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Management Information System 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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Helping You Make Informed Decisions

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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 main focus is on the effectiveness of requirements methodologies, including processes for coordination, communication, and documentation, 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 future systems.

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EXECUTIVE SUMMARY

The primary goal of the Management Information System 2000 system is to serve the information and decision support needs of the decennial census. Management Information System 2000 is the first executive information system used by the Census Bureau to aggregate scheduling and budget information and is the official source of management information for Census 2000. The Management Information System 2000 is an umbrella system with two components: Master Activity Schedule, and Cost and Progress. This study presents information based on debriefings of personnel involved in the Management Information System 2000 program.

The Master Activity Schedule component contains information on the scheduling and duration of all census activities and is the official entry and update point for designated Census 2000 data. The Cost and Progress component of the system uses an efficient enterprise-wide database of cost and progress information designed to enable managers to: assess and modify operational plans as they relate to the Master Activity Schedule; manage operations and cost; and identify problems quickly. Management Information System 2000 is still an active system. Major results of the study include:

- **Comprehensive tool for management.** Both components of the Management Information System 2000 contain a broad variety of functions to support the management of the decennial census. Among these are analytical tools used to assess progress and management functions to aid in the decision making process. Information was presented in various forms such as reports, graphs, summaries, Pert charts, and schedules. These tools were used to manage the operation of the census.

- **System scope and purpose not adequately defined.** Although the Management Information System 2000 proved to be a useful tool for determining high level cause and effect relationships with regard to the operation of Census 2000, some users indicated that they continued to rely on their own control systems and scheduling tools. These users stated that the scope and purpose of the system were never clearly defined. The basic requirements as to what data were needed to monitor programs, and at what level, were not adequately addressed.

- **System usage below expectations.** The Cost and Progress component was not used by some program management offices and divisions. This was due in part to the complex nature of using the software and the users' unfamiliarity with current technology such as graphical user interfaces. Regular usage along with training was needed to become proficient.

- **Some report content difficult to interpret.** In the Cost and Progress component, it appears that a lack of standardization between systems created problems interpreting information in the reports. Some terminology and data element definitions were different

between systems and reports containing aggregated data often reflected different snapshots in time.

- **Schedule updates not timely.** Any system design must consider the entire operational environment including associated business processes such as those designed to maintain the currency and integrity of the data. The Master Activity Schedule component was a useful tool because it provided scheduling information at various levels of detail that enabled managers to identify issues and activities with the potential to impact the project schedule. Current information related to task management was not always available as needed because the process of updating the schedule was not effectively implemented.

- **Testing validated system requirements.** Testing serves to validate that system requirements have been met. Testing for the Cost and Progress component was considered comprehensive. In addition to the unit testing conducted by developers, an independent internal tester who had participated in the Joint Application Development sessions was assigned to conduct alpha testing. Knowledge of system requirements gained from being involved in the Joint Application Development sessions allowed the tester to determine if required functionality had been implemented.

These and other findings have led to the following key recommendations:

- **Management focus - increase senior management commitment.** The requirements for the Management Information System 2000, in particular the Cost and Progress component, were developed very late in the decennial cycle. The system needed consistent senior level management focus and support throughout its development and operation. The system has strong capabilities; however, a fundamental issue was a lack of a well-defined scope and purpose. This limited its full use by the potential user community. Better management focus was needed for requirements development, rollout of training, and scheduling. Senior management needs to set specific expectations about what needs to be accomplished, engage the right people for the job, and ensure continuity and participation of personnel on each task.

- **Feeder system requirements - increase coordination.** Many of the systems feeding data to the Cost and Progress component were produced independently and used varying definitions for data elements. This impacted the ability of the Cost and Progress component to receive data from feeder systems without reprogramming. For reliable results, terminology and data element definitions should be standardized between feeder systems. The census planning and development processes should ensure that extensive coordination and frequent communication occur between developers. This is essential for systems that are involved in exchanging data.

- **Technical support staffing - provide sufficient resources.** Both components of the Management Information System 2000 required a high level of expertise to maintain. Due to a lack of technical support resources, trainers for the Master Activity Schedule

became involved in other activities such as configuring personal computers and installing upgrades. The U.S. Census Bureau should address the need for on-going technical support during the requirements process and ensure that sufficient resources are available to support development teams. This would help ensure that developers stay focused on the development and deployment of the system instead of diverting their efforts to address more general support issues.

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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 Management Information System 2000 (MIS 2000). 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.

MIS 2000 was intended to be the official source of all senior management planning and tracking information about Census 2000 including schedule, operational responsibilities, budget, cost, and progress. It was also intended to provide cost modeling and decision support services. The combined capabilities of MIS 2000 enabled managers to assess and modify operational plans, monitor and manage operations and costs, and identify problems quickly. MIS 2000 has a large and diverse user base which includes: planning staff and Census Bureau managers; project managers and teams; cost modelers; budget staff; promotion staff; field processing staff; executive staff; General Accounting Office (GAO) staff; and the MIS 2000 staff.

MIS 2000 has two separate components: a Master Activity Schedule (MAS) used for scheduling that is based on Primavera Project Planner (P3) software and a client-server based Cost and Progress Reporting (C&P) system. Within the report, a distinction is made between the two components, as appropriate.

The MAS database contains information on the scheduling and duration of all census activities and is the official entry and update point for designated Census 2000 activity data. It contains such information as start and end dates, duration, relationships to predecessor and successor activities, and critical path. After manual updates were made, MAS files were edited, at a minimum, on a weekly basis, and daily during peak operational periods.

The C&P system uses a data warehouse with an executive information system (EIS) to access and mine data. The data warehouse is updated on a frequent basis and is populated by cost and progress data extracted electronically from a variety of production feeder systems, including the MAS. The reports generated from the data warehouse provide information on the cost of data collection, data capture, data processing, and progress of major Census 2000 operations.

For the 1990 Census, a cost and progress system was used to track decennial activities and expenditures. The system was slow and cumbersome and very labor intensive. It was determined that a less complex and more automated system should be planned for Census 2000. By 1998, a new system, the MIS 2000, was in place for testing in the Census 2000 Dress Rehearsal. Sufficient data were available, so reports could be tested. The system was modular, and therefore extensible. That is, as new operations were incorporated, a new release of reports could easily be created. The dress rehearsal provided an opportunity to thoroughly test the system with a small workload. In Census 2000, the system provided a wide range of data

reports.

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. No contractors were interviewed for this study.

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 MIS 2000 who were interviewed by the Titan/SRD Team in September 2000, November 2001, and February 2002. Those personnel had varying levels of knowledge about the MIS 2000 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 MIS 2000, all government personnel who participated in the study are still with the Census Bureau. Contractors were used for some programming on MIS 2000; however, no contractors were interviewed for this study.

4. RESULTS

This section contains findings that relate to the effectiveness of the requirements definition process used during the development of MIS 2000. 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

Requirements gathering for MIS 2000 was conducted as two separate efforts. For the C&P component, Joint Application Development (JAD) sessions were held during late 1995 and early 1996. These were attended by subject matter experts from several divisions and offices of the Census Bureau including: Decennial Management Division (DMD), Decennial Statistical Studies

Division (DSSD), Geography Division (GEO), Technical Services Division (TSD), Field Division (FLD), and Population Division (POP). Additional JADs were conducted in 1999 to update requirements after the change in the Census 2000 design. Requirements gathering for the MAS was less formal. This was accomplished by the MAS staff under guidance of the Division Chief. A list of requirements were created to select a commercial-off-the-shelf scheduling product.

Data warehousing was a strategy chosen because of its ability to physically separate operational data from decision support data. This strategy allows users to get information they need without impacting operational systems. Cost and progress data were updated daily with summary data from feeder systems including: MAS, Operation Control System 2000 (OCS 2000), Pre-Appointment Management System/Automated Decennial Administrative Management System (PAMS/ADAMS), Decennial Master Address File (DMAF) with its updates, Decennial Management Controls (DMC), Post Response Processing Systems (PRPS), and Accuracy and Coverage Evaluation (A.C.E.) 2000 (ACE2000). This was the first time in a census where a management information system was used to extract data from other systems. This data exchange was done through direct interface.

4.2 Requirements issues

4.2.1 Definitions of system variables differ

The C&P component of MIS 2000 gathers and integrates data from feeder systems that support various programs internal and external to the Census 2000 operating environment. Requirements for each of these feeder systems were developed independently. Because standard terminology for census systems does not currently exist, data variables were defined differently from one feeder system to another. Also, changes being made to feeder system variables were not always communicated to C&P programmers. These issues greatly complicated the task of interfacing MIS 2000 with other systems. For example, during the development of PAMS/ADAMS and OCS 2000 systems, modifications were made that impacted MIS 2000 data. MIS 2000 personnel were notified about these modifications from the PAMS/ADAMS team but not from the OCS 2000 team.

4.2.2 Formal training programs were developed

The C&P and MAS components of MIS 2000 had formal training programs. In addition, there were two quick reference guides developed - one for each system - and contained in one red binder. These documents provided summaries of each system's key features. The training program for the MAS component of MIS 2000 was designed, developed, and administered by two experienced trainers. Trainers attended classes sponsored by the software vendors then tailored the material to contain customized features and examples specific to the Census Bureau. There were several training issues confronting system users including an understanding of the following: census operations, project management concepts, Windows technology, and P3 software. Separate training sessions were also developed for general and power users. The trainers perceived that training was not well attended because of lack of management support.

The software contains a lot of features and is not easy to use without training. The MAS software needed to be used frequently to gain proficiency. Pert charts seemed to be the most difficult feature to get people to use.

There were two aspects to the training program for the C&P component of MIS 2000: training for the development staff and training for application users. Some interviewees perceived that the training for those involved in report development was provided too late in the process, insufficient in scope, and sometimes difficult to understand. The training for the application users was undertaken by DMD staff and was considered sufficient. The training was more complex than MAS training due to the number and types of features available in the software.

4.2.3 Graphical view capability added to the MAS

The addition of a Pert chart to the MAS helped the scheduling process to occur faster. Once users learned how to use the Pert chart, it became the favored method for adding activities to the MAS. The Pert chart provided a visual representation of the tasks that comprised the MAS. Participants were now able to visually see critical paths and therefore gain a better understanding of the impact that schedule changes had on the entire operation of the census. When the Supreme Court instituted a change from sampling to full census, major rescheduling issues occurred. Use of the Pert chart was key in helping to resolve these issues.

4.2.4 Setting the schedule was a challenge

Task management and scheduling methodology were two time-consuming challenges that occurred with regard to maintaining the MAS. To coordinate MAS schedule changes and resolve scheduling issues, scheduling development sessions, also known as lock-ups**,** were instituted. During these sessions a large automated Pert chart was displayed for managers to facilitate discussions and change related impacts. Printouts of schedules were also distributed at the beginning of each session. Changes as a result of the lock-ups were distributed the next day. The lock-up sessions began prior to dress rehearsal and involved key managers responsible for making decisions concerning the scheduling and relationship of decennial activities. The sessions were often lengthy, participants were not always prepared, and replacement staff who attended were not always authorized to make decisions. Some attendees thought the lock-up sessions were burdensome, because they required a significant time commitment and did not always address scheduled topics. The scheduling methodology for the MAS was based on activity durations and logical dependencies; however, this concept was not understood by all participants of the lock-up sessions.

4.3 Alignment with business processes

This section contains the findings that relate to how well the MIS 2000 system supported the specific business processes that were associated with Census Bureau goals.

4.3.1 System designed for integrity, accessibility, and availability

The C&P component of MIS 2000 incorporated architectural concepts that were appropriate for its functions and usage. The system's hardware platform was well sized. The planned capacity was three terabytes; it currently uses one terabyte. To protect the integrity of the data, clients are permitted to access the data warehouse server on a read-only basis. This access method also allows for faster throughput because resource intensive activity is performed by the client rather than the data warehouse server. The user has the ability to create data extracts to download for analysis. Data can also be exported to an Excel spreadsheet.

4.3.2 Appropriate level of system security was in place

Much of the information produced and distributed by MIS 2000 was available to anyone with an account, or by request for a hard copy report. Appropriate security controls were put in place to provide adequate protection of information. Access restrictions were implemented for users, as appropriate. Each user was assigned an individual user name and password as a means of authentication. There were no problems reported in connection with unauthorized use of the system. System security proved to be adequate.

4.3.3 Information tailored to a variety of users

The MIS 2000 system as a whole was tasked to perform many functions such as: monitor projects, resources and costs; generate cost and resource estimates; project year end surpluses and deficits; evaluate census design, operations, and quality; target promotion activities to specific geographic areas; and provide information to external users. Users of MIS 2000 included executive staff, program managers, analysts, operations staff, external users and system support staff. The Census Monitoring Board had access to the C&P component of the system.

4.3.4 Scope of business analysis tool unclear

The MAS component showed scheduling information in various levels of detail. Managers were able to identify issues and activities with the potential to impact the project schedule. The C&P component of MIS 2000 allowed users to quickly identify trends using drill down analysis. Users had the ability to start by viewing summary data at the national level then view data in progressively finer detail. Although MIS 2000 proved to be a useful tool for determining high level cause and effect relationships with regard to the operation of Census 2000, several interviewees and some senior management indicated that they continued to rely on their own control systems and scheduling tools. Some users of the system indicated that the scope and purpose of the system was never clearly defined; i.e., was the system designed to provide high level management information or detailed operational data? The C&P component contained both. It does not appear that a clear vision existed for the system. The basic requirements as to what data were needed to monitor programs, and at what level, were not adequately addressed.

4.3.5 Multiple formats were available for information delivery

MIS 2000 has the ability to deliver information to users in a manner appropriate for their needs. Information output can be viewed in a variety of formats including graphs, charts and reports. For the C&P component, each field in a report included "help definitions" to explain data variables. Right-clicking on a field in the report displays all the data used to build the report. This feature was available in all the canned reports. Users were involved in the design of reports. As a result, only a few problems regarding reports were reported during production. Production of ad-hoc reports was more complex and required more training. The ad-hoc reporting component was intuitive once a user knew how to employ the appropriate software tools and understand the structure of the warehouse. Tables were logically named; however, the user needed to know what the acronyms stood for in order to use the tables. For the MAS component, activity and scheduling information was displayed in various graphic and tabular formats. This enabled users to assess the duration and linkage of activities.

4.3.6 Internal software selection process used for the MAS

MIS 2000 employed two major software packages in its development and use. The C&P component of MIS 2000 was developed using SAS; a proven technology widely used throughout the Census Bureau. The platform for MAS was P3. The MAS component required the use of a robust, enterprise level software scheduling package. To satisfy this requirement the MAS development team considered many scheduling software packages. The Census Bureau's standard scheduling software package, which is designed to be used primarily on a personal computer, was not used because it was lacking the multi-user capability and the schedule capacity needed to support an operation of the magnitude of Census 2000. The team determined and documented requirements. Comparisons were made based on preselected criteria such as multi-user capability, depth of scheduling, and scalability. Product research was performed including consultation of industry magazines. The top four packages were selected for further consideration. Trial copies and demonstrations were obtained for each of these packages. Final selection of P3 was based on performance and cost factors.

4.3.7 Extensive testing validated system requirements

Testing for C&P was performed in stages and as a result was considered comprehensive. This testing was guided by formal test plans that were developed for both internal and beta testing. In addition to the unit testing conducted by developers, an independent internal tester who had participated in the JAD sessions was assigned to conduct alpha testing. Knowledge of the system requirements gained from being involved in the JAD sessions allowed the tester to assess whether the intent of each requirement was being expressed in the actual software. The tester communicated with users and incorporated their comments, which improved the overall functionality of the system. Once internal testing was completed, the development team was highly confident that programs would work properly and forwarded the C&P software to the Beta Test Site. The Beta Test Site tested the software before distributing it to the regions. Since feeder systems were rarely able to provide test data, mock-up data were used. Therefore, some problems were discovered only after live data became available. The MAS component of MIS 2000 was tested when upgrades were installed.

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, especially in the case of a completely new system, 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 Schedule updates often not received in time

The MAS component of MIS 2000 had the formidable task of tracking over 5,600 activities for Census 2000. To keep the MAS current, activities needed to be updated by participating divisions and offices on a weekly basis. Activity information was delivered to each office to be updated. Paper reports were distributed because some of the management did not use the system. These paper reports were to be updated and sent back to the MAS team who performed updates to the database. Updates were often not submitted on time to the MAS update team, at times due to employee absences or unavailability of trained or knowledgeable program staff. As a result, current information related to activity status was not always available as needed because the process of updating the schedule was not effectively implemented.

4.4.2 More senior management involvement needed during requirements gathering

Development of an enterprise management system of the magnitude and criticality needed to manage the census requires considerable senior management involvement. This involvement is especially needed during the requirement gathering process, including participation in JAD sessions. During the requirements gathering process, the requirements development team requested feedback on requirement documents that were produced. However, it was difficult getting management support in order to focus on the entire set of MIS 2000 requirements. Management focus did not come about until the latter stages of development. There seemed to be a lack of understanding on the part of the senior management of what was involved in developing a system like MIS 2000. A senior management participant with a high level view of the requirements across applications would have been beneficial since bureau/department guidance for requirements gathering was lacking. MIS 2000 could have been more robust, if management provided timely feedback during the requirements process.

4.4.3 Reporting requirements impact feeder systems

Some interviewees, including those involved with feeder systems OCS 2000 and PAMS/ADAMS, indicated that because MIS 2000 failed to produce some reports, users needed to rely on feeder systems to retrieve information. This often was due to receiving requirements for these reports too late in the development cycle. This placed unanticipated reporting requirements on the feeder systems when the original intent was that MIS 2000 would provide this capability. As a result, the reporting process did not always meet user needs and created an additional burden on the development teams to satisfy reporting requirements.

4.4.4 Some report content was difficult to interpret

For the C&P component of MIS 2000, it was a widespread perception that some of the information in the reports was not clearly understood. It appears that a lack of standardization between systems such as OCS 2000 and the C&P component created problems in interpreting information in the reports. Some terminology and data element definitions (e.g., what is completed work?) were different between systems and reports containing aggregated data often reflected different snapshots in time. These inconsistencies caused misunderstandings among program managers, senior management, and oversight organizations and resulted in extensive time and resources spent to resolve differences.

4.4.5 Some technical limitations in the MAS

Some interviewees noted limitations in the MAS component. For example, the ability to conduct what-if analyses for the purpose of determining the impacts of possible schedule changes on other decennial activities was not sufficiently robust. This created limitations in accurately modeling the census. It is unclear whether the limitations were a result of missing software functionality, lack of training, or advanced features that were disabled for some user types.

4.5 Contract management practices

Use of contractors in the development of MIS 2000 was limited to the hiring of contract programmers. There was a delay in engaging contractors due to budget issues. As a result contract programmers were hired late in the development process, and the need for experienced personnel was therefore critical due to the short learning curve. The contractor's project manager lacked knowledge in data warehousing and SAS and therefore did not initially understand technical requirements. This contributed to additional delays in acquiring programmers with the appropriate expertise. Several iterations occurred before the right people were brought on board. Personnel screening eventually improved. After several false starts, a good working relationship developed between contractor and Census Bureau personnel.

5. RECOMMENDATIONS

This section synthesizes the findings from above and highlights opportunities for improvement that may apply to Census Bureau's future system development activities. The recommendations reflect insights from 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 Management focus - increase senior management commitment.

The requirements for the MIS 2000, in particular the C&P component, were developed very late in the decennial cycle. There were three areas that could have benefitted from greater senior management support: the requirements process, scheduling process, and training program.

Insufficient attention was given to requirements by management until late in the requirements process. The requirements phase should have adequately defined the scope and purpose of the system and management should have communicated this information to all stakeholders. In addition, there was a lack of staff continuity between the planning and development stages. The training program experienced a high number of no-shows. Lock-up sessions often were not attended or managers sent subordinate staff who did not have sufficient authority to make needed decisions. Some participants of the lock-ups were not sufficiently trained nor prepared. On the other hand, some attendees thought the lock-up sessions were burdensome, because they required a significant time commitment and did not always address scheduled topics.

Recommendation: Each phase of a system's life-cycle is critical to the success of the mission that the system supports. High level management focus is needed to ensure there are sufficient resources applied to the task. Requirements and development efforts must be initiated early in the decennial cycle and must include a full assessment of system scope, business processes associated with the system, and coordination among development teams. These actions will help avoid the creation of stovepipe systems that inhibit the successful exchange of data. Senior management needs to set specific expectations about what needs to be accomplished, engage the right people to do the job, and ensure the continuity and participation of personnel on each task. Increased involvement of managers in the requirements definition and planning phases of the system most likely would have diminished the need for the often frustrating lock-up sessions.

5.2 Feeder system requirements - increase coordination.

There were several Census 2000 systems that were in the process of being developed in parallel with MIS 2000. Some of these systems produced data to be used by the C&P component. These feeder systems were produced independently, using varying definitions for data elements, which were not always shared between program offices. Also, some MIS 2000 reports that were based on input from feeder systems were not always able to produce sufficient management level information. This placed an unanticipated reporting burden on the feeder systems.

Recommendation: Executive information systems such as MIS 2000 collect and aggregate data from multiple sources. For reliable results produced in an efficient manner data elements should be harmonized (e.g., standardize global data element definitions) between feeder systems or a mass conversion effort will be required. In addition, timeliness and synchronization of the data is critical to ensure currency and consistency across data products. More efficient and accurate results can be obtained if key individuals from all integrated systems participate in the development life-cycle including telecommunication and field personnel. It is recommended that frequent communication be maintained between developers of all systems that are involved in sharing data and that more emphasis be placed on defining and coordinating reporting requirements.

5.3 Technical support staffing - provide sufficient resources.

Both components of the MIS 2000 system required a high level of expertise to maintain. This in conjunction with the rapid pace of system development produced a need for an experienced

support staff. For the MAS component, two experts were hired to develop, deploy, and maintain the system, as well as design a training program. Due to lack of sufficient technical support these individuals also had to attend technical software classes and participate in user groups. There were many technical issues that had to be addressed which consumed a great deal of their time to resolve. The internal technical support organization was not able to support MAS because P3 was not a Census Bureau standard. A major software upgrade had to be performed during the development phase, which also impacted training. PCs that were used for training had to be configured and set up by trainers rather than a technical support staff. Many hours were spent to accomplish their tasks. For the C&P component there were no critical technical support issues: however, some interviewees indicated there was minimal SAS support provided.

Recommendation: An experienced staff needs to be engaged during the requirements phase and dedicated to handling technical matters with internal support organizations to minimize the amount and complexity of technical issues that must be addressed. Training issues can also be minimized with this approach. It is recommended that the Census Bureau address the need for on-going technical support during the requirements development process by ensuring that adequate resources are available. An extensive reliance on a small number of individuals, although cost-effective and expedient, may introduce risk to the development process. Planning for development efforts should include the designation of back-up personnel for critical positions and cross-training of team members.

5.4 Project management - promote project management practices.

Knowledge of project management is needed by participants from all divisions and offices involved with the operation of a census. To make MIS 2000 a truly successful system, there is a need to ensure that senior management participants promote project management practices. Those who were trained became familiar with the science of project management and more proficient in scheduling activities.

Recommendation: Census Bureau management should continue to promote project management practices to include methodologies, schedule development, and the selection and use of project management tools. These practices would promote a more systematic approach to project management and facilitate better assignment and control of resources. At the time that the MIS 2000 system was developed, the Census Bureau had not yet fully implemented project management. Since then, the Census Bureau has made it a matter of policy to inform and promote project management practices. It is recommended that project management be fully integrated in all future system development programs.

References

Census 2000 Systems Architecture, Version 2.0, September 2000.
Section 9, pages 9-1 to 9-12.

Draft MIS 2000 Data Requirements Document, Chapter 1 - 3, January 18, 2001.

Master Activity Schedule User Guide, December 14, 2000. Author(s): Joanne Bluhm.

MIS Product Samples:

- Master Activity Schedule
- Master Activity Schedule Report Filter Options
- Work Breakdown Structure
- Various MIS Reports
- Statusing Messages, prepared by Technologies Management Office

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