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Topic III: Efficient management of increasing technical complexity

USE OF ENTERPRISE ARCHITECTURE TO MANAGE TECHNICAL COMPLEXITY AT THE U.S. BUREAU OF THE CENSUS

Invited paper

Submitted by the Bureau of the Census, United States [1]

I. INTRODUCTION

1. The Bureau of the Census continues to develo p and implement an Enterprise Architecture (EA) process to guide its information technology modernization and investments. The Bureau of the Census has undertaken this effort to improve its ability to satisfy its mission, meet its objectives, and respond to the significant challenges and drivers that it faces in the twenty-first century.

2. The nature of Enterprise Architecture is one of iteration. New business needs and technical advances drive change in the fabric of the enterprise. The enterprise responds to these by adapting its processes, information, and technologies to meet the new demands. An Enterprise Architecture (EA) is the tool the enterprise uses to facilitate a rapid response to these needs by providing assets to reuse, standards to follow, and an understanding of the interdependencies among business systems. These changes are then woven into the fabric of the EA.

3. The Census Enterprise Architecture is a strategic resource that aligns business and technology, leverages shared assets, builds internal and external partnerships, and optimizes the value of information technology services. It includes and defines relationships between the Census Bureau's Strategic and Operational Plans, standards and uniform products, Business Plans, IT Services, Architecture Principles and provides a migration path for moving from a baseline architecture to a target architecture.

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II. BACKGROUND

4. The Census Bureau Enterprise Architecture was first developed in 1998. In the following years, the Bureau's priorities were a successful Y2K transition and a comprehensive 2000 Decennial Census, all the while conducting the normal business of hundreds of periodic surveys. During the past few years, the Census Bureau, like other government agencies, turned its attention and resources to enhancing its Enterprise Architecture and implementing effective governance and EA life-cycle processes.

5. EA processes are under way at the Bureau and implemented through groups such as our IT Governing Board, our IT Standards Management Program, our Information Systems Support and Review Office and many groups throughout user-area Directorates. These groups, architects, IT managers, and EA stakeholders access our EA tool and repository which allows access to all enterprise architecture-related information. Using our EA tool, personnel at the Census Bureau can run dynamic queries, produce reports and perform what-if analysis to answer critical IT and business questions.

6. Our major EA components, including EA Governance, exist and continue to mature in order to satisfy the requirements that exist for all federal agencies for a comprehensive approach to manage the acquisition, use and disposal of IT.

III. VISION AND GOALS

7. The vision for the Bureau of Census Enterpris e Architecture is that the "Enterprise Architecture will support the core business of the Census Bureau functioning as a strategic resource that aligns business and technology, leverages shared assets, builds internal and external partnerships, and optimizes the value of IT services."

8. The EA vision supports the Census in achieving its mission of being "the preeminent collector and provider of timely, relevant, and quality data about the people and economy of the United States."

9. It also supports the Information Technology Directorate's mission "to foster an IT-rich environment that enhances the way the Census Bureau provides products and services to its customer."

10. Our Enterprise Architecture effort has established the following goals:

EA Goal 1
"Institute an adaptive architecture that aligns with and enables the Census business requirements."

EA Goal 2
"Provide guidance and direction for IT initiatives and programs in the Bureau."

EA Goal 3
"Meet the requirements of Government oversight organizations."

11. The EA reflects the current and future requirements of the IT Directorate and the program areas. It supports the Census Bureau's overall goals and strategic initiatives of the program areas. The Census Bureau has undertaken this effort to improve its ability to satisfy its mission, meet its objectives, and respond to the significant challenges and drivers that it faces in the twenty-first Century.

IV. CENSUS ENTERPRISE ARCHITECTURE FRAMEWORK

12. Enterprise Architecture is a strategic information asset base which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing needs of the business.

It includes and shows relationships between the Bureau's standards and uniform products, IT Business Plans, IT Services, IT Principles, Strategic and Operational Plans and provides a migration path for moving from a baseline architecture to a target architecture.

13. Census EA framework is based on the Federal CIO Council's EA Framework (Figure 1) and serves as the front-door navigation into our EA. This primary navigation page presents to the user an overall graphic conveying the structure of the Bureau's EA, that is, the assembly of work products and processes that frame EA, with navigation links to model views and other navigation pages. Census employees access complex enterprise knowledge through this framework to answer critical questions and solve IT and business problems.

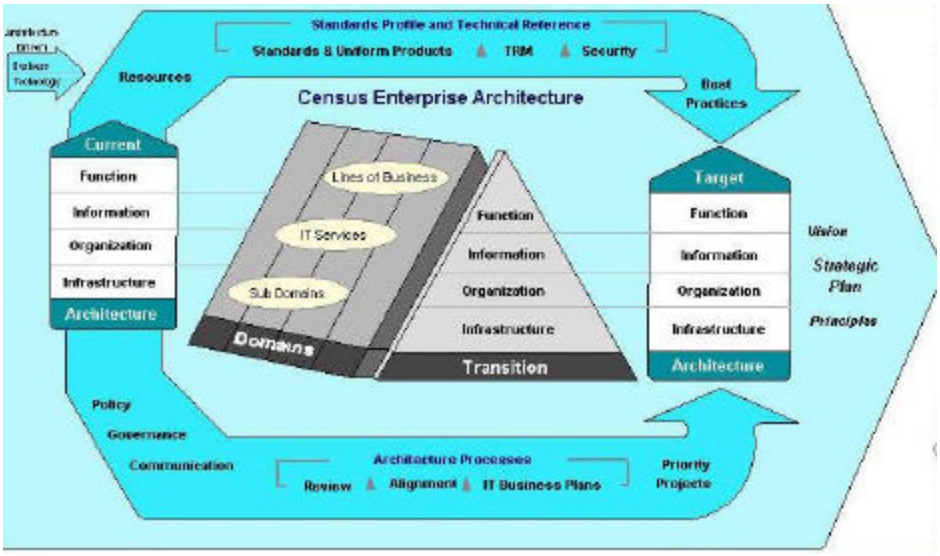

Figure 1. Census Enterprise Architecture Framework

V. CENSUS ENTERPRISE ARCHITECTURE ROADMAP AND PRINCIPLES

14. We developed an EA Roadmap to serve as a guide to the development and evolution of the Enterprise Architecture at the Bureau. To facilitate the iterative development of the EA, the roadmap defines the approach necessary to undertake the EA effort. It defines the vision, goals and objectives, scope, EA products, framework and lifecycle to be used, and the high level schedule.

15. Architectural principles are statements of preferred direction or practice. They are simple, direct statements that describe how an organization wants to use information technology in the long term. They establish a context for design decisions in which business criteria can be translated into language and specifications that technology managers can understand and use in planning, designing, developing, and implementing an information system. They guide the continued evolution of the architecture and the development of information systems that meet the Census Bureau's needs.

16. A set of architectural principles has been created as part of the Bureau's EA. An example of an architecture principal is: "Applications and infrastructure components will be designed and implemented to facilitate monitoring and measurement."

17. Architectural principles provide a stable base from which to make architectural decisions. These principles evolve as the organization's mission or business evolves. Establishing a coherent, consistent set of architectural principles is critical to achieving the goals and objectives of the Bureau.

VI. STANDARDS PROFILE AND TECHNICAL REFERENCE MODEL

18. The development of a standards profile and technical reference model throughout the enterprise plays a critical role in the implementation of an Enterprise Architecture process.

19. Our EA efforts include close collaboration with the Bureau's IT Standards and Uniform Products Program (ITSUPP). The ITSUPP is a Bureau-wide, user based effort focused on the development of Census Bureau IT standards and the selection of IT products for enterprise use and support. In order to help get the greatest value from our IT resources, this program promotes consistency in the automated data processing systems acquired or developed across all Directorates of the Census Bureau. It promotes the production of high-quality products through the efficient use of resources. This program applies to all organizational and operating units of the Census Bureau.

20. Our Enterprise Architecture effort works with the Bureau's Standards Management Team (SMT) to establish and coordinate the information technology standards and uniform products program for the Census Bureau. The SMT defines a methodology for the selection, development, implementation, review, enforcement and maintenance of IT standards. They also guide the evaluation, selection, and implementation of uniform products chosen to meet the Census Bureau's business needs and functional requirements. The SMT is the point of coordination, communication, and final recommendation on any product intended for bureau-wide use.

21. The process for developing Census Bureau IT standards is patterned after national and international standards programs. Participation is Census Bureau-wide, in particular those areas most affected by the developed standards. The standards cover consistent ways of doing business (for example, procedural standards) and Census Bureau functional requirements for particular product categories. All standards and uniform products are in conformance with applicable federal and departmental standards and guidelines. The draft standards go through a Bureau-wide review process before they are formally issued. Every issued standard has a regular review cycle to ensure the standard remains current. Each published IT standard describes mandatory requirements or procedures that can be exempted only through a waiver.

22. The purpose of selecting uniform products is to meet the Census Bureau's business needs and functional requirements and to attain economy, efficiency, and effectiveness of the business processes. Identification of a uniform software product means it is chosen for Census Bureau-wide use based on the organization's functional and business needs. Whether the product is the only one allowed for use is designated by its Use Level placement. The use level indicates whether a product must be used or not, and the level of enterprise support defines whether the product is acquired centrally, and whether there is enterprise support for using the product. All products with either full or partial enterprise IT support are labeled as Uniform Products. The selected products comply with the applicable functional, data interchange, or telecommunication standards issued through the IT Standards and Uniform Products Program.

23. A Technical Reference Model (TRM) is a generally accepted representation of the generic components of an information system. It allows designers, developers, and users to agree on definitions and have a common understanding of the services to be provided, and identify and resolve issues affecting interoperability, portability, and scalability. The objective of a technical reference model is to provide a standardized information system structure or model that can be used to guide the design and development of customized information systems that meet the Census Bureau's specific business needs. The TRM describes the main components of a complete information system as a set of services categorized by a functional area. These services may be implemented on a single platform or on a collection of homogeneous or heterogeneous platforms. The following figure (Figure 2) shows the view of the Bureau's TRM with a Security Services perspective.

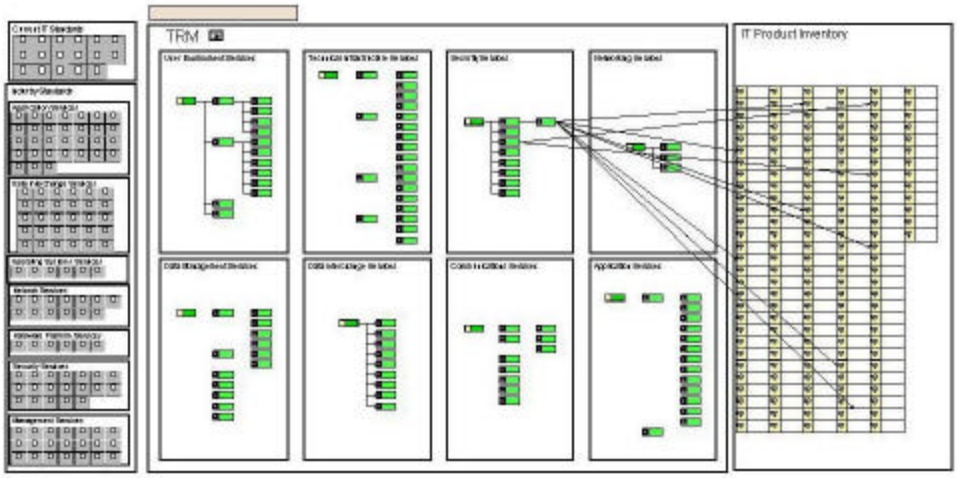

Figure 2. Technical Reference Model with Security Services Perspective

VII. GOVERNANCE

24. EA Governance is a critical component of enterprise architecture and provides for continuous improvement, migration, and measurement of business systems so that business and technology coalesce to meet the mission of the enterprise. EA governance places the political processes for making and enforcing IT-related business policies into the business realm of the enterprise. With EA governance, a structure and process are defined to ensure:

- The architecture reflects the current state of business and technology,
- Common and consistent approaches are used to plan and develop IT systems,
- IT investments are consistent with the enterprise architecture,
- Exceptions to the architecture can be assessed, controlled and managed,
- IT initiatives will be identified, tracked and managed through their lifecycle and
- The architecture brings value to the enterprise.

25. Enterprise Architecture processes are underway at the Bureau and implemented through groups such as our Information Technology Governing Board, our Standards Management Program, our Information Systems Support and Review Office and many groups throughout our organization. These groups, architects, technology managers, and EA stakeholders access our EA tool, which allows access to enterprise architecture related information. Using our EA tool, personnel can run dynamic queries, produce reports and perform what-if analysis to answer critical information technology and business questions.

26. An effective approach to governance is to distribute governance across a role-based organization utilizing a network of an architecture office, local relationship managers, technology expertise, and steering committees. EA governance will add to the management responsibilities of a project leader. Every effort will be made to minimize this impact by using existing governing bodies where possible.

VIII. EA GOVERNANCE MECHANISMS

27. Governance mechanisms fall into three general stages of **planning, assessment, and management,** all of which are bound by EA principles. These mechanisms are procedural in nature and are triggered by a variety of events, such as yearly budgeting cycles, periodic project reviews, EA lifecycle milestones, or requests for knowledge. Additionally, these mechanisms provide guidance on how to access, manage, and maintain the EA.

A. Planning

28. The EA is a key resource to aid in the development of business and IT plans. In its most mature state, the enterprise architecture is central to driving planning towards the desired target architecture. The EA plays a key role in the areas of Strategic and Operational Planning, Scenario Analysis, and Project Planning.

Strategic and Operational Planning

29. A primary function of Enterprise Architecture is to assist the Census Bureau in defining the future state of the business and technical architecture of the enterprise. The architecture is closely linked with the business and operational visions, strategies, and missions, and therefore is a key tool in developing in these activities.

Scenario Analysis

30. This activity is ad-hoc in nature and is driven by the type of analysis required. Examples of the scenarios that could be run through the EA are changes to project budgeting, introductions of new technologies, changes in organization, changes in information domains and the addition of a new business function.

31. Governance procedures for this activity will cover the definition of what the scenario entails and how the analysis should be conducted. In particular, the analysis should include: name and nature of the change, description of the change, cause, driver, or trigger, scope of the change, dependencies, assumptions, impact to technical architecture, impact to business architecture, and associated risks.

Project Planning

32. Alignment of a project's IT requirements to the Enterprise Architecture is achieved during the initial planning stages of the project. Project designers and planners will need to consult the EA to determine what standards and technical references to follow, which processes and functions will require integration, interface, and interchanges, and what core metadata will be needed across the system. EA governance in this activity includes: the role of the project planners, designers, and enterprise architects, providing guidance on the use of associated areas of the architecture, and identifying relationships between the initial planning phase of the project and the EA lifecycle.

B. Assessment

33. The linkage between the Enterprise Architecture and the Capital Planning and Investment Process is one of the core relationships in the management of IT projects in an enterprise. The IT business plan (ITBP) is the main product moving through the management process, and will be the medium in which related EA dependencies will be encapsulated.

34. At various touch points in the process, the EA and the ITBP teams would assess that the proposed or revised project plan is in alignment with the EA. Included in this review would be an evaluation of alignment to the EA framework components, technical reference and standards, and information assurance. The key purpose of this step is not to act a barrier to implementing the project, but rather to assist the project in gaining value from the EA by identifying commonalities, existing EA components, and enterprise standards for reuse. Another touch point would occur during the execution phase of the project and would include a review of a purchase request to assess that the procurement is in architectural compliance according to what has been detailed in the ITBP.

35. Enterprise Architecture by definition is a logically consistent set of standards and models that tie technology to business. Working within that definition, waivers and exceptions to the architecture must be

kept to a minimum in order to develop a coherent and manageable framework. The architecture waiver process is intended to provide a mechanism to grant exceptions where:

- The current architecture does not provide a workable solution to implementing an initiative
- The use of components within the architecture is cost prohibitive for the size of the initiative
- An emerging technology that directly supports the business need has been identified and is not yet represented in the architecture

C. Management

36. Maintaining accuracy of the baseline and target architectures across the shared services and program areas requires continuous diligence on the part of architects across the enterprise. Changes in the artifacts modeled in the architecture must be committed regularly to the EA repository. Moderating the apparent burden of artifact management is the iterative nature of constructing the views and perspectives of the EA. As content builds, so can the management responsibilities. Management of the EA process can be divided into three areas: (1) Updating Process Definitions, (2) Disseminating Process Information and (3) Assessing Process Performance.

37. Access to architecture artifacts can be based upon the intended use of that artifact. Use can be characterized by the traditional data access rights constructs of create, read, update, and delete, yielding a basis for assigning user permissions to access an artifact class. Users can be defined in broad categories and are part of our EA Roadmap:

Informational User: Stakeholders, management, and other casual users who need to see information at a high level, or are looking for general guidance and standards.

Planners: Stakeholders and management who need to run analysis, obtain guidance, and evaluate baseline and current models.

Designers and Developers: Owners and users of EA artifacts who will require access to guidance and standards, sharable components (process, information, application, and infrastructure), and information pertaining to integration, connectivity, and interoperability.

EA Architects: Users within an office of the architect who maintain, update, and refine EA artifacts and processes.

IX. ALIGNMENT TO CAPITAL PLANNING, INVESTMENT AND CONTROL

38. The Bureau of Census Enterprise Architecture process works closely with the Capital Planning, Investment and Control efforts as administered by the Bureau's Information Systems Support and Review Office.

39. An initial IT business plan (ITBP) is prepared during the conceptual stage of an IT project and matures throughout the entire lifecycle of the project. The ITBP is a living document prepared and maintained by the project manager of an IT project. The ITBP is designed to capture all relevant program management information. It can be used as a tool to manage the project and present information to senior decision-making officials at the Bureau, the Department of Commerce, and the Office of Management and Budget, as necessary or required.

40. In the following figure (Figure 3), you will find our Business Process Template that is utilized throughout our enterprise architecture tool.

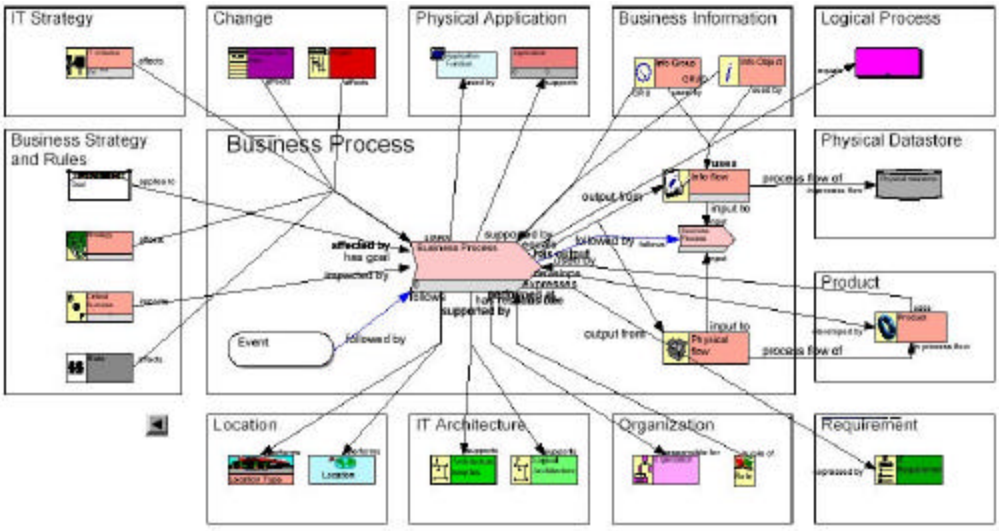

Figure 3. Census Enterprise Architecture Business Process Template

X. ANSWERING CRITICAL QUESTIONS – SOLVING BUSINESS PROBLEMS

41. The Census Enterprise Architecture is supported through the use of an integrated, visually-based EA tool. The goal of the tool is to produce a dynamic, visual representation of our IT environment that is explicitly aligned to our business requirements.

42. In the Figure below (Figure 4) you will see the result of an architect's query to display a view of the Bureau's Enterprise Data Backup System. The display shows relationships of this system, including responsible organization, systems utilizing the system, the associated IT business plan as well as a link to the current project file for the initiative. From this display, the user can zoom to an area of interest to view status reports or launch associated applications.

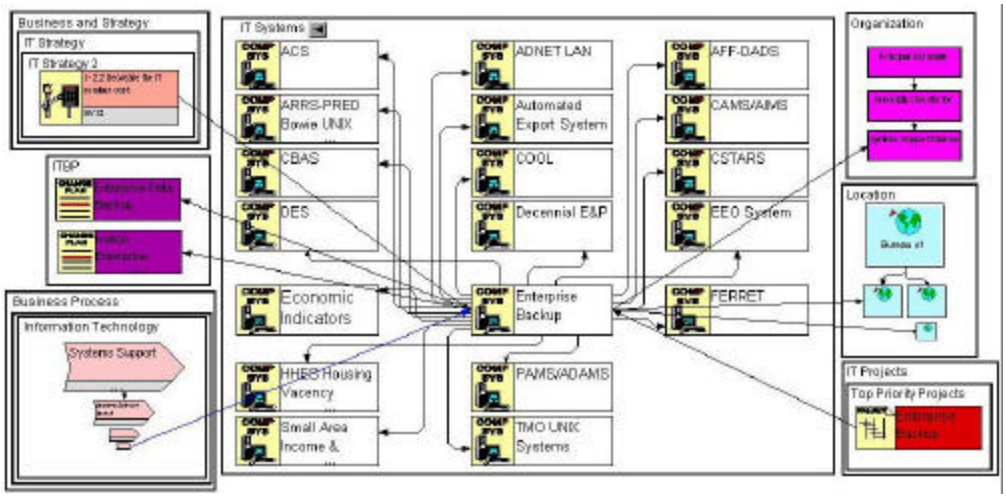

Figure 4. EA Tool View example – Enterprise Backup View

43. The Bureau of the Census Enterprise Architecture serves the function of providing a holistic guide and resource for strategic and tactical planning, and offers planners and designers access to business and technical models, standards, and direction.
