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DECENNIAL CENSUS

Automation of the Geographic Support System

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The Honorable Mervyn M. Dymally
Chairman, Subcommittee on Census
and Population
Committee on Post Office and Civil Service

The Honorable Constance A. Morella
Ranking Minority Member
Subcommittee on Census and Population
Committee on Post Office and Civil Service
House of Representatives

This briefing report responds to your predecessors' March 18, 1985, letter and our subsequent discussions with their offices requesting that we evaluate the Census Bureau's planning activities for the 1990 Decennial Census and that we pay special attention to the Bureau's automation activities. In response to the request, we previously provided the subcommittee a briefing report on the Decennial Census: Status of Plans to Computerize Questionnaire Data (GAO/GGD-86-76BR, May 1986).

This report focuses on the Bureau's efforts to automate its geographic support system. Such a system is important to a decennial census in that it provides the Bureau with tools, such as maps, for collecting the census data and accurately assigning population tabulations to the proper locations. For the 1990 Decennial Census, the Bureau is developing a geographic support system which relies on computer-assisted procedures. If successful, the system would eliminate many of the problems that have occurred in prior censuses, including illegible, late, and outdated maps, as well as inconsistent data in geographic files. The geographic support problems experienced in the 1980 census and the Bureau's approach to avoiding similar problems are discussed further in appendix I.

Overall, we found that the Census Bureau is experiencing problems that could jeopardize successful completion of an automated geographic support system in time for the 1990 Decennial Census. The Bureau now anticipates increased costs to complete the system and despite efforts to maintain its schedule, the Bureau continues to experience project delays. As discussed in appendix II, the Bureau is behind schedule for several reasons, including procurement problems and

underestimation of the project's complexity. For example, because the Bureau underestimated the complexity of the project, a fully operational computer software program needed to divide computer files into county segments was about 13 months behind schedule as of January 1987.

Because building of computer data files is sequential, delays in one task will affect the remaining tasks. Continuation of these delays could affect the timely preparation of maps used for canvassing suburban and rural areas to obtain address lists for those areas, the first major field activity of the 1990 census. The delay in providing maps for canvassing was one of the problems in the 1980 census to be remedied by the automated system.

In the Fall of 1986, the Bureau estimated the maximum potential cost of developing and using the geographic support system to be $371 million, 91 percent higher than forecasted in 1982. The Bureau attributes the increase to underestimating resources and the need for additional system features. One major factor is the unexpected increased use of computer time. In an austere budget environment, there may not be enough money for projects whose costs are escalating. This could affect the completion and/or quality of the Bureau's system. The estimated cost increases are discussed further in appendix III.

Although there are numerous technical considerations in successfully developing the planned geographic support system, outside experts believe the greatest risks to the system are related to project management. The Bureau is taking some steps to enhance its ability to manage the development of the system. For example, the Bureau has directed that more current and accurate information on the system's status be gathered to enable it to recognize and address problems early. As discussed in appendix IV, the data in the Bureau's information system are outdated and the system was not designed to monitor the progress of computer software development, a critical element in completing the system on time.

The Bureau also is planning to take some other management actions, such as preparing contingency plans. The timing and quality of such management actions will be a deciding factor in completing a successful automated geographic support system for the 1990 census.

The development of the automated geographic support system is important to the 1990 census and will require close monitoring. However, oversight by the Department of Commerce, Office of Management and Budget (OMB), and Congress can be hampered by the

lack of sufficient information in the Bureau's formal budget submissions. Most of the cost for the system is not identified in the submissions, although Bureau officials say they are prepared in accordance with congressional and Commerce Department guidelines.

OBJECTIVES, SCOPE, AND METHODOLOGY

Our objectives in reviewing the Bureau's development of its automated geographic support system were to determine (1) the total estimated cost for building and operating the system, (2) whether the development was on schedule, and (3) whether the Bureau's management procedures were adequate to ensure the completion of a timely and cost efficient system.

Our report is based on: our analysis of progress reports, Bureau correspondence, and plans; interviews with Bureau, U.S. Geological Survey, Department of Commerce, and OMB officials; review of evaluation reports prepared by independent experts; analysis of cost reports; observation of operations in the Bureau's Jeffersonville, Indiana facility and at its headquarters in Suitland, Maryland; examination of Bureau evaluations of the 1980 census; and our prior work on the 1980 census.

Our review of cost estimates was limited to comparing overall totals of the 1982 and current estimate and the various features in each. The Bureau could not provide detailed cost information to support its 1982 estimate. Also, the Bureau did not provide us with the detailed composition of its Fall 1986 cost estimate because its fiscal year 1988 budget request had not been submitted to the Congress. To meet the subcommittee's requested reporting date, we were unable to review the details on the Bureau's latest estimate after the detailed budget was released to the Congress in February. Our work, except for the limitations cited above, was conducted in accordance with generally accepted government auditing standards. Our audit work was primarily performed between June 1986 and early January 1987.

AGENCY COMMENTS

On March 25, 1987, we obtained official oral comments from the Bureau. Bureau officials remarked on the difficulty of estimating the time and money needed to develop and use a complex automation system. They offered a number of suggestions to correct technical details and otherwise clarify the information presented. We incorporated the Bureau's suggestions, where appropriate, in preparing the final report.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time we will send copies to the Senate Subcommittee on Federal Services, Post Office and Civil Service; other appropriate congressional committees; the Secretary of Commerce; and the Director, Office of Management and Budget. Copies will be made available to other parties upon request.

If you have any questions about this report, please call me on 275-8387.

Gene L. Dodaro
Associate Director

Contents

ABBREVIATIONS

CPU	Central Processing Unit
GBF/DIME	Geographic Base File/Dual Independent Map Encoding File
OMB	Office of Management and Budget
TIGER	Topologically Integrated Geographic Encoding and Referencing (System)
USGS	U.S. Geological Survey

GEOGRAPHIC SUPPORT AND THE DECENNIAL CENSUS

GEOGRAPHIC SUPPORT SYSTEM'S IMPORTANCE TO THE DECENNIAL CENSUS

Decennial census results are important to the Nation during the ensuing decade. The results are used to apportion seats in the House of Representatives, realign congressional districts, distribute billions of federal dollars annually, and assist government and businesses in managing their operations.

The successful planning and execution of census activities depends on the Bureau's geographic support system which provides maps and files that locate street addresses and political and statistical boundaries. Decennial census data are meaningless unless they can be collected, identified, and tabulated for specific locations. The geographic support system is designed to specifically support these crucial decennial census activities.

The Bureau's geographic support system consists of three major parts: maps, address reference files, and master reference files. Maps graphically display physical and artificial features, such as streets, railroads, streams, and statistical boundaries. Census employees use these maps to follow up on unreturned questionnaires and to distribute and collect questionnaires where personal interviews are conducted. For the 1980 census, about 1,300 Bureau and contractor personnel manually completed over 32,000 map sheets. These maps were copied and divided into over 300,000 individual assignment maps. The Bureau estimated that it spent over $78 million on maps for the 1980 census.

Address reference files contain data on urban streets and the address range numbers for these streets. They allow the automated matching of specific urban addresses to specific geographic areas to facilitate the collection and tabulation of census data. In 1980 these files were called the geographic base file/dual independent map encoding file (GBF/DIME) and consisted of 278 major urban areas. Though it accounted for only 1.5 percent of the Nation's land, GBF/DIME covered about 60 percent of the housing units.

Master reference files contain a catalogue of all geographic and political areas. The files show the relationships between the lowest level geographic areas (blocks) and all other geographic areas (cities, counties, congressional districts, and

states) for which data are gathered, tabulated, and published.

In order to tabulate census results in a timely and precise manner, these three geographic support parts must contain consistent and accurate information.

PROBLEMS WITH GEOGRAPHIC SUPPORT IN THE 1980 DECENNIAL CENSUS

According to a Census Bureau study group, the geographic support problems experienced in the 1980 Decennial Census were more costly to correct and produced more errors than any other category of problems. Errors in and inconsistencies between the geographic support components were said to have caused delays in the collection, tabulation, and publication of data, and to have increased the cost of the census.

The Bureau began its map-making effort several years prior to 1980 to ensure timely maps for the census. However, maps needed for a major pre-census operation, the canvassing of suburban and rural areas to develop an address list (prelisting), were about 4 months late. To hasten distribution, most of the maps were sent to the field for the prelisting operation without being reviewed for accuracy.

The maps had a variety of deficiencies. For example, census boundaries could not be distinguished from other boundaries and boundaries ending on the border of one map sheet did not continue at the same place on the continuation sheet. Maps also had features and political boundaries that were as much as 2 to 3 years out-of-date. In addition, maps were often illegible, had indistinguishable features, or were of insufficient size for the census activities. These problems led Bureau field staff to (1) distrust the maps, (2) purchase and rely on commercial maps, (3) wander outside assigned areas, (4) miscode information, and (5) perform unnecessary work. In addition, the Bureau had to make about 37,000 changes to the out-of-date maps in order to publish 1980 census results.

Inconsistencies among the information contained in the three parts of the geographic support system also raised doubts with local officials about census accuracy and created tabulating problems. Maps, address reference files, and the master reference files sometimes differed on the contents of census blocks and the location of blocks. Clerks had to transcribe 2.5 million block numbers from maps to the master reference files before the maps were sent to the field. The Bureau estimated that as many as 50,000 block numbers were inconsistently transcribed in that process. The field staff spent hours

resolving the inconsistencies. In addition, local officials sometimes noticed census blocks misplaced on maps, errors which would have affected the accuracy of area counts.

Bureau studies concluded that the independent creation and separate updating of the three geographic support parts were responsible for many of the problems experienced with the 1980 census. Because each part was compiled independently using labor-intensive and error-prone manual operations, each differed from the others and none of the three was completely accurate. Although the Bureau's field staff added new features, such as streets, to their maps during the data collection phase, the other parts of the geographic support system were not updated to include this information until much later in the census process. According to the Bureau, resolving the types of problems discussed above added about $34 million to the cost of the 1980 census.

THE CENSUS BUREAU'S APPROACH TO AVOIDING FUTURE GEOGRAPHIC SUPPORT PROBLEMS

In 1981 the Bureau's Geography Division established a planning committee that reviewed the problems experienced during the 1980 census and recommended ways to improve geographic support for future censuses. The committee recommended that (1) the automated GBF/DIME file be updated and expanded to include more of the urban areas and (2) a manual system should continue to be used for rural areas because the committee believed that implementation of an automated system for the entire country for the 1990 census would be not be feasible.

The Geography Division's plan in the Fall of 1981 stated that the long-term goal of the automated system of geographic support services would be to complete automating the Bureau's geographic files for the entire country for the 2000 Decennial Census. The Bureau's initial 1983 budget submission to the Department of Commerce for the new system was rejected because it lacked sufficient justification. For its 1984 budget submission, the Bureau reassessed its position and proposed a plan for automating the entire country for the 1990 Decennial Census.

The Bureau's planned geographic support system features a single automated computer file which would integrate all three parts of the system for 1990. The computerized file is part of the Topologically Integrated Geographic Encoding and Referencing (TIGER) System. The proposed TIGER System would contain all roads, rivers, railroads, census-required map positions, feature names, address ranges, and class codes. The system would also contain boundary positions for areas used in data collecting,

processing, and tabulating operations. According to the Bureau's early plans, TIGER, when fully operational, would provide timely, properly sized, and high-quality maps; quickly assign residential and business addresses to the correct geographic locations; consistently preassign census block numbers for collection and tabulation; and maintain consistent data in all three parts of the geographic support system.

The Bureau's original planning assumed that TIGER would be developed in-house. However, it subsequently entered into an agreement with the U.S. Geological Survey (USGS) in which USGS agreed to convert its maps of the Nation to computer-readable form and provide them to the Bureau for conversion to the TIGER system. USGS estimates that these efforts will cost about $36 million. In return, the Bureau agreed to enter the classification of the roads by type (road tagging) in the geographic file and provide the USGS with a copy of the new file. Bureau Geography Division officials believe that the Bureau's assistance to USGS is equal in value to the USGS' efforts and that this arrangement should provide both agencies with a computerized mapping system sooner than if either had worked independently to develop such a system.

PROJECT DELAYS

The Bureau has experienced continuing delays in developing the TIGER system despite actions taken to maintain its schedule. The Bureau is behind schedule for a number of reasons, including start-up delays associated with procurement problems and underestimation of the project's complexity.

START-UP PROBLEMS

The delay in the procurement of the first computer work stations, needed to begin building the automated files, amounted to about 18 months from late June 1982 to December 1983. According to Bureau officials, the delay occurred because inadequate documentation was initially submitted to the Department of Commerce and because the procurement process took longer than expected.

In an attempt to make up for these delays, the Bureau purchased an additional 40 computer work stations at a cost of about $2.2 million. The Bureau also increased the number of work shifts in some locations to complete portions of the file building tasks. However, the program continued to experience problems because the computer work stations were installed in crowded workspace without adequate air conditioning. Space and air conditioning limitations caused the computer equipment to overheat and shut down. These problems were eventually corrected.

UNDERESTIMATION OF PROJECT TASKS

In addition to start-up problems, the Bureau underestimated the amount of time and resources necessary to complete file building. According to Bureau officials, file building is the only portion of the TIGER system development for which the Bureau has maintained current status information. As of January 3, 1987, 9 of the 10 file building activities were from 2 to 17 weeks behind schedule. (See Table II.1.) The other file building activity was about one week ahead of schedule.

Table II.1:

File Building Activities Behind Schedule

Number of file building activities	Weeks behind schedule
1	2
1	3
3	5
2	8
1	12
1	17
Total 9	

Schedule lags have continued for the past year despite the Bureau's efforts to eliminate the slippage.

For example, the Bureau found that road tagging, the process of entering the classification of roads by type, one of the initial file building activities, was much more demanding than originally estimated. The following table compares the Bureau's 1984 and 1986 plans for tagging 1,512 map files.

Table II.2:

Comparison of Selected 1984 and 1986 Road Tagging Work Requirements (in hours)

	1984 plan	1986 plan
Map preparation	30,240	48,384
Computer work station	60,480	120,960
Quality control	0 [a]	60,480
Total	90,720	229,824

[a] No estimate was included for this procedure.

Computer processing is another area taking much more time than originally estimated. For example, the Bureau believed that

creating the initial map data base would take one hour of central processing unit (CPU) time for each file. This process has actually averaged about 5 hours of CPU time. Because the Bureau has to prepare 2,007 files, this represents an increase of 8,028 hours of CPU time.

The Bureau has also experienced computer software development delays which are currently affecting the file building schedule. Bureau officials believe that overall software development is 6 months behind schedule. For one project, county partitions (the process of dividing USGS-provided maps into county sections), the Bureau was 13 months behind schedule.

The Bureau originally planned to complete the software needed to reformat USGS maps to county partitions by December 1985. However, the Bureau revised its schedule to December 1986. The Chief of the Geography Division acknowledged that as of January 1987, software problems had not been overcome though he expected them to be resolved in the Spring of 1987. The Bureau argues that its original milestone was actually missed by only 4 months as it had developed software to perform the reformatting by April 1986 for a pretest. However, it also acknowledged that the software was inefficient and would not be used for production activity. As of March 1987, the Bureau was still refining the software.

The Bureau had planned to begin making the county maps by January 1986. As of January 3, 1987, none of the 3,233 maps was satisfactorily completed. The Bureau had planned to complete 527 files, needed to prepare the maps, by the January 3 date. The Bureau's expected production was 31 files per week. At that rate it would take about 17 weeks just to complete the backlog.

Since the file building process is sequential, delays in earlier tasks will affect the schedule of the remaining tasks. Significant delays could affect the availability of the maps needed by the Bureau for canvassing suburban and rural areas to develop address lists for those areas (prelisting) in preparation for the 1990 Decennial Census.

The Bureau has taken several actions to deal with the computer usage and software development problems. In an effort to expedite TIGER development, the Bureau transferred 14 programmers from other divisions, hired 9 new programmers, and assigned TIGER processing to a recently acquired mainframe computer with about twice the capacity of the computer it had planned to use. The Bureau also considered obtaining assistance

from commercial firms in completing the software development and prepared a proposal to do this.

At least one task, conflation, was deleted from the system because of time and funding constraints. It was not part of the original plan, but was subsequently believed desirable to improve the map quality. Conflation is the process of merging the precise road and river positions from the TIGER file with 1980 GBF/DIME computer map files covering major metropolitan areas. The Bureau considered this merger desirable because it would (1) improve the accuracy of the maps used by the Bureau employees for such tasks as canvassing areas to develop address lists and follow up on questionnaires not returned in the mail and (2) improve the appearance of the Bureau's maps, which is especially desirable for publication. According to Bureau officials, without conflation the graphic quality of the 1990 publication maps will not be of the same quality as the 1980 hand-drawn maps for major metropolitan areas.

ESTIMATED PROJECT COST HAS INCREASED

In 1982 the Bureau forecasted that the system would cost $194.5 million or about $5 million less than the cost of re-using the 1980 geographic support system process. At our request, the Bureau provided a more current estimate that showed the maximum potential system cost has risen to $371.1 million. The Bureau attributed the increase to such factors as rescheduling and re-estimating, and to the net effect of the addition and deletion of features, as illustrated below:

Table III.1:

Comparison of the 1982 and 1986 Cost Estimates for the Geographic Support System
(in millions)

1982 cost estimate		$ 194.5
Increases		
Re-estimating and rescheduling originally planned work and other changes	$ 74.3	
Net increased cost of items/ tasks added or deleted	102.3	176.6
Bureau cost estimate (as of October 31, 1986)		$ 371.1

Our review of the Bureau's cost estimates was limited. Bureau officials advised that they did not have detailed information to support the original estimate. Also, officials did not provide us with the composition of the most recent estimate because the Bureau's fiscal year 1988 budget request had not been officially submitted to Congress. Our audit work was completed before the release of the budget. For the reasons cited above, we were not able to precisely determine what caused the estimated costs of the geographic support system to increase.

Bureau officials pointed out differences between the system envisioned by the 1982 estimate and that envisioned by the more recent estimate. According to Bureau officials, one of the major factors contributing to the change in the estimated cost for the system is the increased use of computer time. For example, the Bureau had planned to process both TIGER and the economic and agricultural censuses on one of its mainframe computers. Instead, the Bureau had to use a newly acquired mainframe computer with significantly greater capacity than its other computers for TIGER alone.

Also, Bureau documents showed a net increase of about $102 million for items added to the original plan, although some of these were recognized as being needed when the original plan was prepared. For example, items added included preparing materials for the 1986 and 1987 test censuses and for the 1988 dress rehearsal. Bureau officials said that they recognized that materials for tests would be needed, but they did not know how much. As a result, nothing was included in the original estimate for these activities.

FACTORS WHICH WILL AFFECT FINAL SYSTEM COST

Several factors will affect the ultimate cost of the geographic support system. These include the (1) specific features to be included, (2) method used to distribute computer costs, (3) availability of funding, and (4) the Bureau's ability to complete the system as planned.

Specific features

The final determination of the specific features to be included in the system for the 1990 Decennial Census has not been made. The Bureau has acknowledged that many features are "still under active debate." One feature that has already been deleted from the original plan is an address control file which would have provided a continuing inventory of current addresses on the TIGER System. It was excluded because of the Bureau's concern that the address control file might be jeopardized by relying on a developing system (TIGER). Instead of that planned feature, the Bureau will maintain a separate address control file. Information in that file would be used to update the TIGER file by using a computer linkage. However, one of the major geographic problems in the 1980 census, inconsistencies between data products and maps, resulted from updating separate files at different times. Bureau officials believe that the planned updating procedure will avoid having inconsistencies of that type in its files. The cost estimates we have are not of sufficient detail to assess the cost impact of this decision.

Computer costs

To distribute the operation and maintenance costs for computer usage, the Bureau developed a formula and a rate that it charges for all projects, including those for outside customers. However, the TIGER project was not charged for computer usage for about the last 4 months of fiscal year 1986. The Bureau ceased to charge TIGER when funds allocated for Geography Division's

computer usage were expended. If the Bureau's rate had been applied for computer usage during that period, TIGER would have been charged about $6 million for computer usage in fiscal year 1986, $2.1 million more than the $3.9 million actually charged to the project.

The Bureau explained that this special arrangement was adopted because of the unusually high usage of computers for TIGER. The Bureau said that if it had continued to use its established rate (which did not anticipate the high usage resulting from TIGER) it would have recovered more than its costs. The Bureau rejected another available option, lowering the rate for computer use for all customers. For 1987 the Bureau has decided to charge $6.6 million to TIGER for computer usage regardless of actual use. The 1987 charge is based on the estimated incremental costs to operate the computer center for TIGER needs, rather than on using the Bureau's normal cost allocation procedures.

The method used for charging computer use for TIGER development will have a bearing on the total costs reported for the system. According to Bureau estimates, considerably greater computer use will be needed for TIGER in future years, as shown in the following table.

Table III.2:

Estimated Central Processing Unit Hour Requirements By Fiscal Year
(hours in thousands)

	FY85[a]	FY86[a]	FY87	FY88	FY89	FY90	FY91	FY92	Total
Geography data file development	4.1	17.0	50.7	16.9					88.7
Generating products from the data base			6.1	29.4	36.5	21.1	18.1	8.6	119.8
Total central processing unit hours required	4.1	17.0	56.8	46.3	36.5	21.1	18.1	8.6	208.5

[a] Actual
Source: Census Bureau

Funding

About two-thirds of the funds needed to develop and use the geographic support system have not yet been appropriated. Through fiscal year 1987, the Bureau has spent or been allocated about $126 million of the maximum estimated TIGER costs of $371 million. The expected high cost years for the system are in the future, as shown in Table III.3.

Table III.3:

Estimated Geographic Support System Cost By Fiscal Year
(in millions)

	FY82-86	FY87	FY88	FY89	FY90	FY91	FY92	Total
Actual expenditures	$69.5							$ 69.5
Current year appropriation		$56.3						56.3
Total expended or appropriated								$125.8
Potential future year expenditures			$59.9	$61.7	$44.8	$59.6	$19.3	245.3
Totals	$69.5	$56.3	$59.9	$61.7	$44.8	$59.6	$19.3	$371.1

There is no assurance that these funds, if requested by the Bureau, will be appropriated. The deficit targets in the Balanced Budget and Emergency Deficit Control Act of 1985, P.L. 99-177, may have an influence on the amount of funds appropriated not only for the geographic support system but also for completing the census. For example, the Bureau was denied about $11.6 million of the $57.2 million included in its fiscal year 1987 budget request for data processing equipment; however, the Bureau said this cutback would not affect development of the geographic support system.

Schedule

The future progress of the TIGER system will also affect its cost. As discussed in appendix II, the Bureau has experienced significant project delays. To catch up, the Bureau may have to intensify its efforts which could translate into additional costs. As previously stated, the Bureau, in an attempt to maintain its schedule, purchased 40 additional work stations at a cost of $2.2 million. If the Bureau is unable to maintain its schedule through

increased efforts it may be forced to delete features from the system, as has already occurred with the conflation feature. Thus, the Bureau may increasingly face decisions involving cost increases and system quality levels.

MANAGEMENT IMPORTANT TO SUCCESSFUL SYSTEM COMPLETION

Two outside groups have stressed the importance of good management to the successful completion of the automated geographic support system. In 1982 an independent firm, SPAD Systems Ltd., employed by the Bureau to study its geography systems, said in its report that

> "Upon examining these systems, one point becomes immediately clear: there are just as many problems, and possibly more, on the management side of implementing a geographic information system as there are on the technical side."

A team of six outside experts, who evaluated TIGER at the Bureau's request, concluded in its 1985 report that "the greatest risks in the TIGER System are related to project management rather than technical considerations."

During our review, we noted certain management weaknesses and information limitations that could hamper efficient operations and oversight. The Bureau

- --has not established an adequate information system to monitor system status, progress, and cost;
- --does not provide complete cost data to oversight groups in its formal budgetary reporting system;
- --has not prepared contingency plans;
- --has not established an external review group as recommended by outside experts; and
- --lacked an efficient organizational structure for managing the decennial census including the development of the automated geographic support system.

The Bureau moved up its test of the system and said it is planning to undertake other management improvements, including preparing contingency plans and strengthening its information system.

INFORMATION SYSTEM

The information system used for monitoring TIGER's schedule and progress, as acknowledged by TIGER project management, has some key deficiencies. While the system provides monthly and weekly

reports, the information overall is very outdated, no explanations are shown for task slippages, and no data is provided on the status or progress of the software development effort. Bureau officials consider software development to be critical in completing the TIGER System.

The Bureau also did not maintain information to support its original cost estimate of $194.5 million. Thus, a comparison of the Bureau's latest estimate of $371.1 million, prepared at our request, and the original cost estimate will not identify the specific system features contributing to cost increases or decreases. Moreover, the Bureau did not maintain a record to reflect cost revisions for various features.

The Bureau has directed its staff to update the Geography Division's management information system and to devote more attention to keeping it current. In January 1987, the Bureau also started to implement a software monitoring system by designating a system analyst to manage the task.

BUDGETARY REPORTING

The Bureau's budget requests do not provide sufficient information to allow oversight groups, including Congress, the Office of Management and Budget (OMB), or the Department of Commerce to assess overall estimated or actual costs of the geographic support system. In the Bureau's budget submissions, system costs are included in three separate sections: (1) geographic support, which covers the data base development effort including file building; (2) decennial census, which includes the cost for specific census applications; and (3) data processing systems, which includes the cost for automated equipment.

Although system costs are identified in the geographic support and data processing systems portions of the budget, there is no specific line item or dollar amount shown for the decennial census activity which accounts for the major costs of the system. Thus, the overall estimated and actual costs for the system are not discernible. On the basis of an estimate prepared by the Bureau at our request, we were able to determine that $221.2 million, or about 60 percent, of the Bureau's latest estimate of $371.1 million for completing the system is for the decennial census activity. In fact, $187.4 million, or 76 percent, of the future costs (fiscal years 1988 through 1992) are for that activity.

The Department of Commerce, OMB, or congressional reviewers, examiners, and analysts would have difficulty determining overall estimated or actual costs for the system using budget documents only. Our discussions with OMB and Commerce budget analysts

responsible for the Census Bureau confirmed these difficulties, as they were unaware of the total estimated cost of the geographic system. One of these budget analysts, relying only on data shown in the geographic support section of the budget, believed that the system's cost had not changed substantially from the original estimate.

Bureau officials said that the budget submissions are prepared in accordance with congressional and Commerce Department guidelines. The Bureau's submissions are presented in a format that shows statistical activities and functions and does not generally specify support activities or projects. The reviewers we spoke to expressed no problem with the submission format.

CONTINGENCY PLANS

The need for contingency plans has been identified several times including during the system's initiation stage. However, as of early January 1987, no such plans had been developed. The Bureau's Geographic Operations Task Force recommended in its December 1982 report that

> "The geographic support system developed for the 1990 Decennial Census must be automated and integrated into a single system. To ensure that the 1990 census is not delayed, there must be fail-safe backup plans designed into the system which provide the capability to deliver the required set of geographic products according to the schedule if the automated system falls behind."

In September 1985, a team of outside experts submitted an evaluation report on the TIGER program focusing on managerial, technical, operational, integration, coordination, and financial concerns. The report recommended that the Bureau prepare planning documents, such as contingency plans. The Bureau's formal response was that the Geography Division would "identify alternative plans for accomplishing major TIGER System production tasks based on the assumption that the TIGER System will be successful but that specific tasks will fail or be delayed."

In November 1986, Geography Division officials told us that the Bureau's executive staff had recently directed that contingency plans and a system for monitoring and controlling software development should be implemented.

Despite these continuing calls for contingency plans, the Bureau did not start to develop such plans until January 1987. At that time it identified the areas where contingency plans are warranted, but no specific dates were set for completing the plans.

A delay in developing contingency plans could limit the Bureau's options, and possibly eliminate the effectiveness of a substitute plan.

OUTSIDE EXPERTS' RECOMMENDATIONS

In its September 1985 report, the team of outside experts made several other recommendations, some of which have been adopted and some not. For example, the team recommended and the Bureau adopted an earlier production demonstration using the TIGER System. In accordance with the recommendation, the Bureau moved the demonstration from the 1988 dress rehearsal to the 1987 pretest.

The team also recommended that the Bureau establish an external review group composed of technical experts to advise the Bureau on such matters as the adequacy of the TIGER System and project status, and make recommendations for correcting problems. The Bureau agreed with the recommendation and was considering contracting for an external review group, but as of early January 1987 had not done so. The Bureau believed there was still time to establish this group. However, as time passes, the possible remedies suggested by the group for problems will be reduced.

ORGANIZATION

During our field work, we noted that the Bureau's organizational structure for managing the development of the automated geographic support system and for planning the overall census did not lend itself to an efficient operation. The project manager for the system was the Chief of the Geography Division, who reported to the Associate Director for Field Operations. The Geography Division had direct control over file building of TIGER but not over the major cost activity, the applications of the system for decennial census activities. Control over that activity was governed by the Chief of the Decennial Planning Division, who reported to the Associate Director for Demographic Fields.

In January 1987, the Bureau implemented a major reorganization which had been proposed about a year earlier. The new organization consolidates decennial-related resources under a newly established associate director and places the Geography Division under this associate director. While it is too early to determine the effectiveness of the reorganization, Bureau officials believe that it has improved communications between the Geography and Decennial Census Divisions.

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