called Support, which is shown at the top of the diagram. In addition, a separate area, Other Censuses, accounts for the Island Areas Censuses operation, which is unique to the Decennial Census Programs.

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[8] The term operation refers to both support and business functions. For example, Program Management is considered a support function, and Address Canvassing is considered a business function.

SUPPORT				
Program Management	**Census/Survey Engineering**			
1. Program Management (PM)	2. Systems Engineering and Integration (SEI)	3. Security, Privacy, and Confidentiality (SPC)	4. Content and Forms Design (CFD)	5. Language Services (LNG)
Infrastructure				
31. Decennial Service Center (DSC)	32. Field Infrastructure (FLDI)	33. Decennial Logistics Management (DLM)	34. IT Infrastructure (ITIN)	

FRAME	RESPONSE DATA			PUBLISH DATA
6. Geographic Programs (GEOP)	9. Forms Printing and Distribution (FPD)	13. Non-ID Processing (NID)	17. Census Questionnaire Assistance (CQA)	21. Data Products and Dissemination (DPD)
7. Local Update of Census Addresses (LUCA)	10. Paper Data Capture (PDC)	14. Update Enumerate (UE)	18. Nonresponse Followup (NRFU)	22. Redistricting Data Program (RDP)
8. Address Canvassing (ADC)	11. Integrated Partnership and Communications (IPC)	15. Group Quarters (GQ)	19. Response Processing (RPO)	23. Count Review (CRO)
	12. Internet Self-Response (ISR)	16. Enumeration at Transitory Locations (ETL)	20. Federally Affiliated Count Overseas (FACO)	24. Count Question Resolution (CQR)
			35. Update Leave (UL)	25. Archiving (ARC)

OTHER CENSUSES	TEST AND EVALUATION			
26. Island Areas Censuses (IAC)	27. Coverage Measurement Design and Estimation (CMDE)	28. Coverage Measurement Matching (CMM)	29. Coverage Measurement Field Operations (CMFO)	30. Evaluations and Experiments (EAE)

Figure 5: 2020 Census Operations

3. COST ESTIMATION APPROACH

3.1 Cost Estimation Methodology

The 2020 Census LCCE has been developed by a team within the Decennial Budget Office (DBO). This team is comprised of certified cost estimators (as administered by the International Cost Estimating and Analysis Association (ICEAA)), experienced subject matter experts from the Census Bureau, and supporting contractor resources.

The 2020 Census LCCE's methodology is primarily based on a bottoms-up cost estimation approach. Other methodologies (such as historical data, subject matter expertise, analogous systems, and relevant actual costs) are used when required. The 2020 Census Program cost estimation team followed the guidance contained in the GAO *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs* (GAO-09-3SP). Specifically, the 2020 Census LCCE's methodology aligns to the Decennial Directorate's Cost Estimation and Analysis Process (CEAP), which is derived from GAO's 12-step Cost Estimating Process. The overall process (taken from the August 2018 GAO assessment of the 2020 Census LCCE) is shown below in Figure 6: Decennial Directorate Cost Estimation Process.
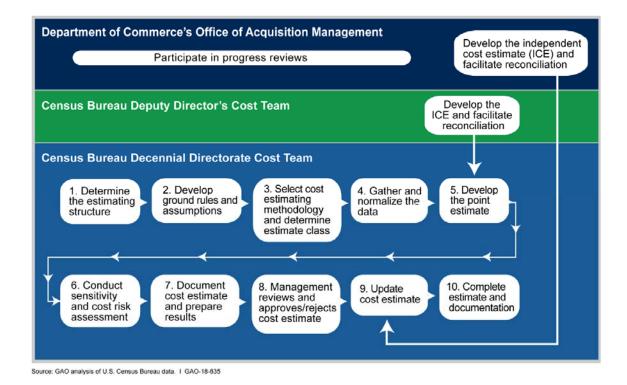
Figure 6: Decennial Directorate Cost Estimation Process

The 2020 Census LCCE utilizes an approach designed to produce a quality cost estimate. This calculation flow enables a clear understanding to facilitate a line-of-sight into how the assumptions, the inputs, and the processes/calculations inform the outputs/results. By following the cost estimate, the process can be effectively replicated and understood. An illustration of this approach, along with a brief description of each of the four primary process areas, is shown in Figure 7: 2020 Census LCCE Documentation Approach below.

Figure 7: 2020 Census LCCE Documentation Approach

The 2020 Census Program cost estimators worked with subject matter experts to obtain data and document the variables that influence the cost of the 2020 Census. Subject matter experts aided the identification of parameters associated with each variable, including historical data collected from the 2010 Census, the American Community Survey, and the 2020 Census Research and

Testing Program. The 2020 Census LCCE team used the inputs after reviewing them for relevancy and credibility in consultation with Decennial Programs leadership.

The parameters for the variables were entered into a cost model. The cost model required three parameters for most variables (minimum, median, and maximum) derived from historical data, test results, or expert opinion. For example, one input parameter used to estimate the nonresponse followup workload included an estimated overall self-response rate after six weeks, using the following values: minimum of 55.5 percent, median of 60.5 percent, and maximum of 65.5 percent. These values were based on findings from the 2010 Census, the American Community Survey, and the 2020 Census Research and Testing Program.

This step in the overall cost estimation methodology concludes with the development of a point estimate.

3.2   Risk Analysis

After the updated point estimate was compared to the ICE and updated as a result, the point estimate cost was then adjusted for risk and uncertainty (to include contingency). A description of the risk and uncertainty is outlined below.

The 2020 Decennial LCCE has structured two direct cost reserves to mitigate risks in the estimate – Program Risk and Secretarial Contingency (for Unknown Unknown risk).

Program Risk

Program Risk comprises two areas of direct costs to mitigate risk in the estimate – Risk-Based Contingency (consisting of Monte Carlo Uncertainty and Discrete Risks) and Additional Sensitivity Analysis – and totals $1.703 billion spread across the WBS level 2 framework.

Risk-Based Contingency

1. To account for uncertainty around the various parameters, the cost estimators ran a Monte Carlo simulation. This method randomly samples parameters from a probability distribution for each variable (based on the minimum, median, and maximum) over thousands of simulations and then uses those values to calculate a distribution of cost estimates. The additional funding required to move from the point estimate to the estimate at which 80 percent of the simulations fall beneath is the Monte Carlo uncertainty contingency, which is then applied to the Program Management WBS element. The Program Management WBS covers elements associated with the definition and implementation of program management policies, processes, and the control functions for planning and implementing the 2020 Census to ensure an efficient and well-managed program. This funding is designed to be utilized if actual cost-driving parameters deviate from estimates in a direction and magnitude that would require

additional funding to complete an operation. The estimated direct cost for Monte Carlo uncertainty was approximately $305.5 million.

2. Discrete Risks are those identified in the 2020 Life-Cycle Risk Register that were analyzed, quantified, integrated into the estimate; mitigations were also evaluated and incorporated in the estimate when relevant, as part of the 2020 LCCE process. Examples of the major risk categories in the risk register include cybersecurity incidents, issues in system performance and scalability, and issues in operational readiness and execution. The Census Bureau Enterprise Risk Management (ERM) process was followed to ensure the integration/linkage of the 2020 Decennial Program risks into the cost estimation process. The direct costs for these risks was estimated to be $1,097.5 million. This estimate is higher than the analogous estimate in the previous LCCE, which captures the effect of fewer risks remaining and some risks reduced in probability following the 2018 End-to-End Census Test, but that the remaining risks are more costly if realized. This is due to better and more granular information about the costs of late decade mitigation as well as the greater lack of schedule or scope flexibility to resolve problems without sacrificing data quality in any manner other than increasing cost. This dynamic is evident in the programmatic point estimate decreasing since the last estimate as the confidence level around operational costs has risen, while reflecting that the total potential cost has not changed if this higher confidence level proves false due to the realization of one or more major risks.

Additional Sensitivity Analysis

Program risks associated with Additional Sensitivity Analysis were discretely estimated based on impacts of occurrence and program mitigation techniques. The following program risks have been reflected in the risk-adjusted cost estimate via additional sensitivity analyses:

1. Self-response rates are critical, uncertain variables with expected large cost impacts in the Response Data life-cycle costs. Response rates have declined decade-over-decade for reasons outlined in "Section 2.1: Challenging Environmental Factors", and there are numerous external influences on the program that could cause a dampened self response for the 2020 Census. While the Monte Carlo and Risk Register risks include funding designed to address lowered self response rates, to acknowledge this uncertainty and cost impact, additional sensitivity analysis was performed to account for the possibility that the self-response rate declines below the modeled levels from Census Bureau experts. This would cause an increase in the Nonresponse Followup Workload and cost. The impact of this risk was estimated by decreasing the self-response rate point estimate from 60.5 percent to 55 percent. The estimated direct cost for this risk was $251.4 million.

2. The cost of field operations is considered sensitive to the size and cost of recruiting and hiring the necessary workforce in all geographic areas. To acknowledge this uncertainty and cost impact, additional sensitivity analysis was performed to account for the possibility that additional funds are needed above the modeled recruitment size and wage rate to secure the temporary workforce needed in all given geographic areas. This risk

was modeled by increasing the nationwide average wage rate of the temporary workforce by about $0.50. The estimated direct cost for this risk was estimated to be $48.3 million.

3. In LCCE Version 1.0, the Census Bureau had postulated a significant increase in the efficiency of field operations, with a higher Enumerator-to-Supervisor staffing ratio than in the 2010 Census. This assumption to generate the point cost estimate in LCCE Version 1.0 was contingent on the proper implementation and management of resources, and the risk was that planned efficiencies from field management staffing are inadequate to support the temporary workforce. The impact of this risk was estimated by assuming a decrease in the Enumerator-to-Management staffing ratio from 20:1 to 16:1, at a direct cost of $44 million in the previous LCCE. Based on highly successful results from the 2018 End-to-End Test proving out the effectiveness of a 20:1 ratio, this risk has been retired and specific funding related to this sensitivity is excluded from LCCE Version 2.0.

Careful research, analysis, testing, and planning throughout the decade has led the Census Bureau to establish a higher self-response rate and operate effectively with a lower wage. However, even with level of preparation, response rates and wages are more difficult to predict with precision, as the exact value for each that will be experienced in the 2020 Census lie further from the direct control of the 2020 Census program managers. The response rate could be affected unpredictably by both public and private data breaches, the public's overall opinion of the government, and the Census Bureau's commitment to confidentiality. Wage rates for a temporary work force are impacted by the strength of the economy and the competitiveness of the job market. As a result of these external factors, it is unlikely these risks could be retired and the corresponding estimates included for these discrete risks reduced until very late in the cycle. The Census Bureau will continue to manage the 2020 Census Program to the objective assumptions contained within the LCCE that is based on the higher threshold assumptions noted in the self-response and wage risks above and be continuously monitoring external conditions and their impact on these assumptions.

Even though the program may carry these risks throughout the entire life-cycle, the Bureau is committed to managing this risk and minimizing the use of contingency funding. For example, the Census Bureau will invest in a robust communications and partnership program designed to promote self-response through accurate and timely information about data security and confidentiality. A robust governance process is also in place at the Census Bureau and Department of Commerce to ensure that use of appropriated contingency funds of any type only occurs in valid cases of realizing and/or actively mitigating risks or responding to evidence of costly deviations in operational parameters.

Finally, the Bureau does not expect the cost of the 2020 Census to change following the outcome of litigation regarding the inclusion of a citizenship question on the 2020 Census questionnaire. However, it is important to note that *any* reasonably foreseeable impacts to the operational assumptions for the 2020 Census underlying the LCCE are covered by the program risk funding.

Secretarial Contingency

The Secretarial Contingency represents the unknown-unknown category of risk to account for unforeseen risks, such as a natural disaster driving residents of an area away from their residences leading up to Census Day for the 2020 Census. This category is a 10 percent addition to the risk-adjusted cost in FY 2019 through FY 2023 and 5 percent in FY 2018. To the extent that such a contingency is appropriated by Congress, the Department of Commerce will only approve use of this contingency following a formal governance process involving the Census Bureau and Department of Commerce oversight entities for the 2020 Census program. The direct cost assigned to the unknown-unknown risk was $1,182 million. The Census Bureau would only utilize funding made available under this category in situations where other contingency reserves had been fully exhausted or in situations so unforecastable and unknowable that the Census Bureau and Department of Commerce, in addressing them, should prudently choose to utilize funding in such a manner as to avoid impacting the future availability of program risk mitigation funds needed for the addressing of known risks that may be realized in the execution of the 2020 Census program.

At the end of the risk and uncertainty analyses, the risks and uncertainty were added to the point estimate to produce a total risk-adjusted cost estimate for the 2020 Census Program. The risk-adjusted life-cycle cost was determined to be approximately $15.625 billion (including overhead).

3.3 Estimation Tools

The 2020 Census is a large and complex operation, and therefore the cost estimate that supports it is also large and complex. To accommodate the operation, the 2020 Census LCCE is built within the Decennial Budget Integration Tool (DBIT) system. DBIT is a suite of applications used by the Decennial Programs to support cost estimation, budget planning and execution, and contracts management functions for the 2020 Census and other programs. It consists of a database, data collection webapp, mathematical model, and analysis/reporting tools. Part of the DBIT application suite comprises the IBM Cognos platform, which provides two major capabilities: TM1 is an enterprise planning tool that provides advanced Online Analytical Processing (OLAP) and reporting capabilities[9], and the Analytics capability enables highly-capable analysis and interactive reporting of cost information.

The point estimate is developed and modeled using Cognos TM1. TM1 can accommodate the entire planning cycle and allows for modeling the cost of complex programs such as the 2020

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[9] TM1 is an IBM tool that enables the generation of cost estimates with higher levels of dimensionality, precision, accountability, and reporting. The enterprise planning capabilities of TM1 are well-suited for detailed modeling of the cost of complex programs comprised of multiple products and operations, which require hundreds or thousands of variables. TM1 Performance Modeler can produce estimates under multiple model scenarios using groups of inputs that conform an internally-consistent regarding the estimate.

Census. Hundreds of variables across the 35 operations were incorporated into the model to generate a total cost estimate for the 2020 Census. Within the 2020 Census LCCE there are 1,151 data cubes and over 1,859 inputs and assumptions. There are 73,000 summary cost records. The use of the IBM Cognos platform provides the 2020 Census LCCE with the ability to use multi-dimensional cubes to bring data sets to bear for calculations, analyses and reference.

4. Ground Rules & Assumptions

4.1 Inflation

All costs are presented in then-year (also called current-year) dollars. Then-year dollars are those that have been inflated using an established inflation rate that are expressed in the year when the disbursements or expenditures are expected to occur. The 2020 Census uses the Chained Price Index (CPI) from the Office of Management and Budget's (OMB's) Table 10.1 entitled Gross Domestic Product and Deflators Used in the Historic Tables: 1940-2022.

4.2 Major Assumptions

The major assumptions changed from the October 2017 Version 1.0 of the LCCE and the relative scale of impact on the overall cost (as denoted by a Major/Minor +/-) are shown in Table 3 below.

Table 3: Major Assumptions and Impact of Changes

Item	Change	Driver	Impact on LCCE
Late Self-Response During Nonresponse Followup (NRFU)	**Increased** from 62.5% to 65.5%	Expected increase based on results from earlier field tests, including the 2018 End-to-End Census Test, that leaving a notice at nonresponding housing units which states it's not too late to self-respond, will increase overall self-response.	Major –
Shift in Primary Enumeration Method Designation from Update Leave to Mailed-out Invitations	**Increased** designation of housing units invited by mail to self-respond from 133.5 million to 140.0 million **Decreased** designation of Update Leave housing units where an enumerator leaves an invitation to self-respond while double checking the address list from 11.9 million to 6.6 million	Updated analysis by Census Bureau subject matter experts. Updated analysis by Census Bureau subject matter experts.	Minor +

Nonresponse Followup (NRFU) Workload and Productivity	**Added** a single NRFU visit to double check nonresponding housing units resolved by using administrative records **Increased** NRFU productivity from 1.25 cases/hour to 1.55 cases/hour	Updated operational assumption to align with updated operational plans, following 2018 End-to-End Census Test experiences. Expected increase based on results from the 2018 End-to-End Census Test.	Offsetting: Net Minor –
Major Contracts	**Overall decrease** due to re-estimation	Updated cost data from contract award system and contract renegotiation, reconciliation with the DOC ICE, and greater ability to define requirements at low levels. Updates led to major decreases in Field IT Deployment (FITd) and the removal of portions of CEDCaP from the program baseline after FY 2018, partially offset by smaller increases in Technical Integration, Census Questionnaire Assistance, and Decennial Device as a Service (dDaaS).	Offsetting: Net Major –
Coverage Improvement	**Modified** Coverage Improvement quality follow-up cost estimation method	Updated cost estimate to align with updated operational plans that activity will be conducted by phone.	Major –
Information Technology Maturity	**Increased** support to ensure systems readiness and security for buildup, deployment and closeout	Updated operational assumption to align with updated operational plans.	Major +
Strengthening Program Management and Operational Planning	**Increased** support to continue robust program management	To align with GAO recommendations and industry best practices, further strengthened program management, IT program management, cost, schedule, and risk management. Includes added investments in the planning and management of the partnership and communications program.	Major +

5. POINT ESTIMATE & RISK ADJUSTMENTS

5.1   The Cost Estimation Results

This section discusses the summary costs of the 2020 Census LCCE.

Table 4: Cost[1] Estimate Summary (In Millions) below presents the estimated life-cycle cost (including overhead) for each of the WBS level-2 elements of the Census Bureau WBS. Response Data, which includes most costs associated with the actual collection of data by multiple means, and other supporting activities such as printing, distribution, and questionnaire support, accounts for almost one third of the total cost of the 2020 Census at $5.480 billion. Infrastructure, with a cost of $3.432 billion, is the second largest cost component; this WBS element includes the required IT and field operations investments, as well as the infrastructure required to support logistic management and service centers. Census Survey and Engineering, which includes systems engineering and integration, system security, content and forms design, and language services, is the third largest component with $2.055 billion, followed by Program Management at $1.789 billion.

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Table 4: Cost[1] Estimate Summary (In Millions)

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Fiscal Year	1 - Program Manage-ment [2]	2 - Census / Survey Engineering [3]	3 - Frame	4 - Response Data [4]	5 - Published Data	6 - Test, Evaluation and Special Censuses	7 - Infra-structure [5]	8 - Secretarial Contingency	Grand Total
2012*	9	16	3	6	1	17	12	-	63
2013*	8	8	4	8	3	26	41	-	99
2014*	20	18	27	18	11	48	85	-	227
2015*	41	16	26	56	15	94	93	-	340
2016*	99	118	82	91	32	83	145	-	650
2017*	65	194	55	177	23	39	238	-	791
2018*	87	342	67	249	15	40	270	6	1,075
2019	369	468	294	1,048	24	97	814	359	3,473
2020	846	480	66	3,662	26	190	1,409	669	7,348
2021	170	238	37	128	29	107	226	91	1,025
2022	51	132	15	19	27	23	61	39	368
2023	25	24	14	18	13	12	39	19	165
Total	1,789	2,055	690	5,480	220	777	3,432	1,182	15,625

1 Actual costs displayed for fiscal years 2012-2018 are sourced from the Commerce Business System (CBS) as of October 2018.

2 This framework contains $1.108 billion in program risk, in addition to $681 million in programmatic costs.

3 This framework contains $46 million in program risk, in addition to $2.009 billion in programmatic costs.

4 This framework contains $492 million in program risk, in addition to $4.988 billion in programmatic costs.

5 This framework contains $56 million in program risk, in addition to $3.376 billion in programmatic costs.

5.2 Detailed Costs by WBS Category

Additional details are provided for each level-2 WBS element within this section, providing specific insights and more granular cost breakdown. A visual representation of the overall program cost is displayed in Figure 8: 2020 LCCE Costs by Level-2 WBS below.

Given the nature of the program, the majority of the Census operations occurs between FY 2019 and FY 2020. During this period, $10.82 billion of the projected $15.625 billion 2020 Census costs (nearly 70 percent of the total costs) are expected to be incurred; this highlights the significant concentration of expenditure in those years, as well as the importance of prior preparation to deploy investments and operations efficiently over this period of intense activity, and the potential for significant deviations in cost.

Figure 8: 2020 LCCE Costs by Level-2 WBS

Program Management Costs

The Program Management element, which includes all activities that implement and support policies, processes, and control functions oriented to improve the efficiency of operations and management of the program, accounts for $1.789 billion (including bureau overheads) over the lifespan of the 2020 Census Program (representing eleven percent of total program cost). The program management costs are shown in Figure 9: Program Management Costs by WBS Level 3.

Program risk direct costs to mitigate risk and uncertainty are the largest contributor to program management costs during the program implementation phase (FY19-FY21), estimated at $1.108 billion. Program risk contingencies account for inherent uncertainties captured through Monte Carlo simulations; as well as certain discrete risks from the risk register that could require additional program oversight, scheduling, or other supporting efforts.

Programmatic costs for Program Management are estimated at $681 million (including bureau overheads).

Figure 9: Program Management Costs by WBS Level 3

Census/Survey Engineering Costs

Census/Survey Engineering costs are estimated at $2.055 billion (including bureau overheads) over the lifespan of the 2020 Census Program, representing 13 percent of the life-cycle cost of the program. An overview of the Census/Survey Engineering costs is displayed below in Figure 10: Census/Survey Engineering Costs by WBS Level 3. Programmatic costs for Census/Survey engineering are estimated at $2.009 billion (including overheads). Additional direct program risk costs are estimated at $46 million.

Systems Design and Integration (SEI) is by far the main driver of program costs associated with Census/Survey Engineering. This is consistent with expectations for a program of this size, which is developing an integrated system-of-systems to complete its innovative redesign. The concentration of SEI costs around the implementation phase of the program is indicative of potential high technical integration and testing costs and risks to deliver the 2020 Census system of systems. The vast majority of the total life-cycle direct cost for the Technical Integration (TI) contract of $1.34 billion is captured in Census/Survey Engineering. (Note that a small portion ($71 million) of the total TI contract ($1.4 billion) is aligned with specific operations in the Response Data and Infrastructure WBS Level 3 elements.

Census/Survey Design is the second largest component of costs under this WBS category. Though substantially smaller than its SEI counterpart, it includes the operational (readiness, integration, and testing) and demographic (content and forms) design of surveys.
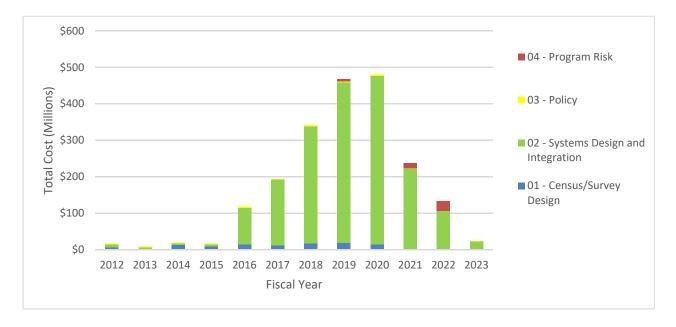

Figure 10: Census/Survey Engineering Costs by WBS Level 3

Frame Costs

Geographic Frame activities costs are estimated at $690 million (including bureau overheads), which represents four percent of the program's total life-cycle cost. These are the costs spent by the program with the goal of developing a high-quality address and geospatial frame that serves as the universe for the enumeration activities.

Address Frame, the delivery of a complete and accurate address list and spatial database for enumeration and includes the type and characteristics of each living quarter, is the main driver of the cost associated with frame activities. The second highest costs are a result of the Geospatial Frame effort, which provides the geographic foundation to support data collection and tabulation activities.

As depicted in Figure 11: Frame Costs by WBS Level 3 below, the spike in Address Frame costs in FY 2019 is a result of the in-field address canvassing operational cost of $185 million (excluding contingency), which is executed prior to the deployment of 2020 Census field enumeration operations.
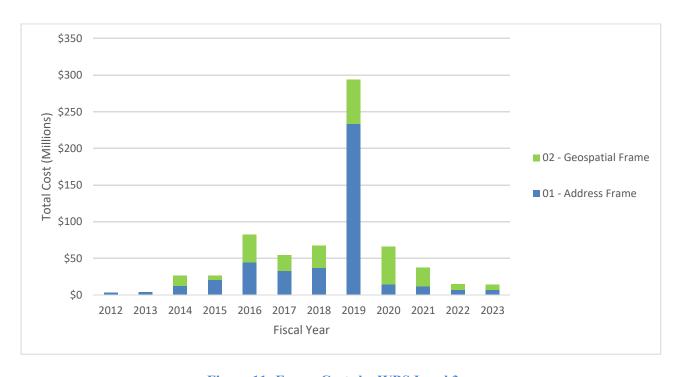

Figure 11: Frame Costs by WBS Level 3

Response Data Costs

The total life-cycle cost for Response Data is $5.480 billion (including bureau overheads), representing 35 percent of the total 2020 Census estimate, and is the largest cost element for the 2020 Census Program. It consists of activities to collect information from 2020 Census respondents by multiple means of communication, including all operations associated with the gathering of responses, management of cases, and initial processing of the data. Figure 12: Response Data Costs by WBS Level 3 below provides an overview of the Response Data costs. Programmatic costs for Response Data are estimated at $4.988 billion (including overheads). Additional direct program risk costs are estimated at $492 million. Included in this direct program risk cost is all of the $300 million for Additional Sensitivity Analysis.

The concentration of forecasted expenses in FY 2020 reflects the nature of Response Data, which involves activities interrelated with deployed field resources to perform the collection of Census data.

Nearly half of the Response Data cost in FY 2020 corresponds to Computer Assisted Personal Interview (CAPI) files, which includes Nonresponse Followup at a direct cost of $1.4 billion; one of the costliest activities of the 2020 Census. The direct costs for Respondent Outreach is at $880 million, which includes advertising and partnership. This is followed by Advertising and Computer Assisted Telephone Interview (CATI) files, which includes the Census Questionnaire Assistance (CQA) contract, with an estimated direct cost of $802 million. Device Development/Procurement is the next costliest, and includes the Decennial Device as a Service Contract (dDaaS), with estimated direct costs of $447 million.
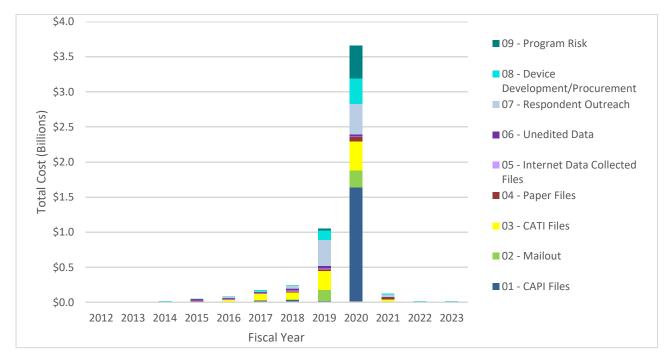

Figure 12: Response Data Costs by WBS Level 3

Published Data Costs

Published Data is the least costly level-2 WBS activity with life-cycle costs of $220 million (including bureau overheads), which represents one percent of the 2020 Census life-cycle cost. Even though Published Data accounts for a very small portion of the overall cost, it provides high-value activities which include supporting imputation of data and adjustments, data review and analysis, tabulation, and data product dissemination. An overview of the Published Data costs is provided in Figure 13: Published Data Costs by WBS Level 3 below.

The highest cost within Published Data is Data Products, which includes the preparation, review, approval, and dissemination of final data products. Data Products costs are most pronounced in FY 2020 and FY 2022, when the most relevant intermediate and final products are completed and released. Tabbed data, which includes data reviews, analysis, and tabulation, is the second largest cost driver within this category. Its cost profile year-over-year, however, is smoother than Data Products given the more continuous nature of its associated activities.

It's important to note that the Center for Enterprise Dissemination Services and Consumer Innovation (CEDSCI), the system which will be used to disseminate the 2020 Census data, is not part of the LCCE's scope and therefore is not reflected in these life-cycle costs. CEDSCI is an enterprise system and therefore is budgeted and managed outside of the 2020 Census program.
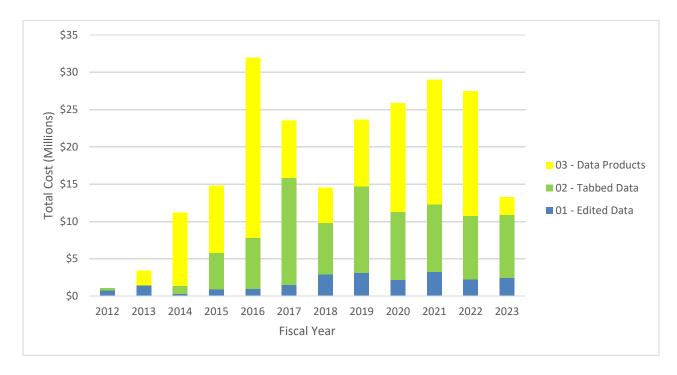

Figure 13: Published Data Costs by WBS Level 3

Test, Evaluation and Special Census Costs

Test, Evaluation, and Special Censuses element is estimated at $777 million (including bureau overheads), or five percent of the 2020 Census life-cycle costs, and is illustrated in Figure 14: Test, Evaluation, and Special Censuses Costs by WBS Level 3. This level-2 WBS element is comprised of two relatively unrelated sets of activities: Test and Evaluation and Special Censuses.

Test and Evaluation involves conducting tests throughout the decade aimed at investigating specific research questions and objectives needed to make decisions on important aspects of the 2020 Census operational design. This included the costs of field and/or self-response testing in every fiscal year from 2012 to 2019. It also assesses the quality of the 2020 Census and is the start of preparations for the 2030 Census Decennial Program. It includes coverage measurement as well as evaluations and experiments. It covers the Post Enumeration Survey and sample, the identification of matches between the 2020 Census and the survey (an independent collection of information for the coverage measurement sample), the development of measures of success, and the early planning activities to support the transition and design of the 2030 Census. Coverage measurement, Census tests, and research and planning are the activities that require the largest uses of funds within Test, Evaluation and Special Census, estimated at $583 million (including overheads).

Special Census, includes the enumeration of residents of the Islands Areas of American Samoa, Northern Mariana, Guam, and the Virgin Islands. The cost of Special Censuses at $80 million (including overheads) is a relatively small portion of the total cost of this level-2 WBS element.
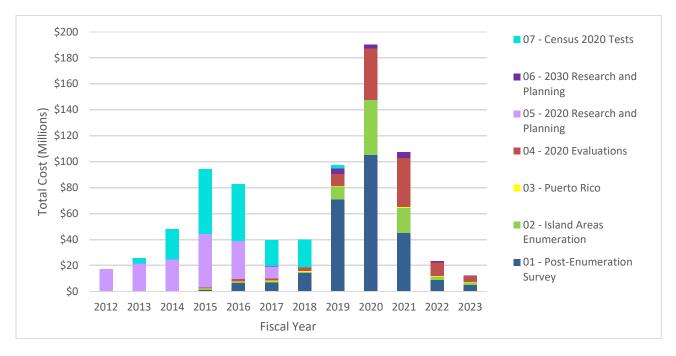

Figure 14: Test, Evaluation, and Special Censuses Costs by WBS Level 3

Infrastructure Costs

Infrastructure is the second-highest level-2 cost element of the WBS, totaling $3.432 billion (including bureau overheads) or 22 percent of the 2020 Census life-cycle cost. Nearly half of Infrastructure's life-cycle costs are expected to be incurred in FY 2020 when field office infrastructure[10], staff, office space, and equipment usages peak, along with non-Headquarters staffing operations (such as training, recruiting, and onboarding). Programmatic costs for Infrastructure are estimated at $3.376 billion (including overheads). Additional direct program risk costs are estimated at $56 million.

The life-cycle direct costs of ACO and RCC office staff are $968 million and the ACO and RCC space direct costs are $265 million. The life-cycle cost also includes the Field IT (FITd) infrastructure contract, which was awarded late in FY 2018. The life-cycle direct cost for the FITd contract in the LCCE is $122 million (of which $21 million is in Response WBS). See Figure 15: Infrastructure Costs by WBS Level 3 below for the breakdown of Infrastructure costs.

Consistent with the peak infrastructure spending in FY 2020, program risk is included in the prior-years to mitigate potential operational risks described previously. Program Risk costs are projected in the FY19 and FY 20 to account for the risks with deployment and execution.

IT infrastructure, though not as costly as other Infrastructure components, began peaking earlier than those (starting in FY 2016), as IT needed to be ready for deployment before the additional staff would be hired and the space and other infrastructure would be fielded.

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[10]   This includes Area Census Offices (ACO) and Regional Census Centers (RCC).
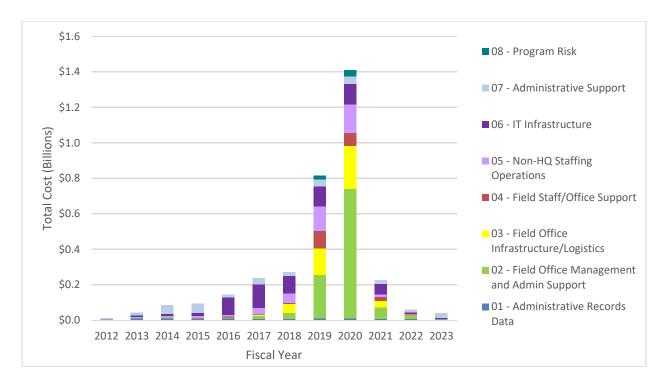
Figure 15: Infrastructure Costs by WBS Level 3

5.3 IT Costs

Since the 2020 Census will be the most automated decennial census in history and includes many technological innovations, IT investments have contributed to a large portion of the overall program costs. These investments for this decade will lay the foundation for a new decennial census design framework for decades to come. Though IT expenses are embedded throughout the 2020 Census WBS structure, this section focuses on IT-specific costs.

The cost estimators developed a multi-step process to estimate the IT components of each operation and WBS element. This process does not apply uniformly to all IT components, but includes the integration of past execution data, as well as cost estimates produced parametrically and/or by analogy with past estimates or similar systems. The LCCE team utilized the list of systems developed by Census Bureau's Enterprise Architecture Group (EAG), along with other IT elements, to achieve a comprehensive estimate of all IT costs in the 2020 Census. To describe this, two categories were developed by the LCCE team to align the IT costs to the LCCE WBS. These categories and their descriptions are shown below.

The associated IT Cost Categories are provided in Table 5: 2020 Census IT Cost Categories.

Table 5: 2020 Census IT Cost Categories

IT Cost Category	Description
IT (Systems and Services)	Systems on the EAG's systems list that support the 2020 census and the service contracts that support IT development, maintenance, etc. (such as the Technical Integration contract).
Census Enterprise Data Collection and Processing (CEDCaP)	An enterprise system for data collection and processing that is being developed to support data collection and response processing first for the 2020 census and later other Census Bureau surveys and censuses.

The graph below in Figure 16: IT Costs by Fiscal Year illustrates the breakout of costs by 2020 IT Services and Systems and 2020 CEDCaP. In this graph, the 2020 IT Services and Systems costs are the largest element of IT costs in the 2020 Census LCCE.

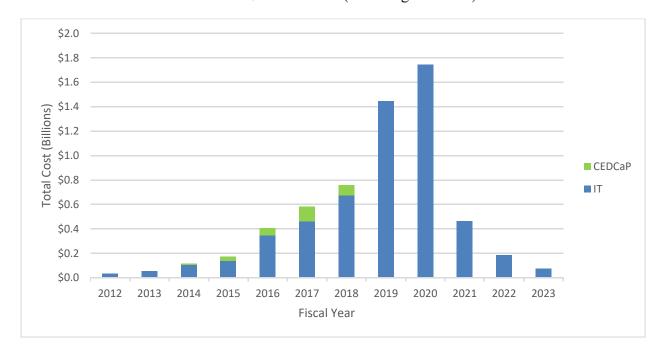The total cost for IT is estimated at $5.035 billion (including overhead).

Figure 16: IT Costs by Fiscal Year

2020 IT Systems and Services Cost Details

The 2020 IT Systems represent system capabilities funded by the 2020 Census. These systems include many small and relatively inexpensive systems, including Decennial Response Processing System and Integrated Logistics Management System but also includes larger and more expensive systems, including Census Schedule A Hiring, Recruiting and Payroll System, Geographic imagery and matching systems, and the Decennial Tabulation System.

Supporting the development and integration of these systems are the 2020 enterprise IT Services, which largely contain contract costs, but also includes infrastructure costs. The major contracts in this category include Census Questionnaire Assistance (CQA), Decennial Device as a Service (dDaaS), Field IT Deployment (FITd), and Technical Integration, which were all referenced above in the WBS Level 2 elements each is aligned with. It also includes the cost of IT infrastructure provided in the Census Bureau's data center related to the 2020 Census and the costs related to security assessment and testing prior to the issuance of an authority to operate.

CEDCaP Cost Details

CEDCaP is the enterprise system that supports data collection for not only the decennial census but other censuses as well. This is a major investment that peaks in FY 2017 and FY 2018 to support the 2018 End-to-End Test and lays the foundation for the ramp up to the 2020 decennial census. This was budgeted as an enterprise investment after FY 2018, so only costs of operating and maintaining these systems and scaling them up for the 2020 Census are included in this iteration of the LCCE after FY 2018.

5.4   LCCE Leading Elements of Cost

The life-cycle cost of the 2020 Census is largely driven by a select few categories. The primary four cost elements account for over 50 percent of the overall costs of the LCCE: Major IT Contracts, Field Operations, Risk-Based Contingency, and Level of Effort and Program Management. This is illustrated in Table 6: 2020 Census LCCE below that shows the individual and cumulative percent of costs. Note that the five bottom cost elements account for a small portion (approximately 20 percent) of the total cost.

Table 6: 2020 Census LCCE Leading Elements of Cost

Cost Element	Cost ($M)	% of Total	Cumulative %
Major IT Contracts	$3,095	20%	20%
Field Operations	$1,815	12%	31%
Program Risk	$1,703	11%	42%
Level of Effort and Program Management	$1,646	11%	53%
Census Bureau Overheads	$1,549	10%	63%
ACO/RCC Staff, Space, Supplies, Kits	$1,412	9%	72%
Secretarial Contingency	$1,182	7%	79%
Partnership and Advertising	$870	6%	85%
Other	$753	5%	90%
Systems Engineering and IT Infrastructure	$758	5%	95%
Printing, Postage, Paper Processing	$461	3%	98%
C-SHaRPS and Employee Check	$382	2%	100%
Grand Total	$15,625	100%	100%

Costs by Budget Object Class

The federal government's standard chart of accounts utilizes a standard set of budget categories called Budget Object Classes (BOC). Funds are allocated using BOC. The BOC provide a view of the 2020 Census LCCE costs by resource category. Figure 17: Life-cycle Costs by Object Class provides a view of the major cost elements by BOC. This graph highlights the cost significance of contracted services within the 2020 Census LCCE.
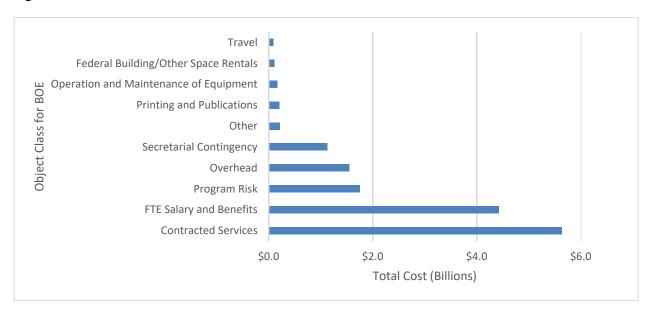

Figure 17: Life-cycle Costs by Object Class

5.5   Program Risk Reserves and Contingency

See Figure 8: 2020 LCCE Costs by Level-2 WBS in section 5.2 Detailed Cost by WBS Category for additional details on the risk methodology employed and category definitions.

Program Risk and Secretarial Contingency direct cost totals $2.885 billion across the life-cycle of the program with the Program Risk costs embedded into the associated WBS level-2 elements discussed in section 5.2. Risks have been grouped into two main categories based on the level of risk awareness and program control: Program Risk ($1.703 billion) and Secretarial Contingency ($1.182 billion) as shown in Figure 18: Program Risk and Contingency Breakdown below.

After completing the risk analyses, the calculated risk and uncertainty values were added to the point estimate subtotal to produce a risk-adjusted, life-cycle cost estimate for the 2020 Census Program of $15.625B.
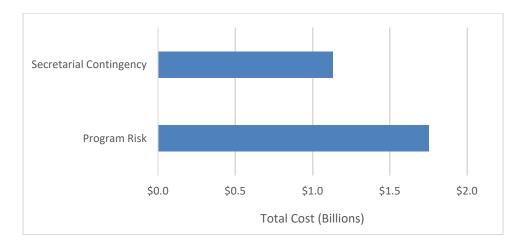
Figure 18: Program Risk and Contingency Breakdown

Figure 19 Contingency Costs by Fiscal Year below provides an overview of the scale and fiscal year time frame in which the Program Risk and Secretarial Contingency costs are allotted in the 2020 Census LCCE. The majority of the costs, 90 percent, are in FY 2019 and FY 2020, the main years of the 2020 Census implementation.
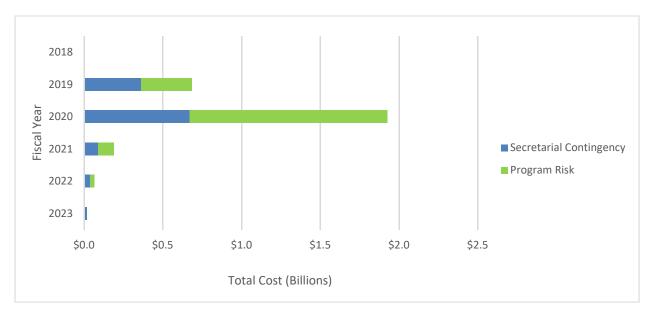

Figure 19 Contingency Costs by Fiscal Year

5.6   Independent Cost Reviews

The 2020 Census LCCE has been compared to three independent cost estimates (ICEs)[11] in its developmental history. GAO treats an ICE as a useful tool to determine the reasonableness of a cost estimate. Specifically, the GAO states:

> An ICE is considered one of the best and most reliable validation methods. ICEs are typically performed by organizations higher in the decision-making process than the office performing the baseline estimate. They provide an independent view of expected program costs that tests the program office's estimate for reasonableness. Therefore, ICEs can provide decision-makers with additional insight into a program's potential costs – in part, because they frequently use different methods and are less burdened with organizational bias. Moreover, ICEs tend to incorporate adequate risk and, therefore, tend to be more conservative in forecasting higher costs than the program office.[12]

In all instances of comparisons of an ICE and the 2020 Census cost estimate, there were differences in individual cost categories but the overall (total) cost was similar between the ICE and the 2020 Census Program Office Estimate (POE).[13] The primary reason for the differences were the estimating method and the different application of contingency and uncertainty. The results of the ICE to POE comparisons are shown in Table 7: Comparison to Independent Cost Estimates below.

Table 7: Comparison to Independent Cost Estimates

Date	Estimate	Estimator	Direct Cost	Delta from ICE	Risk, Uncertainty & Overheads	Delta from ICE	Total Cost	Delta from ICE
May-16	POE	DBO	$10,989	-2%	$1,323	-31%	$12,312	-6%
Jun-16	ICE	OCEAA	$11,229	N/A	$1,931	N/A	$13,160	N/A
Apr-17	POE	DBO	$10,284	-10%	$3,196	106%	$13,480	-4%
Aug-17	ICE	DOC OAM	$11,406	N/A	$1,551	N/A	$14,074	N/A
Sep-17	ICE	DOC OAM	$11,406	N/A	$4,218	N/A	$15,625	N/A
Nov-17	POE	DBO	$11,405	-0%	$4,224	-0%	$15,625	0%
Mar-19	POE	DBO	$11,191	-1%	$4,434	3%	$15,625	N/A
Mar-19	ICE	DOC OAM	$11,325	N/A	$4,300	N/A	$15,625	0%

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[11] An ICE is conducted by an independent organization using the same technical and procurement information used to develop the POE. The ICE provides an unbiased test of a LCCE's reasonableness in terms of cost, risk, etc.
[12] GAO Cost Estimating and Assessment Guide, March 2009, GAO-09-3SP, page 186
[13] A POE is the official projected cost for a system or program that is formally submitted to justify budget requirements to higher headquarters, Congress, GAO and others.

The first ICE was conducted by the Census Bureau's Office of Cost Estimation and Assessment (OCEAA), beginning in FY 2015 and ending in June 2016. The differences between the point estimate (direct cost) was approximately two percent. The OCEAA ICE used more conservative costs for mitigating risks and uncertainty, and therefore the difference was just over 30 percent. The total delta between the two estimates was 6.4 percent. The differences between the ICE and the POE were reconciled in a series of meetings between the OCEAA ICE team and the 2020 Census LCCE. The information from the reconciliation was used to update the POE.

A second comparison was conducted between the April 2017 POE and an August 2017 ICE. The second ICE was conducted by the DOC's Office of Acquisition Management (OAM), which reports to the Office of the Secretary (OS). This ICE utilized a top-down approach that made use of newly available Census data on IT costs as well as more conservative risk and uncertainty assumptions. The difference in direct costs (the point estimate) was just over 10 percent, largely due to more direct reliance on 2010 Census historical operational assumptions. However, the OAM ICE assumed less costs to mitigate risk and uncertainty. The overall difference was approximately 4.2%

Following reconciliation between the April 2017 POE and the August 2017 ICE, additional reconciliation occurred with the DOC OAM estimate in September 2017. The difference in risk and uncertainty between this latest estimate and the April 2017 POE accounted for the addition of $1.1 billion for the Secretarial contingency. The results of the September 2017 reconciliation between the POE and DOC ICE was under one percent.

The latest comparison of the 2020 Census POE to an ICE was completed during March 2019. The ICE was again prepared by the DOC OAM beginning in mid-2018 as one of the key recommendations of the Milestone 3 Review for the 2020 Census. The purpose was to continue to refine the ICE reconciliation with updated program office estimates and actuals, as well as the results of the 2018 End-to-End Census Test and system performance and scalability testing in FY 2019. The final difference in direct costs (the point estimate) was about one percent, while the difference in risk and uncertainty was about three percent. The delta between the two estimates (the current version) is zero at an aggregate level. The ICE cost estimators increased their confidence level in the sufficiency of the $15.625 billion cost estimate for the 2020 Census from 80 percent in FY 2017 to 86 percent in FY 2019, reflected by the increased ICE risk reserve within the same overall cost total.

6. CONCLUSION

The 2020 Decennial Census is a large and complex program that has a 12-year life-cycle and a projected total cost of $15.625 billion. The estimate includes the mobilization of technology, office space, people and infrastructure across the entire U.S. and its territories. As demonstrated in this Version 2.0 of the 2020 Census LCCE and its BoE, the cost is of a large scale.

The 2020 Census LCCE is a key tool for management to justify budget requirements, support resource allocation decisions, and to develop an informed understanding of the projected costs and risks of their programs. A reliable LCCE will increase the probability of program success. The Census Bureau will be using the 2020 Census LCCE to focus on delivering a cost-effective and high-quality census.

Despite the challenges of developing, improving, and maintaining a reliable cost estimate for a program as large and complex as the 2020 Decennial census, the Census Bureau is using certified cost estimators, advanced tool sets, and ongoing enhancements to internal controls to continuously improve the cost estimate. This commitment is underscored by the close working relationship that the Decennial Programs Directorate has established with both GAO and the DOC. The Census Bureau will continue to build upon and mature the 2020 Census LCCE and will be regularly updating the cost estimate with actual cost data that will assist in strengthening internal controls as the Census transitions into full execution.