Accuracy and Coverage Evaluation 2000 System Requirements Study
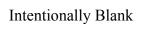
FINAL REPORT

This evaluation study reports the results of research and analysis undertaken by the U.S. Census Bureau. It is part of a broad program, the Census 2000 Testing, Experimentation, and Evaluation (TXE) Program, designed to assess Census 2000 and to inform 2010 Census planning. Findings from the Census 2000 TXE Program reports are integrated into topic reports that provide context and background for broader interpretation of results.

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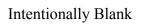
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PREFACE

Purpose of the System Requirements Study

The main objective of the System Requirements Study is to assess the efficacy of the requirements definition processes that were employed by the U.S. Census Bureau during the planning stages of the Census 2000 automated systems. Accordingly, the report's <u>main focus is on the effectiveness of requirements methodologies</u>, including processes for <u>coordination, communication, and documentation</u>, and their impact on overall system functionality. The report also addresses certain contract management issues and their effect on system development and/or operational considerations.

The System Requirements Study synthesizes the results from numerous interviews with a range of personnel--both U.S. Census Bureau staff and contractors--who were involved with the planning, development, operations, or management of Census 2000 systems. Our findings and recommendations in this report are qualitative in nature; they are based on the varied opinions and insights of those personnel who were interviewed. The intent is to use the results from this study to inform planning for similar future systems.

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EXECUTIVE SUMMARY

The Accuracy and Coverage Evaluation is a survey and coverage methodology designed to assess the size and characteristics of the population missed or erroneously included in Census 2000. The methodology is designed to develop an independent estimate of persons and housing units for use in evaluating the final census results. The Accuracy and Coverage Evaluation 2000 is a control system that includes both tracking and communication functions. The system was used to control Accuracy and Coverage Evaluation field operations and some smaller operations such as relisting, Targeted Extended Search, and Quality Assurance. A.C.E. production usage began in August 1999 and continued until May 2001. This study presents information based on debriefings with personnel involved with the Accuracy and Coverage Evaluation 2000 system.

The original tracking and control system was character-based, operating in a DOS environment. A Windows-based version of the software was developed as part of the Integrated Coverage Measurement program. The Integrated Coverage Measurement 2000 system was used to control and track all Integrated Coverage Measurement field operations in addition to the Computer Assisted Personal Interview operations during the Census 2000 Dress Rehearsal. Although the Dress Rehearsal was considered a success, issues such as data volume, changing survey requirements, and concerns regarding performance resulted in the need for further system enhancements. Integrated Coverage Measurement 2000 was renamed Accuracy and Coverage Evaluation 2000 when the survey was renamed Accuracy and Coverage Evaluation. Major results of the study include:

- **Right system for the job.** The Accuracy and Coverage Evaluation 2000 system was considered by those involved in the study to be the "right system for the job." The system was successful, but its success results from the dedication of the U.S. Census Bureau and contractor staff, not from a well-planned development timeline or supporting development methodology.

- **Continuous changes were identified.** The development of the system was subject to continuous changes. The changes forced the development team to focus on core functionality thus preventing some requirements from being implemented due to schedule constraints.

- **Changes affected testing.** The number of changes limited the testing that could be accomplished. Although several layers of testing were in place, testing was implemented based on a careful review of resources, time available, and risk.

These and other findings have led to the following recommendations:

- **Project planning - define adequate resources.** Development of the Accuracy and Coverage Evaluation 2000 system was subject to wholesale changes in census methodology, technology, and business process. A census is not the time to try unproven approaches or to develop systems without sufficient time for development and a sufficiently large staff of both subject matter and development personnel. The U.S.

Census Bureau must plan well in advance to ensure that the necessary personnel resources are available to support the project and that those resources can devote a sufficient amount of time in requirements definition and testing without being diverted to other activities.

- **Dress rehearsal environment - replicate census environment more closely.** The Census 2000 Dress Rehearsal environment provided for only one Local Census Office within each of the three Regional Offices involved in the exercise. This environment did not provide the opportunity to test and evaluate certain aspects of the software such as the movement of staff members across teams. We recommend that the U.S. Census Bureau establish a more complete cross-section of the business process during dress rehearsal so that the nuances of each operation can be better tested and evaluated.

1. BACKGROUND

The Titan Systems Corporation, System Resources Division (Titan/SRD) was tasked by the Planning, Research, and Evaluation Division (PRED) of the U.S. Census Bureau to conduct system requirements studies for 12 automated systems used in the decennial census. This report is a study of the Accuracy and Coverage Evaluation 2000 (ACE2000) system. It addresses the extent to which the requirements definition process was successful in identifying the needed system functionality and offers one of several evaluation approaches for examining these automated systems. The report results are intended to assist in the planning of similar systems for the 2010 census.

The Accuracy and Coverage Evaluation (A.C.E.) is a survey and coverage methodology designed to assess the size and characteristics of the population missed or erroneously enumerated in Census 2000. A.C.E. incorporates several interrelated field and processing operations; it is designed to develop an independent estimate of persons and housing units for use in evaluating the final census results. The concept was originally part of the Integrated Coverage Measurement (ICM) program.

A.C.E. identifies a listing sample of about 750,000 housing units. Field representatives systematically canvass block clusters during the A.C.E. Listing operation in order to create an address list that is independent of the census address list. After sample reduction, the A.C.E. universe is reduced to approximately 300,000 housing units to interview. A comparison is then made between the two lists to identify the housing units which are common (or match) between the two lists. Differences are resolved as part of the Housing Unit Followup (HUFU) operation. After HUFU, sample addresses are prepared and used to create input files for the Person Interview (PI). A comparison of the person files is made and differences between A.C.E. and census person data are then resolved in the Person Followup (PFU) operation. Activities include: conduct independent listing; key listing books; match and followup housing units; create enhanced list; conduct A.C.E. Person Interview (PI); conduct A.C.E. person matching and followup; and match and followup final housing units.

ACE2000 is a control system that includes both tracking and communication functions. The system was used to control the A.C.E. field interviewing and Quality Assurance (QA) operations for listing, HUFU, PI, PFU, and Final Housing Unit Followup (FHUFU) and smaller operations such as relisting, Targeted Extended Search (TES and TES II), and Quality Assurance (QA). A.C.E. production usage began in August 1999 and continued until May 2001. All A.C.E. operations, except person interviewing, utilized paper questionnaires. For these operations, ACE2000 interfaced with hand held bar code scanners to track the individual paper questionnaires. The system tracked the documents that were shipped to each region and back to the National Processing Center (NPC) and compared that information to the documents that were actually received. For the PI operation, Computer Assisted Personal Interview (CAPI) was used. ACE2000 provided sample addresses and questionnaire input files to more than 9,000 laptop users. These users completed automated questionnaires and uploaded the data to the central

system. For both paper-based operations and CAPI, ACE2000 provided laptop reports for the Field Division (FLD) staff.

2. METHODOLOGY

The Titan/SRD Team interviewed key personnel for each of the Census 2000 automated systems using a structured approach centered around four fundamental areas. A set of questions under each of those areas was designed to explore: (1) the effectiveness of the requirements definition process; (2) how well the systems were aligned with business processes; (3) identification of any deficiencies in functionality or performance relative to actual operational needs; and (4) how effective the agency contract management activities were in regards to contractor performance.

A similar, but separate set of questions, was designed for contractors who were identified as key personnel. The contractors were asked about the following areas: (1) the clarity of the statement of work and the impact of any changes to the specifications; (2) their interactions with government personnel and the technical direction they received; (3) the timeline for completing the work; and (4) their impressions of the system's suitability and operational effectiveness.

The purpose of the system requirements study is to summarize the results of interviews with key personnel by system. A variety of related system documentation was reviewed in connection with the interviews. The assessments provided in Section 4., Results, reflect the opinions and insights of key personnel associated with ACE2000 who were interviewed by the Titan/SRD Team in October and November 2000. Those personnel had varying levels of knowledge about the ACE2000 system based on their involvement with system planning, development, implementation, or operational issues. Section 5., Recommendations, provides value-added perspectives from the Titan/SRD Team that seek to illuminate issues for management consideration in the planning of future systems.

Quality assurance procedures were applied to the design, implementation, analysis, and preparation of this report. The procedures encompassed methodology, specification of project procedures and software, computer system design and review, development of clerical and computer procedures, and data analysis and report writing. A description of the procedures used is provided in the "Census 2000 Evaluation Program Quality Assurance Process."

Study participants reviewed the results of this system requirements study. Comments have been incorporated to the fullest possible extent.

3. LIMITS

The following limits may apply to this system requirements study:

- The perception of those persons participating in the interview process can significantly influence the quality of information gathered. For instance, if there is a lack of communication about the purpose of the review, less than optimal results will be obtained and the findings may lack depth. Each interview was prefaced with an explanation about its purpose in order to gain user understanding and commitment.

- In some cases, interviews were conducted several months, even years, after the participant had been involved in system development activities. This extended timeframe may cause certain issues to be overlooked or expressed in a different fashion (i.e., more positive or negative) than if the interviews had occurred just after system deployment.

- Each interview was completed within a one to two hour period, with some telephone followup to solicit clarification on interview results. Although a detailed questionnaire was devised to guide each interview and gather sufficient information for the study, it is not possible to review each aspect of a multi-year development cycle given the limited time available with each participant. Although this is a limitation, it is the opinion of the evaluators that sufficient information was gathered to support the objectives of the study.

- Every effort was made to identify key personnel and operational customers who actively participated in development efforts. In the case of ACE2000, all government personnel who participated in the study are still with the Census Bureau. The contractor interviewed for the study is no longer active on the ACE2000 program.

4. RESULTS

This section contains findings that relate to the effectiveness of the requirements definition process used during the development of ACE2000. The requirements process establishes the foundation for a system and, as such, must be designed to thoroughly consider all technical and functional aspects of development and operation of the system.

4.1 Requirements definition

A character-based program with a DOS-based operating system was used as the control system to assign and track ICM Person Interview - Computer Assisted Personal Interviews in the 1995 and 1996 Census Tests. Person Interview and Person Interview Quality Assurance (PIQA) interviews were done using DOS-based laptop computers in these tests and in Census 2000. A Windows-based version of the control system software, named ICM2000, was tested at the three Census 2000 Dress Rehearsal Regional Offices.   The ICM2000 was used to control and track all ICM field operations in addition to the CAPI operations. Although the Dress Rehearsal was

considered a success, issues such as data volume, changing survey requirements, and concerns regarding performance resulted in the need for further system enhancements. The ICM2000 was renamed ACE2000 when the survey was renamed A.C.E.

Initially, requirements were gathered from Joint Application Development (JAD) sessions planned by contractors and facilitated by Census Bureau personnel. The products from these sessions were not conducive to the development of the system so new requirements were identified and existing requirements redefined. Requirements for the tracking and control software were identified primarily from FLD personnel. Throughout the development process, additional requirements were added as new operations were identified. These requirements were expressed in many different forms. A Change Control Board (CCB) was established after Dress Rehearsal. The CCB did not have to approve any changes made to the ACE2000 and laptop software during development. Only after the testers from the Technologies Management Office (TMO) had officially received the software did proposed changes require CCB approval. Changes to the automated questionnaires went to a different CCB.

Census Bureau and contractor personnel were co-located during the development of ACE2000. Regular meetings were conducted to discuss project status and schedule information as well as identify and resolve critical development issues.

4.2 Requirements issues

4.2.1 Agency endorsed methodology was not available

There is no agency-wide methodology to address requirements definition or system development within the Census Bureau; however the project team did attempt to define requirements using a structured approach. Preliminary requirements for the ACE2000 were expressed as Use Case scenarios. At the most basic level, a Use Case is a collection of possible interactions between the system and its external actors, related to a particular goal. This technique is labor intensive and not always easily understood by the user community who must participate in the development of each scenario. Despite the extensive effort to document requirements using the Use Case methodology, requirements for the system were completely reworked in order to proceed with development for Census 2000. Also, the original JAD sessions were large with stakeholders from the regions and Headquarters (HQ). The large number of participants made it difficult to control the meeting and produce meaningful results. Regional representatives had different perspectives regarding the functional and information requirements for the system. Although the sessions were facilitated by trained Census Bureau personnel, the different opinions caused confusion and, in some cases, the identification of conflicting requirements.

4.2.2 New and changing requirements impacted development

The Dress Rehearsal provided an opportunity to identify changes to the ACE2000 software; however, implementing lessons learned was not the only challenge that confronted the development team. Entirely new operations were identified between Dress Rehearsal and Census 2000. These new operations required the identification and implementation of additional ACE2000 functionality to ensure the sufficient tracking and reporting of each operation's progress. The new requirements, coupled with the level of effort to make corrections identified during Dress Rehearsal, forced the development team to focus on core functionality. As a result, some of the "bells and whistles" desired by the subject matter organizations could not be implemented in time for Census 2000. The ability to conduct extensive software testing was also delayed by this continuous stream of changes.

4.2.3 Two methods used for problem reporting

Two primary means of problem reporting were used for ACE2000. During development, PVCS Tracker was used by FLD and TMO testers as the primary tool to record bugs and track recommended changes. A Merant product, this tool captures, manages and communicates changes; documents development issues and tasks; and provides basic process control to ensure coordination and communication within and across development teams. Remedy Help Desk, from Remedy Corporation, was used to record problems once ACE2000 was in production. This product provides functionality for problem identification and resolution, change request management, and inventory management.

4.2.4 Change control board established to manage changes

The CCB managed changes to ACE2000 and the laptop software. The CCB met twice per week and discussed problems and recommendations from both the PVCS Tracker and Remedy systems. Proposed changes were reviewed for technical implications, cost impacts, and schedule risks. Since the schedule had activities and timelines for all operations any changes had to be carefully timed to minimize disruption to the operations themselves. Approved changes were then prioritized and grouped together for implementation.

4.3 Alignment with business processes

This section contains findings that relate to how well ACE2000 supported the specific business processes that were associated with the Census Bureau's need to track and control enumeration activities.

4.3.1 System perceived as effective by study participants

ACE2000 was plagued by new and changing requirements. Despite the continuous evolution of the product, those interviewed believed the system to be the "right system for the job" providing an efficient and effective approach to the management of field operations. In retrospect, additional time for development and the availability of more qualified and experienced personnel would have improved the product.

4.3.2 Last minute questions regarding the use of CAPI versus PAPI

After the supreme court decision in 1999 that sampling could not be used for apportionment and the consequent sample reduction, there were questions raised as to whether CAPI or the Paper Assisted Personal Interview (PAPI) should be used as the primary means of data collection for the A.C.E. PI operation. The questions related primarily to cost and timing factors. The concern that providing laptops for this operation might prove too expensive and logistically difficult was raised again. The Census Bureau staff working on A.C.E. were confident that CAPI would succeed and that PAPI could not produce the data turnaround time required by the survey. The CAPI system had been tested as early as 1995 and proved successful. Its advantages as an electronic interchange include the provision for computer readable output without the need for subsequent data capture and the more timely acquisition of data that provided a good monitoring capability.

A.C.E. CAPI preparation was put on hold at a crucial time while staff were directed to investigate how a PAPI operation could be implemented. The conclusion reached was that the survey had passed the point of no return and that switching to PAPI could not be accomplished in time to field a successful PAPI version of the survey in 2000.

4.4 System deficiencies

This section contains findings that relate to any specific shortcomings that were identified with respect to the system's ability to accomplish what it was supposed to do or impediments encountered during the development and support processes. Recognizing that 100 percent success is rarely achievable, it is still worthwhile to assess deficiencies in the spirit of constructively identifying "lessons learned." Such insights can greatly contribute to improvements in future system development activities.

4.4.1 ROSCO not available for use in ACE2000

The Regional Office Survey Control System (ROSCO) was being developed by the TMO as the new control system for current surveys at the same time that ACE2000 was under development. It was intended that some of the functionality, and supporting code, provided by ROSCO would be re-used for the development of ACE2000. ROSCO was not completed early enough for ACE2000 to piggy back on its development; therefore, some of the functionality that would have been shared was created from scratch for the ACE2000 system. Resources were not allocated to

support this additional effort which contributed to insufficient testing and software inaccuracies. One advantage was that the database designer for ACE2000 was familiar with the ROSCO design and was able to apply some of the same concepts to ACE2000.

4.4.2 Personnel resources were limited

Both Census Bureau and contractor resources available to design and develop ACE2000 were limited. Very few Census Bureau personnel had the necessary subject matter expertise to define requirements for ACE2000 and to evaluate the interim software products provided by the contractors. These subject matter personnel were also providing input and feedback on other A.C.E. development projects which limited the time and depth of each review.

4.4.3 Case assignments caused some difficulties

Enumerators at Accuracy and Coverage Evaluation Regional Offices (ACEROs) were assigned specific cases to complete during Census 2000. There were difficulties getting these cases assigned to the field personnel. Payment was based on the number of hours worked. Hours worked were impacted by two factors. The success of the telephone operation reduced the overall workload for field personnel. There also was a requirement to complete Nonresponse Followup (NRFU) before beginning the A.C.E. interviews. NRFU caused delays in the timing of work available for an enumerator, but did not reduce the number of total hours that an enumerator could work.

Initially if a case was reassigned to another enumerator, the original case assignment remained on the enumerator's laptop appearing to create a duplicate assignment. This problem was resolved early and for most of the interview period, cases reassigned to another interviewer were "disabled" on the original interviewer's laptop. As intended, the ACE2000 always reflected the most recent assignment. Any problems encountered were not due to the disable function itself, but due to the manner in which the files were being identified by the ACE2000 system. This was considered a major automation problem with a potential to have impacted the survey data quality.

These problems relating to case assignment were caused by some limitations in the software and from the user's lack of knowledge of the system. Both software changes and manual workarounds were introduced to resolve these problems.

4.4.4 Software testing was not as thorough as desired

Several layers of software testing were conducted on ACE2000; however, the process was not as thorough as it could or should have been. Developers were responsible for unit testing their own code. Alpha testers exercised each software module to ensure the code functioned as intended and conducted regression testing to ensure that changes between versions did not introduce problems in other parts of the system. Field testers conducted functionality testing to see if the software reflected the requirements and to determine whether the software would support the

business process as it was defined. The Census Bureau Beta Test Site used test scripts and data provided by the developers to test the software within the hardware and software infrastructure established for Census 2000.   The number of changes that had to be implemented in a very short timeframe limited the testing process. Testing was prioritized based on resources, time available, and risk.

4.4.5 Multiple databases required synchronization

There were 12 development databases and 12 production databases as well as databases for the alpha, beta, and field testers. Multiple databases were necessary because each was being used for a different purpose. Separate databases shielded the users from changes that other users might have made during the testing process. The ability to automatically synchronize these databases to the latest software versions would have saved a substantial amount of time and effort on the part of the development staff.

4.4.6 Development personnel assigned to assist help desk staff

Help Desk personnel fielded questions and documented problems for ACE2000 once it was in production. These personnel were skilled in many aspects of automation and knew the Remedy product for Help Desk Management. However, they did not have in-depth knowledge about the ACE2000 system itself. Some development personnel were later assigned to augment the Help Desk. Although this was part of the original plan, it diverted essential resources away from the development effort.

4.5 Contract management practices

This section contains findings that relate to the effectiveness of contract administration activities. In general, even when system requirements are well-defined, ineffective management of contractors can lead to less than optimal results when the system is deployed. Consequently, it is beneficial to evaluate past practices in order to gain insights that can lead to improvements in system development efforts. Contractors were selected to provide C and PowerBuilder skills for the development of ACE2000.

4.5.1 Contractor performed well despite challenges

Overall, the contractors that were selected for ACE2000 development were qualified and experienced professionals that produced a high quality product. This was accomplished despite limited resources, severe schedule constraints, and continuously changing requirements.

4.5.2 Team approach was used

A mix of junior and senior developers were included on the project team. The developers worked closely with Census Bureau personnel to meet the project requirements and implement the system within the time constraints. Personnel from the two contractor organizations also

worked closely together because the back-end database software had to integrate successfully with the front-end user interface software. Despite some strong personalities and a high stress environment, Census Bureau and contractor team members were ultimately effective in communicating and coordinating project activities.

4.5.3 Contractor turnover impacted development

There was some turnover of contractor personnel during ACE2000 development, most notably with the C programmers. At one point during development, two C programmers were hired; one as the primary developer and one to provide back-up. Identifying replacement personnel was sometimes difficult due to the skill requirements of the position. Also, any new personnel, although technically qualified, were subject to a learning curve as they became familiar with the project goals and requirements and as they interacted with the other individuals assigned to the project.

5. RECOMMENDATIONS

This section synthesizes findings from the above sections and highlights opportunities for improvement that may apply to the Census Bureau's future system development activities. The recommendations reflect insights from the Titan/SRD analysts as well as opinions regarding "lessons learned" and internal "best practices" that were conveyed by Census Bureau personnel during interviews.

5.1 Project planning - define adequate resources.

ACE2000 was subject to wholesale changes in census methodology (i.e., sampling versus full enumeration), technology (i.e., Oracle Forms to PowerBuilder), and business process (i.e., PAPI versus CAPI). A census is not the time to try unproven approaches or to develop new systems without a sufficiently long lead time for development and without a sufficiently large staff of both subject matter and development personnel. The Census Bureau must plan well in advance to ensure that the necessary personnel resources are available to support the project and that those resources can devote a sufficient amount of time in requirement definition and testing without being diverted to other activities. The ACE2000 development schedule was unrealistic because it did not allow for the full development of requirements, adequate testing, or the opportunity to accommodate virtually continuous program changes. Fully functional systems, based on well documented requirements baselines, must be available for the dress rehearsal so that necessary changes can be identified, implemented, and tested well before actual deployment.

Recommendation: Initiate development efforts early enough so that fully tested, robust systems are available for dress rehearsal. The purpose of the dress rehearsal should be to evaluate a fully functional system and fine tune system features, not to identify major changes in system functionality. Although some requirements may change from the lessons learned in dress rehearsal and from external forces (e.g., Congress), there would be a higher chance that all

requirements would be identified and implemented for the actual census. In addition, establish realistic development timelines that incorporate sufficient time for requirements definition, development, testing, and enhancements.

5.2 Dress rehearsal environment - replicate census environment more closely.

The Census 2000 Dress Rehearsal environment provided for only one LCO within each of the three Regional Offices involved in the exercise. This environment did not provide the opportunity to test the movement of staff across teams, the reassignment of cases, and the integration of report data for multiple teams. In addition, the field personnel used for the Dress Rehearsal possessed enough knowledge and experience that they were able to work through problems that in fact should have been reported as shortcomings in the system.

Recommendation: The Dress Rehearsal environment should mirror the census environment to the fullest possible extent. This would mean the establishment of a complete cross-section of the business process so that the nuances of each operation can be tested and evaluated. The Dress Rehearsal is not a full scale undertaking; however, it should incorporate the same type of offices, personnel, systems, and data that are intended for the census.

5.3 System development methodology - establish standard life-cycle methodology.

A standardized methodology provides the agency with guidance for project planning and management and provides a contractor with direction for the technical approach, types of documentation, and level of detail appropriate for each phase of the development life-cycle. A typical methodology covers requirements definition, system design, development, testing, deployment, and on-going maintenance phases. A standardized methodology for system development would benefit the Census Bureau by establishing the structure and procedures for the specification and development of complex systems. A standard methodology would help to ensure the consistency and completeness of system development efforts.

Recommendation: Establish an agency-wide system development life-cycle methodology using input from other federal agencies and established industry standards. This methodology should be implemented in conjunction with an organization devoted to standards and methodology development and to project management. Training and documentation should be made available to Census Bureau personnel and representatives from the new organization should be available to coach development teams through each phase of the development life-cycle.

5.4 Help desk staffing - ensure adequate training and early system exposure.

Help Desk personnel must answer questions and document comments and recommendations for

each software product under their jurisdiction. Training on the Help Desk Management software is only part of the training that is required; exposure to a system during the development process and formal training on the fielded system is essential for Help Desk personnel to be effective. Other considerations to ensure more adequate training include providing more in-depth information on the A.C.E. and determining the optimal times for hiring and training Help Desk Staff.

Recommendation: Help Desk personnel should be selected to participate as part of each development team. This would allow the greatest exposure to the business processes supported by the system, the system functionality, the data, and any system interfaces. Once the system was deployed, these personnel could be reassigned to support the Help Desk as the primary focal point to conduct training and answer questions about their assigned system. Daily interaction with other Help Desk staff would reinforce the formal training and serve as a continuing means to cross-train other staff members in the intricacies of the system.

5.5 Contractor turnover - ensure contract fully addresses this issue.

Skilled development contractors are in high demand throughout industry and government. Many developers have their choice of companies and even their choice of projects within the company. Aggressive salaries and benefits often lure developers to new jobs even when they have been with a company for only a short time. Frequent movement between projects and between companies is disruptive and sometimes detrimental to the success of a project.

Recommendation: Contractor turnover from "better offers" or extenuating personal circumstances cannot be prevented, but it may be reduced if certain steps are taken during contract negotiations with the vendor. Skill requirements should be clearly specified for each labor category in the contract. Critical labor categories should be designated as "Key Personnel" so that the individuals proposed during negotiations are indeed the same individuals that support the project once it begins. Labor rates proposed for each category should be checked against other vendors and industry benchmarks to ensure that qualified personnel can be attracted and retained at the proposed rate.   The government should request a minimum of 30 days notice from the vendor for any change in Key Personnel and resumes of any replacements should be provided for review as quickly as possible. Conversely, the government should specify a process to enable the immediate removal of any non-performing personnel. For critical positions, both a primary and backup resource should be included on the project; the backup having sufficient skills and experience to function interchangeably with the primary resource. Cross-training should be encouraged throughout the project. Lastly, the Census Bureau has unique needs that must be addressed within a very short timeframe. Vendors and contractor personnel must be made aware of the importance of the census mission, the intensity of the census environment, and the critical need for continuity of project personnel.

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