Systems Modernization and the Strategic Plans of the Social Security Administration

A Report Prepared by the
Committee on Review of the SSA's System Modernization Plan (SMP) and Agency Strategic Plan (ASP)
Board on Telecommunications and Computer Applications
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PREFACE

The Social Security Administration (SSA), together with the computer and communications facilities which it operates, can be characterized as huge in both absolute and relative terms. At the SSA nothing is small; little is easy to accomplish; and change comes with difficulty.

Historically the SSA followed the same automation trail as did other contemporary organizations in the 1940s—with punched paper cards and electric accounting machines (EAM) for processing. Gradually SSA migrated to digital computers to process the card-based data in batches. Then the punched card files gave way to magnetic tapes for storing data, but the processing of this information continued to be performed in batches.

In the last five to seven years the SSA has taken significant strides toward modernizing its claims process for entitlements through the application of information technology. To support taking claims electronically the agency developed new computer programs, moved its magnetic tape files onto magnetic disk, and installed about 25,000 computer terminals nationwide. While the front end of the process for taking entitlement claims has thus become technologically contemporary, the massive processing is still done on a periodic basis in batches at the National Computer Center. In no area of the SSA is automation complete. In some parts of the agency there is continuing high level of reliance on paper-based manual methods, a situation which it is advisable to remedy.

The ancestry of SSA data processing is still evident in its batch processing and in the legacy of old software that now runs on modern hardware albeit inefficiently. Some of its present practices and procedures, its present lineup of batch runs, and its present management attitudes and internal organization reflect former days and still have vestiges of past batch operations. In time the heritage will fade, but for the moment it is a fact of life when considering bringing about change in SSA's information environment or when requiring SSA to respond to externally imposed changes in policy and rules.

The policy that controls SSA derives primarily from Congress and from its parent cabinet department, the Department of Health and Human Services. Over the years various changes have been instituted by creating new programs, changing the details of others, or creating special categories of people with individualized benefits. A data processing organization might be inclined to regard such collective changes as tinkering with the requirements that the information infrastructure must meet. In a sense tinkering it is because the large overall structure will be little different, and the mandated changes are seemingly

minor adjustments. What is not visible from policy levels are the intricate and extensive consequences throughout hundreds of computer programs, millions of computer instructions, and tightly organized procedures of an information factory.

The SSA's intrinsic problem is one compounded of mammoth size, an external expectation for inherent agility to accept change, a built-in inertia that impedes change, often late-breaking changes, and all overlaid with a demand for maximum accuracy and stable operations. So far as the nation is concerned the SSA is a big information production line that must deliver checks to its clientele consistently and with certainty. Jiggling the SSA into a different posture on short notice is akin to attempting overnight retooling of an automobile production line to make cars that are seemingly changed little—just a few inches longer.

It would be a major engineering feat to design an information system from scratch to support the SSA. In a way, it borders on the remarkable that a system that has evolved to its current posture over some 30 years in the face of Congressional changes and sometimes reluctance to fund computer upgrades works as well as it does. Yet improve it must; keep up with change it must; become a contemporary information-based organization it must; and do it all with best economy and efficiency. But the SSA has not always fulfilled such expectations.

Our report examines this complicated situation. It looks at the SSA efforts to improve in recent years, and it considers future trends and desired future actions.

An effort of this kind depends on many people and the contribution of each of them is gratefully acknowledged. On the SSA side, of course, we owe much to former Commissioner Dorcas R.Hardy and to present Commissioner Gwendolyn S.King. Also crucial to our work was the intensive liaison provided by Deputy Commissioners Herbert R.Doggette, Jr. and John R.Dyer, Chief Financial Officer Norman Goldstein, the many other executives and staff of the agency who briefed us and fielded our probing insistent questions, and John Ryan (of the Commissioner's staff) who has been our point of contact.

From the National Research Council side, we were ably supported by senior staff officer Anthony M.Forte, his secretary Linda L.Joyner, and other staff individuals of the Board on Telecommunications and Computer Applications.

Willis H.Ware
Chairman

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EXECUTIVE SUMMARY

The Social Security Administration (SSA) administers a broad national program of social insurance as prescribed by legislation, which is amended and changed from time to time. To perform its mission, the SSA must rely on modern computer and physical facilities, which include a nationwide field network of more than 1,300 offices and 37 teleservice centers, an agency headquarters (in Baltimore, Maryland) that includes the National Computer Center (NCC), 3 data operations centers (DOCs) (Wilkes-Barre, Pennsylvania; Albuquerque, New Mexico; and Salinas, California), and 6 program service centers (PSCs) (New York, New York; Philadelphia, Pennsylvania; Birmingham, Alabama; Chicago, Illinois; Kansas City, Missouri; and Richmond, California).

Among other activities, the agency must issue social security numbers (SSNs), maintain correct records of earnings, receive and establish claimant applications for benefits and assemble the evidence to prove eligibility, adjudicate retirement and survivors insurance claims, determine the amounts of benefits payable, forward disability insurance claims to cooperating state agencies, provide the information necessary for each citizen to understand his or her rights and obligations under the program, certify benefit payments to the U.S. Department of the Treasury's disbursing centers, maintain beneficiary records, and collect overpayments and debts.

By any measure the SSA is a mammoth organization.

- The trust fund balance for fiscal year 1988 was $85.5 billion.
- It has about 66,000 employees.
- Over 35 million people are receiving retirement and disability benefits.
- Some 7 million new SSNs and 5 million changes to existing ones are requested each year; 327 million SSNs have been issued.
- Wage postings for 200 million people are made each year.
- Approximately 3 million new claims and 120 million changes affecting retirement and survivors disability insurance are processed each year.
- One million new claims and 9 million changes for Supplemental Security Income are processed each year.

- The NCC has 14 major mainframes that support a database of 1.3 terabytes, provide an aggregated processing capability of 453 million instructions per second (MIPS), and service (presently) 25,500 remote terminals nationwide and worldwide.
- There are 7 million transactions per day against the master database.

By the year 2000, the population over age 65 is expected to increase by 36 percent, the number of people receiving retirement and disability benefits will reach 44 million, and new claims are projected to become 5.6 million annually. This report (in three of the chapters) deals with the committee's assessment of the past, the challenges of the present, and strategies for the future.

THE PAST

The SSA and the officials and organizations that oversee its activities have not always appreciated that a continuing ongoing capital investment must be made to maintain the currency and adequacy of its information infrastructure and the computer systems and networks that implement it. The complexities of advocating, justifying, budgeting, and seeking appropriations in the federal government are a major complicating factor. Thus, the SSA has periodically found itself in a crisis situation in which its computer systems were antiquated or hopelessly overloaded and unable to support the agency's mission.

The most recent crisis occurred in 1982; the recovery plan, essentially now complete, became known as the Systems Modernization Plan (SMP). Reflecting a capital investment of $500 million, the SMP included two major changes in the SSA's operational computer environment: data were moved from 700,000 reels of magnetic tape onto direct-access on-line magnetic disk storage, and some functions were transitioned from batch style to an on-line interactive style delivered at computer terminals throughout the country. As part of such a huge effort, the SSA had to put in place a modern software development environment and modern project management methods and provide extensive training to its development and user (field) organizations.

We conclude that the major goals of the System Modernization Plan have been successfully achieved.

THE PRESENT

Because continuity in the SSA's programs is vital to the well-being of the nation, it is unreasonable that the SSA, which is more critical to the citizens of the nation than any private firm, continue to operate without significantly improved provisions for assuring continuity of service to its clients. Because the SSA depends completely upon the operation of the NCC, we recommend that:

The Social Security Administration immediately develop a workable strategy for surviving a partial or major loss at the National Computer Center.

The SSA should consider, as a minimum, alternatives for (1) a second computer center and (2) elaborating the current hot-site strategy to provide on-line support in the event of a loss of the NCC.

The SSA's current intent to use a commercial hot site provides only for processing a small subset of the normal workload in the old-style batch-only environment using backup reserve copies of the agency's master files stored offsite on magnetic tape. The present arrangement cannot support the agency's 25,500 on-line computer terminals, nor will it allow for use of the SSA's modernized claims system; it would also cut off support of the teleservice and other sites. Accordingly, under the current plan for backup and recovery, the SSA must concurrently maintain both software-based and paper-forms-based processing methods, and employees must maintain familiarity with both methods so that they can revert back to paper-based methods should the NCC go down. This will become increasingly more difficult as time goes on and the agency's automation of processes expands.

There are many forces outside the control of the SSA that drive its workload and hence its needs for more computer power and networks (e.g., population growth, changes in the law, aging of the population, shifts in life style, social changes). There are also events that the SSA can control to some extent that additionally drive the computer demand (e.g., upgrades of equipment, improvements in quality of service to clients, level of automation).

The SSA will have to become much more attentive, if not aggressive, in presenting its case to Congress for continuing infusion of capital investment in its information infrastructure and in its internal planning and managing for ongoing system expansions and upgrades.

Because the agency's workload is directly influenced by the scope and quality of services it provides to clients, the agency must recognize the additive, cumulative, and uncontrollable effects that on-demand services, such as nationwide teleservices—notably the nationwide 1–800–234–5SSA universal access phone number-and the Personal Earnings Benefit Statement (PEBES), can, and probably will, have on its workload. The SSA must carefully plan and implement all new services, with particular emphasis on assuring that adequate computer and communications capacity are available to support such new services. We recommend that:

The Social Security Administration thoroughly analyze the impact of new client-driven services or the quality upgrade of services that entail additional identified or latent on-line computer support to assure the adequacy of supporting automation.

In this regard, note that the PEBES is a new service, whereas the “area code 800” is largely a new way to package the delivery of existing and traditional services. It would be valuable to retrospectively examine each to ascertain what effect each has had. For example: How much unexpected latent demand has there been? Has there been any productivity increase in service delivery? Have there been new problems not present previously?

The SSA's ability to offer its clients appropriate services is dependent on its ability to acquire suitable, compatible, and reliable information technology, particularly computer and communications equipment. The acquisition of such technology in the federal government is

subject to lengthy internal and external reviews and to budget considerations that effectively constrain the agency's ability to respond quickly in the environment in which it operates. Because of the impact on the public, the SSA must necessarily proceed more slowly and cautiously than the private sector in providing new or expanded services. Contracts with indefinite delivery and quantity procurement terms can improve the SSA's ability to acquire needed resources in a timely manner.

The information systems crisis in 1982 was largely caused by the agency's neglect and failure to invest routinely in the upkeep of its systems. However, neglect is not the only reason that a systems crisis can occur. Overly aggressive introduction of new services or increases in service levels that are not supported by adequate personnel or system capacity can also precipitate a crisis. In order to avoid such "self-induced" crises, the SSA must have a management process that will ensure that a crisis does not occur. We recommend that:

The Social Security Administration adopt management processes of strict analysis and control to avoid the recurrence of an information systems crisis.

For example, it may prove to be that on-line computer support for the recently installed 25,500 computer terminals is inadequate, perhaps as a result of the SSA's having only early experience functioning in a terminal environment. Problems can also be caused by a release of unperceived latent user demand. To deal with changes in demand, the agency must: (1) thoroughly forecast and justify expansion and upgrade of the existing information systems infrastructure on a continuing basis, (2) quantify and define in advance the specific performance goals to be provided its clients, (3) measure and monitor actual performance, and (4) plan for the orderly introduction of new services consistent with available personnel and budgetary resources.

The following specific actions would be a part of such a process:

- Institute regular senior management review of actual quality delivered.
- Conduct frequent management reviews to ensure that planned changes can be executed without negatively affecting current services.

With respect to service quality, the SSA has long pondered what it should set as an objective for responsiveness. We recommend that:

The Social Security Administration quantify each aspect of service quality (e.g., elapsed time to complete), monitor its overall performance, and manage against such a priori service goals.

Even though substantial capital investment and agency effort went into systems modernization, automation of the SSA is far from complete. While the agency has made important progress in automating many basic tasks, particularly those involving database file

updates, many areas still rely heavily on manual processing for most program functions. To be a modern service agency, in which case actions are processed on-line and batch processing is reserved for routine support applications such as periodic database backups or data transfers, the SSA must continue the modernization of its automation that began in 1982. Users should have single-session access to all needed data for each case and to all editing and processing capability that is required to perform completely all programmatic functions, including updating the database.

In large extent the SSA has automated individual data processing tasks as they happen to derive from prior batch program runs, whereas the future will require that it automate overall information processes from initial data input through final output. The automation must be a smoothly flowing sequence of events automatically proceeding through the computer system; it must not be a series of individual tasks with manual handoff of data from one to the next, or controlled by actions of an operator at a console, or with awkward exchange of data among individual actions.

Given where it was in 1982 versus the task that had to be completed to achieve its present 1989 posture, it is not surprising that automation is incomplete or that parts of the SSA have been little touched at all. We recommend that:

The Social Security Administration aggressively carry forward to completion automation of the basic functions of the agency, including the many for which automation is currently under way or partially implemented, as well as some for which automation is not yet started.

A particular target of opportunity is in the area of disability processing, which continues to be almost exclusively a paper file folder operation that consumes a disproportionate share of operating budget. Because automation holds such promise for disability processing, the SSA should conduct a feasibility study to determine technological and system alternatives that can be introduced in a phased manner to support this function.

THE FUTURE

A very pertinent issue is whether the present computer system architecture, which is derived from the prior batch-oriented configuration, is adequate or appropriate for a fully automated, and probably highly integrated, on-line programmatic and administrative environment. In this regard we recommend that:

The Social Security Administration retain the present centralized database architecture but plan for the introduction of "intelligent" workstations providing increased local support to the users of the system and embodying a common user interface for performing any agency function.

Having a common user interface implies that each user will, for example, log onto the system in the same way, access databases in the same way, and use a consistent set of key strokes to accomplish specific actions. It does not imply that any SSA employee will be able to perform

every SSA function from his or her terminal. Quite the contrary, each employee will be carefully confined by the system to just those actions that he or she is authorized to do.

To provide for greater responsiveness and completeness of services that clients will come to expect and to increase productivity, efficiency, and accuracy, the SSA strategy should build upon its centralized database as opposed to decentralizing it to a large number of dispersed geographical locations (i.e., a so-called distributed data system). A second computer center to assure continuity of service, however, is not in conflict with this view.

At the same time, the present architecture burdens the NCC with handling every user keystroke and action at every terminal. Such functions can be offloaded by extending the architecture to include workstation technology but, importantly, with each of them having a common user interface throughout the agency. The agency's stated intention to evolve toward an integrated information system infrastructure to support its combined program, administrative, and financial functions is a major technical-economic issue that requires careful examination before sizeable investments are made to achieve this end. As a beginning, we advocate developing a level of integration and concomitant architecture to support just the programmatic functions.

Moving toward a more integrated work environment for SSA personnel raises two collateral issues that must be considered as essential aspects for consideration in planning and implementing advanced architectures.

- While the SSA has carefully installed security safeguards of various kinds to protect its database and its physical facility at the NCC, the computer and network security aspects of extensive on-line integrated services are quite different in nature and detail. Both the data per se and the systems have much higher exposure to a much larger population of users and ensuing risks. The SSA will have to become knowledgeable and skilled in contemporary computer security technology and safeguards and both include security as an integral design goal of new systems and retrofit safeguards into existing systems as the transition to on-line operation progresses.
- A word processing capability is an obvious need for all users in an integrated programmatic environment. Whether it should be provided separately or through integration of office automation systems and programmatic systems is an issue to be carefully and thoroughly examined.

Quite aside from computer technology, the SSA is an enormous consumer of communications capability, for both telephone and data services. Historically, communications services have been procured in bits and pieces as individual requirements came along.

Because telecommunications cost is the largest segment of the SSA's information technology systems budget and because economy of scale can be realized by consolidating telecommunications requirements for organization wide acquisition and management, the SSA should consolidate its telecommunications requirements for voice and data and centrally specify, procure, and manage such resources within a single management structure. We recommend that:

The Social Security Administration consolidate voice and data requirements to take advantage of possible economies of scale in procurement and management of telecommunications facilities.

Finally, there are other things that the SSA must do in its ongoing course of business but perhaps more aggressively or with more determination in the face of the unflagging press of technology.

- The SSA already has written an Agency Strategic Plan (ASP). It clearly needs frequent, possibly annual updating to reflect a quickly changing world, but the present version also needs a better context. It does not properly portray SSA's "strategic vision" of what it believes it will look like, or alternatively what it would like to look like, in the time frame over which any version of the ASP will be relevant.
- There is much existing technology that is potentially exploitable in SSA systems and networks; there are also many promising developments that may prove to be valuable (e.g., expert-system technology to support and aid decision making).

In regard to these two points, we recommend that:

The Social Security Administration study and inventory its technological base with the view toward establishing the relevance and candidacy of promising new technologies to its systems and needs, identify opportunities to exploit them to reduce costs and enhance services, and incorporate the results of such studies and examinations into revised editions of its Agency Strategic Plan.

1

INTRODUCTION

The Social Security Administration (SSA) must rely on modern computer facilities in order to carry out its mission to administer equitably, effectively, and efficiently a national program of social insurance as prescribed by legislation.

The SSA has a nationwide field network of more than 1,300 offices and 37 teleservice centers. Field operations are directed by the 10 regional commissioners and their staffs. The field installations are the main points of contact by the public with the SSA. They issue social security numbers (SSNs), help workers and employers correct records of earnings, help claimants file applications for benefits and assemble the evidence necessary to prove their eligibility, adjudicate retirement and survivors insurance claims, help determine the amounts of benefits payable, forward disability insurance claims to cooperating state agencies (generally state vocational rehabilitation agencies) for determination of disability, and give workers and their families the information necessary for them to understand their rights and obligations under the program.

In addition, the SSA headquarters, located in Baltimore, Maryland, consists of staff offices, the National Computer Center (NCC), disability operations, central records maintenance, and foreign claims operations. The SSA also operates data operations centers at Wilkes-Barre, Pennsylvania; Albuquerque, New Mexico; and Salinas, California. The data operations centers do not perform data processing; their major function is to maintain earnings records and convert annual wage reports from source documents to electronic form for transmittal to the NCC. All data processing for SSA is done at the NCC. Six program service centers (PSCs) (located in New York, New York; Philadelphia, Pennsylvania; Birmingham, Alabama; Chicago, Illinois; Kansas City, Missouri; and Richmond, California) certify benefit payments to the U.S. Department of the Treasury's regional disbursing centers, maintain beneficiary records, review selected categories of claims, collect debts, and provide a wide range of other services to beneficiaries.

The following illustrates the magnitude of the tasks performed by these operations:

- Over 35 million people are receiving retirement and disability benefits.
- Seven million new SSNs and 5 million changes are requested each year.
- Wage postings for 200 million people are made each year.

- Three million new claims and 120 million changes affecting retirement and survivors disability insurance are processed each year.
- One million new claims and 9 million changes for supplemental security income are processed each year.

By the year 2000, the number of Americans over age 65 is expected to increase by 36 percent, and the number of people receiving retirement and disability benefits will reach 44 million with new claims projected to hit 5.6 million annually.

Considering these factors it is not surprising that the SSA operates one of the largest recordkeeping systems in the world. Automated techniques must be used to perform the huge job of posting earnings to individual records and computing benefits from these records. The use of automatic data processing and telecommunications has been extended to practically all areas of program operations. Under the Systems Modernization Plan (SMP), the processing power of SSA's computer systems was increased eightfold and put to new uses. For example, the claims modernization project allows a claims process to be performed by field office staff by entering information directly into the system. It also allows field office staff to request any information in agency records needed to process a claim and provides a paper copy of the completed application for the claimant to sign. However, many functions and entire processes are still performed manually, and so the SSA has a great deal more to do in automation. The SMP was released in February 1982 by Commissioner John A.Svahn to correct the crisis state that the SSA's data processing operations faced, primarily the result of years of neglect. Originally, the SMP was formulated as a 5-year plan to modernize the SSA's information technologies and its management. However, in October 1986 the SMP was reissued by Commissioner Dorcas R.Hardy as a long-range strategy covering another 5-year period. The purpose of the reissued plan was to refocus emphasis from hardware acquisition to improving performance on software developments, which were progressing much slower than initially estimated.

Responding to oversight suggestions, Commissioner Hardy also created the Office of Strategic Planning (OSP), which produced the Agency Strategic Plan (ASP) in January 1988. The purpose of the ASP is to establish the broad directions the SSA would adopt to serve the nation 10 to 15 years into the future. The ASP recommended 29 objectives in all that were aimed at simplifying programmatic functions, increasing customer service, applying technology, and improving the SSA's organization and management. With the introduction of the ASP, the SSA decided to complete the remaining active projects that were initiated under the SMP in 1990. At that time, the agency plans are to have transitioned fully to its ASP and the tactical and operational plans and projects that are to be developed based on the ASP.

There have been considerably different views regarding the status, accomplishments, completion date, and eventual cost for modernizing the SSA's systems under the SMP. Given the SSA's substantial investment in modernization and the newly established strategic directions, the agency needed an independent assessment of whether these investments and strategies for the future were consistent and appropriate.

In 1988, at the request of Commissioner Hardy, the Board on Telecommunications and Computer Applications of the National Research Council convened a committee to review the SMP, ASP, and the technical and technical management environment's in which these plans are and will be implemented. The resultant committee undertook a two-phase study. This is

the committee's report at the conclusion of the first phase. In this first phase we reviewed and assessed the SMP, ASP, and the software engineering methods used at the SSA. In the upcoming second phase we will evaluate the technical and technical management environments at the SSA for modernizing its information systems along with the associated human resource development and planning activities.

We approached our task in four ways: (1) we heard briefings on SSA operations, processes, information systems, and resources; (2) we visited specialized facilities and examined information systems in operation; (3) we studied relevant planning and technical documents; and (4) we interacted informally with selected SSA officials.

Recognizing the time it would take us to prepare and release this report and the urgency of near-term decision making, Commissioner Hardy requested that we provide accelerated advice on the progress of the SMP, its achievements, and the agency's computer processing capacity requirements. In response to this request we issued a letter report to the commissioner dated April 3, 1989 (See Appendix D). In it we tabulated changes at the SSA since 1982 in several key areas and also compared the agency's automated data processing (ADP) investments with those of a private corporation. Our letter report also stressed the need to use technology as a means to reduce the agency's dependence on paper and advised a review of the computer center backup and recovery strategy and vulnerabilities.

The next 3 chapters of this report deal, respectively, with our assessment of the past, the challenges of the present, and strategies for the future. In Chapter 2 we provide our assessment of the SMP and the software engineering methods being adopted by the agency that came out of the refocused SMP of 1986. Chapter 3 deals with what we believe are the most pressing information management challenges facing the agency today, and in Chapter 4 we provide our assessment of the ASP and the strategies that we believe the agency should adopt to guide its future information architecture. Appendixes A through E, respectively, give the committee's statement of work, briefings heard, a summary description of the various functions that the SSA performs, a copy of our letter report to Commissioner Hardy without attachments, and a glossary.

2

SYSTEMS MODERNIZATION JUST PAST

In this chapter we provide an assessment of the System Modernization Plan (SMP) and its current status and examine the software engineering methods that were adopted by the Social Security Administration (SSA) as part of its modernization efforts. In addition to providing our assessment of the use and success of these methods within the agency, we also offer suggestions for their improvement and identify promising new developments.

Systems modernization should be viewed as a continuous process rather than a distinct program. In the 1960s the SSA was seen as a model of effective data processing, but for many years that followed the SSA neglected its information systems infrastructure until it was near collapse. In 1982 drastic measures were required to restore the agency's systems and a comprehensive plan to accomplish this was undertaken with the approval of Congress. That plan was called the SMP.

Today, 7 years after the SMP was initiated, the general structure of SSA's systems is derived from an architecture that was conceived and oriented toward conventional batch processing. An essential requirement for the SSA's computer operations is the maintenance and protection of its database, which includes earnings and benefits information. Through its 25,500 computer terminals, the SSA has extended its remote job-entry operations and now supports on-line queries and claims entry. The agency plans to increase its on-line operation. In just the past 2 years the agency has gone from 4,000 terminals to 25,500. In addition, terminal inquiries resulting from the new teleservice center operations will further increase processing demands and stress the current network and host capacities. On-line transaction volumes are up from 1.5 million per day a year ago to 7 million per day now. These aggressive moves aimed at expanding and improving service to the SSA's clients require equally aggressive technology investments in data processing capacity and communications in order to ensure performance and maintain the stability of those systems.

THE SYSTEMS MODERNIZATION PLAN

The original plan, as conceived in 1982, consisted of three phases: survival, transition, and state of the art. The survival phase targeted and resolved the most critical problems that then confronted the agency. Following survival, a transition phase was entered that introduced long-range goals into the modernization projects and initiated systems redesign. Completion of these phases would then position the SSA to implement and maintain modern, efficient

information systems-a continuing phase referred to as state of the art. The SMP was further defined and broken down into six major programs: (1) institutionalize software engineering methods, (2) integrate the agency's databases, (3) establish a data communications network, (4) increase data processing capacity, (5) improve the management of the SSA's computer operations, and (6) provide administrative and management information. Figure 2.1 was taken from the original SMP (U.S. Department of Health and Human Services, 1982) to illustrate how the SSA approached modernization, the relationship between the projects and phases, what was intended to be accomplished, and in what time frame.

Prior Study

In addition to the briefings and documents provided by the SSA, we also examined the reports of two earlier committees of the National Research Council that reviewed the SSA's data management system (National Research Council, 1978 and 1979). For the period prior to these reports the agency had been criticized for its apparent inability to handle claims and payments. A planning effort initiated in June 1975 addressed those criticisms by proposing a transition from an antiquated tape-based processing system to one that used random access storage and a database system that was commercially available and vendor supported. Such programming systems and components would ensure that the functions performed by the SSA could migrate to newer systems, thus providing some protection from technical obsolescence. The envisioned improvements were aimed at the accuracy, promptness, reliability, and responsiveness of the SSA's service delivery system. The referenced reports thoroughly explored the architectural and planning aspects of that effort. The recommendations in these reports were satisfactorily addressed in the 1982 plan. The SSA has implemented a disk oriented random access database architecture and has adopted the controls and process steps needed to further enhance those systems.

Modernization's Effects

From a functional standpoint the SSA has been able to keep up with the expansion and growth in its client-based transaction volumes as a result of its automation steps. Through its modernization investments the SSA has also been able to improve operational efficiency and provide more responsive services to its customers during a period of significant downsizing. The following achievements, while not an exhaustive list, provide examples of the progress that has resulted from modernization:

- Retirement payment accuracy, in which fiscal year 1983 was 99.5 percent, by fiscal year 1988 had improved to 99.8 percent-a 60 percent improvement in the error rate.
- Wage posting, which exhibited a 4-year backlog in 1982, has been brought up to date and is now accomplished within 5 months.
- Enforcement operations, which carried a 5-year backlog in 1982, have been brought up to date and are now current.

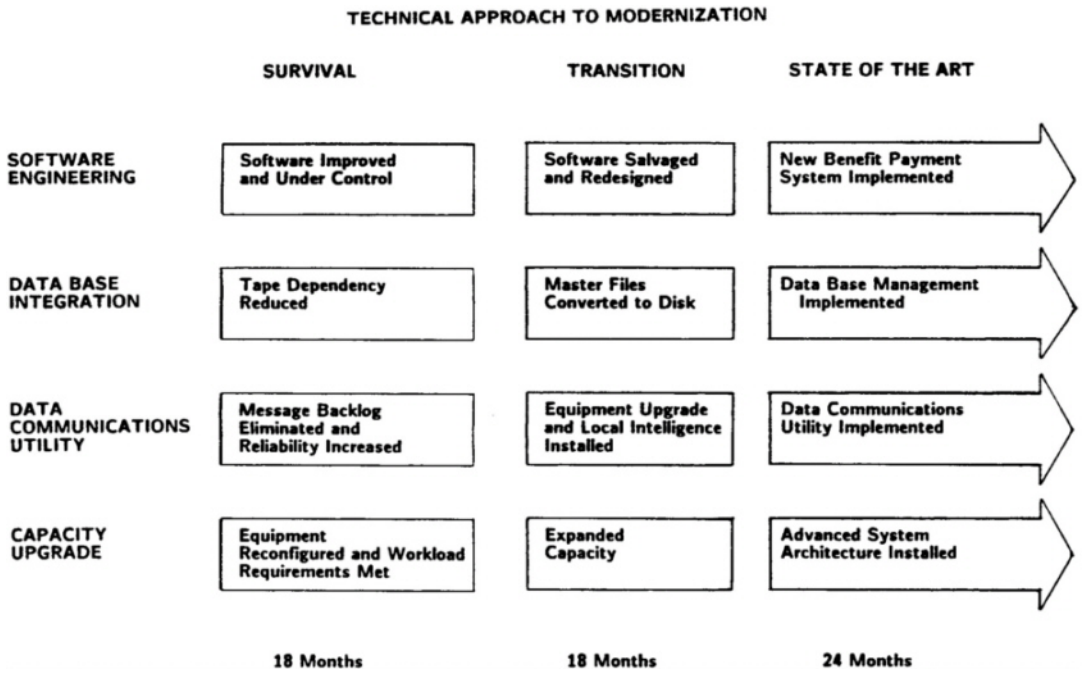

FIGURE 2.1 Technical approach to modernization. Social Security Administration (1982)

- Annual recomputations, which required a 48-month period to process in 1982, are now accomplished in 9 months.
- Cost-of-living allowance calculations, which required 2 to 5 weeks to process in 1982, are now available in 36 hours.
- New or replacement social security cards, which took 6 weeks to issue in 1982, are now issued in 6 to 10 working days.

Over the period 1982 to 1988 the benefits of automation on the productivity of the agency were observed in a number of areas. While the regional workload increased 12.4 percent over the period, the agency was able to reduce the labor input by 20 percent, resulting in a 40 percent overall productivity improvement in regional operations. At the same time the automation investments have resulted in savings to the agency because of increased payment accuracy that reduces overpayments and underpayments. During the period 1985 to 1988, this resulted in savings of $980 million.

Total agency employment, which was the equivalent of 81,532 full-time employees in 1984, decreased to 66,000 at the end of fiscal year 1988. This downsizing was made possible as a result of the SSA's investments in information technology. The capital investment in millions of dollars made by the agency for information technology for the years 1982 through 1989 is shown in Table 2–1.

Table 2–1 Capital Investment by Category and Year, 1982–1989 (in millions of dollars)

Year	Voice Telephone	Office Automation Administrative Information	Operations ADP Equipment Management and Data Communications	SMP	Total
1982	n/a	104.1		8.5	112.6
1983	n/a	93.3		30.8	124.1
1984	6.9	72.1		47.1	126.1
1985	2.4	13.3	56.0	58.4	130.1
1986	27.2	14.6	46.5	98.6	186.9
1987	66.1	23.7	52.0	72.9	214.7
1988	117.6	32.2	32.6	73.8	256.2
1989	83.7	35.9	105.7		225.3
Total					1376.0

For recent years, we suggest that SSA combine its automation expenditures and other related internal and external costs and normalize these costs on a per transaction or per account basis. Parameters such as cost per transaction or cost per account are useful as one measure in evaluating automation investments made and intended. Such normalized costs also provide useful management information when compared to other organizations or trended in concert with service levels provided to SSA's customers.

The Crisis Survived

In light of these and other data we have reviewed, the SSA did survive the crisis faced in 1982 by its information systems. This came about as a result of major efforts proposed and executed under the SMP and the associated management and fiscal investments in information systems made since 1982. The agency has successfully managed to move its main data bases off of hundreds of thousands of magnetic tapes and onto contemporary magnetic disks. This was a major information system transition and a significant achievement that now allows the agency to quickly access information and positions it for supporting on-line operations. Now, the agency must manage its next major transition from strictly paper-based processes at the district offices and batch computer operations to the use of on-line terminals—a significantly greater challenge.

The Transition to On-line Services

The transition phase was entered operationally with the introduction of the 1987 SMP (U.S Department of Health and Human Services, 1986). The transition phase introduced automation and productivity tools to the tasks of the SSA's workers. Productivity measurement and advanced telecommunication technology have been introduced into the agency's processes. Such capabilities provide for first point of contact data capture and help eliminate paper as the primary interface to the automation system. This phase is well under way and is critical to the ability of the SSA to establish a technology base for the development of intelligent systems that the SSA should plan to exploit over time and incorporate in its vision of the future.

Effects of the transition phase are beginning to become evident from several perspectives. The agency's automation investments have grown substantially, but now new factors related to the increase in automation and the consequences of its interruption begin to come into focus. For example:

- Loss of the NCC will severely reduce the SSA's ability to provide expected services to clients. Only emergency services such as locally issued checks would be feasible.
- As dependence on automation increases, employees' knowledge of details is incorporated in computer programs and this reduces their ability to respond to client's manually. Thus, the SSA increasingly will become less able to revert to manual methods.
- System stability and the ability to quickly restore service in the event of a failure has become critical. This implies the need for crisis planning, database support and operational support in the event of a disaster.
- Wider access to proprietary information requires that protective steps be taken to prevent misuse or damage to data or violation of privacy.

While we support the SSA's transition to on-line services, we believe that any organization having limited experience with true on-line operations tends to underestimate the resources

it will require. This suggests the advisability of introducing new services in a deliberate and measured manner that is supported by well-planned and approved steps to increase the agency's information systems infrastructure along with the development and training of its work force. For example, sufficient processing capacity needs to be assured before introducing a new on-line application or procedure. A management infrastructure must be in place that establishes and communicates quantitative service-level goals while ensuring that developments are geared toward those goals and the capacity to execute them is provided. However, such an approach does not always satisfy the timetable of a top management whose short tenure will tend to prioritize actions that show near-term results. Furthermore, on-line operations require more processing power and better backup and recovery services, and, unlike batch operations, peaks of demand cannot be smoothed out over long periods of time. Such peaks can cause terminal transactions to be queued, resulting in inefficiencies and dissatisfaction.

State of the Art

The unflagging advance of information technology constantly redefines the state of the art. In the context of the SSA's SMP, this phase is one in which the agency is able to incrementally modernize its systems and avoid crisis situations. In this sense the state-of-the-art phase does not have a distinct conclusion. Its achievement may be always elusive and certainly defies verification.

Just as the state-of-the-art phase was intended to represent the long-range goals of the SMP, the Agency Strategic Plan (ASP) constitutes SSA's current plans for the future and embodies long-range goals for the agency's modernization. The ASP, therefore, is the continuation of the SSA's technical modernization efforts, and its introduction marks the conclusion of the SMP.

Status of the Systems Modernization Plan

Since the SMP was initiated, the SSA has replaced an obsolete computer architecture, expanded its computer capacity eightfold, substituted on-line storage for magnetic tape, established a disciplined approach to software development and project management, centralized its master files and implemented database management, installed 25,500 computer terminals, acquired a data communications network, and modernized its claims processing system.

We conclude that the major goals of the System Modernization Plan have been successfully achieved.

By 1982 the SSA's batch system environment was out of control and not able to handle its workload as backlogs grew and downtime averaged 11 percent. The potential for crisis was apparent. The agency underwent a recovery period from 1982 to 1987 in which it regained control of its batch processing environment and began to develop its real-time data access and management strategy. As a result of its recovery, the agency found that after 1987 it could

begin planning for its future rather than concentrating on day-to-day problems and survival. This period set the stage for the SSA's first strategic plan. The ASP provided an opportunity for the agency to clarify how it intends to carry out its mission. In this new period of modernization guided by the ASP, the SSA's strategy calls for the agency to increase its real-time access and management of data, including real-time client query, real-time data entry, and some on-line application development and testing (e.g., enumeration).

SOFTWARE ENGINEERING METHODS

One of the major objectives of the SMP was to install modern software engineering methods at the SSA, and one of our tasks was to review the software engineering methods being used by the agency and assess their adequacy. To accomplish its objective for a modern software engineering environment, the SSA, during the past several years, has embraced a development methodology referred to as software engineering technology (SET). The SET (Social Security Administration, 1986) is defined as the process by which all new systems and software are developed and existing systems are maintained. This methodology appropriately begins at the planning stage of the development life cycle, continues with requirements definition and analysis, design, development, implementation, integration, testing, and finally operation and postimplementation support. The SET appropriately addresses the use of tools, configuration management, quality assurance, security, capacity planning, and management.

Given a vision of how to operate the agency, an effective development method for large software efforts such as the processes that the SSA requires must include the following three basic interlinked elements:

1. A formal requirement, design, development, and implementation methodology that is well documented and enforced across the systems and software organizations.
2. A comprehensive set of tools, preferably embedded in an integrated environment, consistent with and supporting the methodology; to the extent possible, providing integrated automated support across the entire development cycle and subsequent life-cycle support.
3. Training, both in the form of initial staff training on the methodology and use of the tools and continued training of incumbent staff as the methodologies are refined and the tools enhanced and upgraded.

All three of these elements need to be employed in harmony in order to achieve optimum software development results. In addition, inherent within the methodology and management infrastructure for software development, there must be (1) rigorous and effective project management techniques supported by comparably disciplined quality assurance and (2) configuration management backed by well-documented and enforced policy, plans, and procedures. **Quality assurance, program management, and configuration management elements must report above or separately from the organization responsible for software development, testing, and operation.** In the following sections we address each of the five key aspects of an effective software engineering infrastructure from the perspective of the SSA's status and accomplishments to date. These are methodology, tools, training, project management, and quality assurance and configuration management.

Methodology

Version 1.0 of the SET was completed in 1984. It was then substantially enhanced through the acquisition and incorporation of a structured system development methodology. A major upgrade to the SET (version 2.0) was released in 1986. After that there were several interim upgrades in 1987 and 1988. The latest version 3.0 of the SET, dated July 1989, was released in August 1989. The SET is quite comprehensive and documented in great detail in a six-volume manual (about 6,000 pages). In September 1987 a condensed version consisting of about 300 pages and called the *Desk Top SET* (Social Security Administration, 1987) was issued to provide a much needed overview of both the SET manual and the prescribed life-cycle development stages. The *Desk Top SET* also provides a quick reference and index to the information contained in the more comprehensive manual.

The SSA's practices incorporate many principles considered requisite to successful system and software development, including direct participation of users throughout the development life cycle and system validation performed by the same staff that developed the requirements.

The SET suffers from having the appearance of being a compendium of "everything" relevant to software development in the SSA. It includes structured methodologies popularized by Yourdon and Jackson as well as nonprocedural methods. It also provides a detailed tutorial on flow chart techniques that really should have been superseded long ago by the structured techniques and modern computer-aided software engineering (CASE) tools. In addition, multiple sections are devoted to many extremely low level utility routines that are characterized as tools but are a wide variety of material better suited to a policy and procedures manual.

The SET should provide more guidance to direct the user toward a specific technique for particular applications or application types. For example, it should advise the user when to use Yourdon or Jackson or nonprocedural design. To improve its effectiveness, we suggest that the SET manual should focus on the appropriate and current methodologies and their supporting tools. Obsolete materials, procedures, and policy items must be removed or, if still necessary, transferred to other kinds of documents. A 50 or so page summary manual could overview the entire methodology and reference other stand-alone volumes for more details on the specifics of the recommended approach or technique. A comprehensive, full-life cycle example and several smaller examples should be included to illustrate the various processes and techniques. An improved tool kit must also be incorporated into the SET.

Given that the present form of SET methodology has been in place for about 3 years, there is a definite need for the SSA to initiate a formal "metrics program" to collect productivity data on all system and software development projects. This will permit ongoing assessment of the effectiveness of new methodologies and tools as they are introduced; but even more importantly, it will provide the quantitative basis for making more accurate schedule and resource estimates of future development efforts. To be most meaningful, appropriate quantitative measures of productivity must be collected throughout the development process, preferably at the conclusion of each stage, rather than being "retroestimated" at the conclusion of the project.

A designated group, not necessarily a new organizational component, within the SSA should have the responsibility for remaining current on modern system and software development tools, techniques and methodologies, and evaluating their suitability for the SSA environment. Such a group would also sponsor, perhaps in conjunction with the systems development organization, pilot applications of tools and methods that are most likely to

benefit the SSA. The group should focus on the development process rather than on products produced by the process. This group can also be the custodian and evaluation organization charged with administration of the "metrics program" discussed above.

Finally, in the area of methodology we suggest that the SSA monitor the activities of the Software Engineering Institute at Carnegie Mellon University. Even though the focus of the institute is on assessing and improving software development practices for the U.S. Department of Defense, it is concerned with all of the above issues and has both government and industrial sponsorship and support.

Tools

The SET manual has primarily identified a tool set of very modest capability. The many powerful CASE tools now beginning to appear on the market are not discussed in the manual. However, the SSA did have the foresight to begin applying the problem statement language/problem statement analyzer (PSL/PSA) tool to the requirements analysis efforts in the mid-1980s and has continued to use it for software development efforts.

The current proliferation of CASE tools, integrated development environments, and their expansion to highly desired full life-cycle coverage, which is expected to be mandatory for such tools in the future, means that the SSA must not only stay abreast of this dynamic area but must also aggressively incorporate any tools selected for new capability into an "improved SET" but still constraining it to a manageable size. New tools can well be evaluated on small noncritical pilot applications initially, preferably by a team of developers enthusiastic about this type of technology. Short-term benefits will likely come from improved quality and uniformity of application programming. Productivity improvements will come in the longer term, initially in the maintenance areas and then in the development areas.

In the next 5 years we anticipate significant improvements in the power and breadth of capability of the tools that become available in the commercial marketplace. Therefore, it would be a mistake for the SSA to "freeze" on a tool such as PSL/PSA; there are already improved derivatives that can be used with minimum transitional difficulty.

The SSA operates in the International Business Machines's (IBM) database environment, which fortuitously is the target of the majority of today's tools, in that the tool "platform" itself may be either an IBM mainframe or workstation.

A comprehensive and integrated CASE tool set may not be available for several years. Even so, the SSA need not wait to take advantage of today's tools. The agency should expose its development organization to a variety of applicable tools so that it will have the experience to know what works and what does not in its environment using in-house methodology. In so doing the agency can gain the benefits from immediate usage and be in a position to quickly capitalize on the "right" tool set when it emerges.

The SSA should also examine the so-called reengineering tools that are beginning to appear. They are focused primarily on the life-cycle support phase. Fortuitously again, most of them work in the IBM database environment. Since 50 to 80 percent of the software life-cycle cost for a production system occurs during the operational/maintenance phase, the payoff for productivity enhancements in this portion of the life cycle is substantial, considering the millions of lines of code in existing applications. One example of a life-cycle-support tool is a Common Business Oriented Language Structuring Facility (COBOL SF) restructuring tool that is intended to increase the span of code that a programmer can

maintain by a factor of about two—a doubling of productivity. As different systems are processed through COBOL SF, a side benefit is that the COBOL II code produced appears very similar to the original, which allows programmers to be moved from one system to another with relative ease because little effort is required on their part to gain familiarity with the new system. In addition, COBOL II output of the COBOL SF system has the attributes of a well-structured program (e.g., single-entry/single-exit procedures, no GO-TO or external PERFORM statements). Furthermore, it is linear and extremely straightforward in its logical structure and executes with little or no performance penalty compared to the original difficult-to-maintain COBOL source code.

This tool can also be effectively used as a standards checker. If a programmer's work is modified as a result of running it through COBOL SF, this is an indication that it has not been developed according to proper well-structured programming practices. We expect that well within the next decade such capabilities as outlined for COBOL SF will be incorporated into much more comprehensive integrated tool sets that will cover the development life cycle from requirements analysis through maintenance.

Training

Both training and subsequent retraining performed by the SSA for its systems staff are very comprehensive and consistent with the high level of training apparent across the entire SSA. New hires in the systems organization are given an 8-week training program that includes both formal classroom and hands-on activities, followed by an on-the-job component. A training profile for each individual is developed and maintained in the Employee Training History and the Systems Training Data System.

Four levels of training are provided for software staff: core, foundation, advanced, and expert. Core training is further partitioned into one of the following areas: analysis/design, software support, operations, and hybrid (other). The SSA has clearly made a commitment to training and is willing to make the continuing training investment required to develop and maintain a first-class staff.

Project Management

An SSA development project is managed by a project manager who heads a small project management office (PMO). By the nature of its function, specific tasks follow a matrix approach in which the assignments are carried out in separate organizations by technical staff under the direction of a line supervisor. The evidence is that the PMO performs good and effective planning and tracking at the top (task) level of the project but that there is no detailed subtask management. The project manager and PMO focus tends to be almost exclusively short range. There is little detailed subtask management by the PMO.

Since each task is usually composed of many dozens or even hundreds of subtasks, there is little visibility of the current status of the project at the lower subtask levels at the PMO level that depends on the line managers and supervisors to stay on top of the many tasks to be performed for their projects and the other projects competing for the same resources. However, line managers and supervisors have no formal task breakdown and tracking system at the detailed levels.

We suggest that the SSA use work breakdown structures to aid in developing sufficiently granular task statements for closer monitoring of status. Other techniques that the agency should consider include earned value or the cost/schedule control system criteria (C/SCSC) that the U.S. Department of Defense (DOD) commonly uses to plan, measure, and monitor its high-risk projects.[1]

We suggest that life-cycle cost estimates be produced prior to project initiation as a basis for decision making and thereafter be refined as the development process proceeds. Based on our observations, the current process calls only for incremental estimates of each step as the full development cycle proceeds. Hence, it appears that the project is completed before the full cost is visible to decision makers. We recognize that the precise cost cannot be known until project completion but suggest that life-cycle cost estimates that are updated throughout the development process will allow better management visibility and control. An evaluation of life-cycle cost and associated benefits should be the basis on which to authorize, track, and manage each project. Updates to such cost-benefit analyses produced at the end of each stage and analysis of variances from the original assessment should be the basis of decisions to proceed to the next stage or to modify the plan. Even in the case where a development is necessitated by legislated action, cost-effectiveness analyses can be helpful to select a good alternative approach and to ensure that requirements growth does not enter the development process.

Quality Assurance and Configuration Management

The life-cycle development methodology employed by the SSA describes 37 different products that are produced by various organizations during the development process. These products consist of plans, analyses, requirements, specifications, reports, schedules, and other defined documents. For this process the quality assurance (QA) focal point is the Office of Strategic Planning and Integration. Adherence to QA standards is reviewed by the originating organization for each SET product and functional quality and technical quality are assessed by each organization that receives an SET product. The SET manual describes the functions and responsibilities of the QA element for the various stages.

There is a wide variation in the type of review required. In many instances the more traditional assessment of adherence to standards and procedures is required. In other instances the QA mission as defined in the SET manual calls for the evaluation or assessment of the correctness, consistency, and completeness of the product. Such evaluations require senior experienced technical staff and in other organizations are typically done by a verification and validation (V&V) organization rather than the traditional QA group. The SSA should modify the responsibilities of its QA function and adopt a new V&V function, equipping it with the appropriate charter, tools, and organizational independence from the development organization.

It is common for a QA function to report to the highest level of an organization. Strikingly, we did not find this to be the case at the SSA. The ability of the SSA to perform

[1]The DOD also offers a comprehensive 6-month training program at its Project Management Institute (located at Fort Belvoir, Virginia), which the SSA should consider using to gain the invaluable and hard-won experience of the DOD; it applies directly to the SSA system and software development.

its mission in an effective and efficient manner is becoming increasingly dependent on access to adequate high-quality software, hardware, and training. Given that the SSA relies on its software systems to accomplish its mission, commissioner-level focus and backing are appropriate for enforcement of QA policy and standards within the agency.

Configuration management (CM) and change control are appropriately focused and accomplished through two tiers of configuration control boards (CCBs). The higher-tier CCB operates at the deputy commissioner level and selects projects for review based on size and importance. Procedures call for further reviews at lower management levels with configuration management offices to support them. Requirements for an automated CM document tracking and control system have been developed but have not yet been implemented. Such a system can provide an effective means to track the documents placed under configuration control. Once the system is implemented, it should be expanded to automate document traceability from requirements, through design, and on to the implementation of software modules. This capability will help the SSA assess the effects of a change to its systems and should also help ensure that software changes are appropriately documented. The SSA should also place its test files, test databases, test scripts, and test results under change control and configuration management with the eventual objective of possibly automating the testing process.

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3

THE CHALLENGE OF CHANGE IN THE PRESENT

By the nature of its mission, the Social Security Administration (SSA) serves the general population of the United States—its 50 states and territories. From time to time Congress modifies the details of the programs that the SSA administers and/or adds new programs to the agency's repertoire. Also, from time to time the SSA will decide that it must upgrade its facilities or level of service as a general action unrelated to any program. Thus, many factors combine to influence the workload that the SSA's computer systems must support.

- Because the population and work force of the country are constantly growing, even if all other things were to remain constant, the number of enumerations and the volume of taxes collected will increase correspondingly.
- The age distribution of the population is independently changing; the number of individuals of retirement age is increasing. Hence, the volume of retirement-related payments will increase correspondingly as will collateral decisions and actions related to retirements.
- As Congress changes the details of the SSA's programs, changes in the software are usually required. Inevitably, the software grows more complex and in turn imposes an increasing workload on the computer systems.
- As Congress creates new programs to be administered by the SSA, such as Supplemental Security Income (SSI), there is an impact on the software and hardware and, in general, a growth in computer workload. The complexity of the new program, the segment of the population covered, integration with one or more other extant programs, and basic characteristics of a new program will all combine to increase the SSA's computer needs.
- As Congress modifies tax laws, this too can have consequences for the SSA (e.g., social security numbers [SSNs] for dependents).
- The nation's life styles are more complex and are changing in fundamental ways. Joblessness, single parentage, mobility of individuals—all such things in their own way increase the complexity and volume of the SSA's workload and its diversity.

- The health history of the country is also changing as medical science progresses. This contributes to aging of the population and increases the scope and complexity of the health care programs that may involve the SSA in some way.
- The job environment is also changing, in many ways becoming more complex but also introducing new health and accident threats as higher technology and new substances appear in the workplace. These phenomena also impact aspects of health care programs, the volume of disputes over disability claims, and possibly the complexity of the disputes.

Everything points to ever-increasing complexity in many dimensions for the SSA. The SSA, as the administrator and overseer of vital social programs, can do nothing to slow or redirect the forces of change. The forces are all external. The one factor that is essentially certain is the consequent growth in demand for computer services and the computer-based systems that provide the services.

Quite beyond the natural events in the country that drive the magnitude of the SSA's total workload, there are pragmatic events that derive from growth and the simple passage of time.

- Computer equipment becomes obsolete and must be replaced when spare parts and maintenance expertise become unavailable or excessively costly.
- Computer technology continues to advance in major ways, and replacement is sometimes the only way to improve cost to performance factors or accommodate growth.
- At some point the concentration of resources in one location becomes too risky for the country to accept, and steps to disperse computing facilities are not only prudent management actions but also valid technical options for responding to workload growth.
- As the number of clients grows and as the diversity of entitlements available to them increases, the simple problem of handling the flow of people, relating them to the data in the computer system, and making appropriate decisions outgrows the state of art of the field office equipment. Upgrading the environment in the field offices becomes a necessity, not a luxury to make life more pleasant for the SSA's representatives.

So far, the various points have discussed here dealt only with the consequences of natural forces at work in the country and the pragmatics of keeping pace. Such forces drive the SSA and its computer needs but cannot be controlled by the SSA or, for that matter by the federal government.

There are, in addition, things that the SSA wishes to do on its own initiative. For example, it is expedient to upgrade its level of service by instituting entirely new kinds of service or entirely new dimensions of old services. Depending on the details of such an improvement effort, the consequences for computer workload can vary from a major impact to one that can be swallowed as a part of the normal growth progression.

However, even in this connection the SSA does not always have control over the level of

service that its clients expect. The citizens of the United States derive their expectations for service from what they receive from systems in the private sector, state governments, and other federal agencies. The dominant force is undoubtedly the private sector because it is always ready to be innovative in its computer-based offerings in the expectation of achieving a competitive advantage. Therefore, the private sector and its measures of service quality are yet another force outside the SSA's control that drives SSA's clients' expectations for level and quality of service and therefore the agency's workload as well.

As a consequence of the observations made in the foregoing paragraphs, we conclude that:

Because of forces beyond and outside its control, the Social Security Administration will require periodic infusion of capital to expand and improve its computer base and scope of its information systems.

Beyond what is required just to keep up, we also conclude that:

The Social Security Administration will require occasional infusion of capital to institute and implement new computer- and/or communication-based services to keep itself in line with societal expectations for its interface with the public.

The “feast to famine,” “good condition to impending disaster” circumstances that have characterized the SSA's cyclical computer posture over time derive in part from failing to identify the different reasons for which the SSA computer workload has grown in a given period. Hence, a proper case for capital funds for new or upgraded equipment has not been made. A simple argument that “we need more computer capacity to avert a disaster” is not a satisfactory basis for defending a budget request. The Congress and the country deserve to know what is driving computer needs and how funds will be required to meet the demand. We recommend that:

The Social Security Administration adopt management processes of strict analysis and control to avoid the recurrence of an information systems crisis.

For example, it may prove to be that on-line computer support for the recently installed 25,500 computer terminals is inadequate, perhaps as a result of the SSA's having only early experience functioning in a terminal environment. Problems can be caused by a release of unperceived latent user demand. To deal with changes in demand the agency must (1) thoroughly forecast and justify expansion and upgrade of the existing information infrastructure on a continuing basis, (2) quantify and define in advance the specific performance goals to be provided its clients, (3) measure and monitor actual performance, and (4) plan for the orderly introduction of new services consistent with available personnel and budgetary resources.

In the following sections of this chapter we focus on several of the near-term challenges—ones that we believe are the most important but that have not been addressed in the plans we reviewed.

LEVEL OF SERVICE

The specific levels of service to be offered to the agency's clients need to be defined more clearly. Use of such qualitative terms in the Agency Strategic Plan (ASP) goals as “improve” or “best” can lead to endlessly chasing ephemera that can only be subjectively analyzed for achievement and that will always be subject to disagreement between the SSA's management and its oversight authorities. We recommend that:

The Social Security Administration quantify each aspect of service quality (e.g., elapsed time to complete), monitor its overall performance, and manage against such a priori service goals.

By quantify, we mean, for example, completing an enrollment in 3 days or issuing a social security number in 1 week. Unless this is done, the tendency will lead to excessive and unnecessary expenditures. Based on our observations, we found that the service levels provided by the SSA are good to adequate but that disability processing experiences significant delays in validation by state authorities and appeals of rejected claims. However, automation of disability functions has not received the same level of attention as the retirement and survivors insurance programs.

Service Levels Affect Workload

The agency has moved toward on-line telephonic services for its clients through introduction of the area code 800 service. Such “on-demand” services create a workload that cannot be controlled or even accurately anticipated by the agency. Furthermore, providing such services will require a greater degree of computer system and budgeting flexibility than the agency, as currently controlled, is able to exercise on its own. We urge the SSA to recognize that on-demand service is likely to result in an increased workload that is not necessarily tied to increased productivity. Providing on-demand services will also increase complexity and cost. Therefore the SSA must specify in detail the services to be offered its clients while carefully assessing their cost and planing for their impact on operations.

The agency must also must be constantly aware of the fact that on-demand processing results in uncontrollable volumes with significant daily, monthly, and annual peaks. Operating efficiency will need to be measured and improved over time through the creation of procedures, and organizational actions and the application of technology. As efficiency improves, improvements in service performance specifications can be realized or, alternatively, service levels can be held as they are but provided at lower cost.

Planning for Quality

It is important to distinguish between services to be provided (e.g., by telephone) and the quality of services offered. A quality assurance mechanism should be established with independent reporting relationships to monitor service delivery quality. In this regard the quality of service should be limited to delivering services to specifications rather than maximizing them. Such a mechanism will form the basis for complete planning.

A complete planning process considers such factors as workload volume, service levels, and efficiency as parameters that can be traded against one another in determining resources and cost. Each factor becomes a "control lever", so to speak, that can be adjusted to arrive at an appropriate overall mix. For example, given fixed budget constraints and an uncontrollable volume, either efficiency must be improved or service specifications reduced in order to achieve balance. If a complete planning process is followed, it should begin by establishing the basis for objectively evaluating and presenting agency performance. Without such a process, performance will always be in the "eye of the beholder"—something over which the SSA can have little control or influence.

In the on-line environment the general public is the "driver" in the sense that the public's behavior governs the demand for services and therefore the workload. While it is true that by throttling service, notably response time, the SSA can discourage the public from demanding attention, it is likely that the SSA would not do so because it could and probably would provoke public outcry and criticism.

Previously, the demand for computer services was driven by the SSA employees, over which the agency has tighter control and who generally are tolerant of less responsive service delivery. Thus, the conversion to an on-line environment, as desirable as it may be for many reasons, opens the agency to a vulnerability that it has never faced.

The Potential for Overload

The control factors described above must be balanced. Otherwise, a self-induced crisis can be precipitated. For example, the nationwide rollout of area code 800 service implemented in October 1989 and the annual workload peak that will follow in January 1990 have the potential for overloading the agency's work force and information infrastructure, consisting of its computers and communications. We recommend that:

The Social Security Administration thoroughly analyze the impact of new client-driven services or the quality upgrade of services that entail additional identified or latent on-line computer support to assure the adequacy of supporting automation.

CONTINUITY OF SERVICE

The SSA has been a long-time user of automatic data processing (ADP), and, as a result of the System Modernization Plan (SMP), its ADP capabilities have been dramatically

improved. During the period of modernization the National Computer Center (NCC) has become a pivotal element in SSA operation, and this dependence should grow in the future. The agency has progressed in its transition from paper-based operations to the installation and use of over 25,000 computer terminals located throughout the agency. From each terminal, an employee can access central data files and enter data for processing. With a downsized work force and increasing workload, the agency has appropriately chosen to increase the productivity and efficiency of its work force through automation. We endorse these improvements and support the continued transition to on-line processing.

Increasing Dependency and Current Plans

As the agency's reliance on information technology increases, the adverse consequences of failure become more severe. As it progresses toward paperless processes, its ability to fall back to a paper-based system will diminish. At present, the SSA's plan for backup, should the NCC become inoperative, is to revert to batch processing and move to a commercial hot site.[1] Under such conditions this would permit restoration of only limited batch processing capability within 72 hours. Only critical work consisting primarily of claims and payment adjustments will be processed and the performance of even these tasks will degrade because less computer capacity will be available. Other important workloads such as data matching, wage posting, and cost-of-living adjustments will have to be suspended along with software development and management information support. There would be no support for on-line access to the SSA's databases which is currently needed at the teleservice centers and district offices nationwide. The SSA's backup and recovery plans need to be reconsidered in light of the agency's growing dependence on its information systems and their on-line use throughout the agency.

Two Basic Approaches

The risks and consequences of loss of the NCC warrant immediate attention to assure that adequate backup capabilities, fallback plans and procedures, and system safeguards are in place to guarantee continuity of operation across a full spectrum of disaster scenarios. Short of a major and long-term redesign of the SSA's applications and systems architecture to a distributed or hierarchical configuration, there are two basic variations that can provide adequate backup for the NCC and be rapidly implemented:

1. An on-line, remotely located, highly automated dedicated system routinely processing a portion of the workload. In this variation either the NCC or the dedicated backup would be able to support all critical functions.
2. A standby system available to run critical elements of the operation in the event of a catastrophic failure at the NCC.

[1]A hot site is a fully operational data center—equipped with host computer systems, front-end processors, and network necessities—where an organization may move its operations in the event of a disaster.

For the first option we suggest dividing the processing load approximately equally between the NCC and the on-line Backup National Computer Center (BNCC). Thus, the latest versions of the software and databases and required communication access to support district, regional, and local offices will be in place and operational for both the NCC and the BNCC, and either could take over for the other in an emergency.

For the second option, which would be only employed in the event of an emergency, it is critical that effective methods be in place to assure that the latest version of the software, databases, and operational staff can be rapidly relocated to the standby system. The SSA's hot-site plans reflect its selection of the second possibility. However, this approach currently precludes access to the community of on-line users unless an extensive investment is made to establish network connectivity to the standby system and possibly to enhance its hardware and software capability as well. Having processing capability is necessary but not sufficient in itself to provide the current level of information system support. The data communications network is now a vital part of the SSA's information systems that link computer and data resources to the agency's employees. As time progresses, the SSA will become less able to fall back to manual methods. In another version of the second option, the standby system might ordinarily serve to support administrative or non-critical functions such as decision support or software development. In the event of a disaster at the NCC, these functions could be deferred and their processing assets reassigned to support the critical programmatic functions.

The Risk Is Real

Despite the excellent precautions and facility design measures taken by the SSA to protect the NCC, the possibility of an outage is real. For example, on May 12, 1989, the SABRE reservation system of American Airlines failed for about 13 hours due to the side effects of a routine installation of disk storage (*PC Week,* 1989). In addition to causing a direct loss of revenue during the outage, discounted tickets were sold by other airlines against a seemingly unlimited inventory in the airline's noncurrent but operational systems. The impact of the loss of this system rippled through travel agencies, car rental companies, and hotels. Attempted fallbacks to “long abandoned methods” of telephone calls and paper logs resulted in lost or double bookings.

Regressing to Paper

Unless all of the manual data capture forms are changed to precisely reflect their counterpart computer terminal screens, fallback to manual data entry and retrieval will become more and more difficult, even during short periods when the on-line automated system is unavailable. But even if this is done, at some point in the future as reliance on the automated system increases, regardless of the resources applied to the recovery process, it will be impossible for the SSA to recover from an extensive system outage without an on-line backup system and up-to-date databases.

Reevaluation Needed

Since the NCC has become such a critical element in the SSA's ability to serve its clients, we recommend that:

The Social Security Administration immediately develop a workable strategy for surviving a partial or major loss at the National Computer Center.

One of the alternatives that must be considered is a second geographically separate computer center. A second site can, with minimal staffing, be quickly implemented, provide an effective backup, and also assist in meeting increasing capacity needs that will accompany the transition to on-line operations.

DECISION MAKING

In order to improve our understanding of the rationale behind the SSA's selection of projects to be implemented, we reviewed its decision-making process. Our purpose was to arrive at an appreciation for the basic objectives that drive the agency and thereby influence its decision making. In addition to the discussions we had with the agency's executives on this subject, we also reviewed the internal administrative instruction that deals with the commissioner's decision-making process (Social Security Administration, 1988). Instead of revealing the agency's established and well-defined objectives, we found a reactive environment driven by external and largely unpredictable forces. Thus, while the ASP talks in long-range terms, the reality is that short-term exigencies and crises still dominate the decision-making process. The major and obvious steps have been taken to proceduralize decision making, but the agency must recognize the need to move from making reactive to proactive decisions by more comprehensive planning and consistent management. The sources of projects can come “top down” from SSA executives or higher governmental authorities or “bottom up” from the component organizations. The issues and actions that require the commissioner's decision are described in the administrative instruction referenced above. Once a proposed project or initiative is so identified, the following five-part executive review process takes effect. This process applies to all major projects and generally occurs in the sequence noted:

1. Component Development—Each organizational component proposing a project is responsible for ensuring that its proposals state the general requirements, identify available options, assess costs and benefits, consider relative priorities, and are coordinated with other interested components.
2. ADP Plan Impact—All proposed projects requiring systems development resources must be considered in light of other ADP projects competing for those resources.
3. Budget Impact—Any proposed project requiring a procurement must be considered in light of other Information Technology Systems (ITS) expenses, including telephones, telecommunications, and ADP systems. Project budget proposals are

reviewed by an internal Systems Review Board (SRB), the commissioner, and executive staff. Proposals are prioritized.

4. SRB Action—The SRB was created to provide for an independent internal review of major ADP projects. It formulates recommendations to the commissioner and is composed of an executive board chaired by the chief financial officer with dedicated technical staff support.
5. Commissioner's Decision—The commissioner is the final decision maker on major ADP projects at the SSA.

At any of these stages the SSA can and does make use of outside consultants to review its strategies and provide expert advice. In terms of specific ADP responsibilities, duties are divided along three principal lines:

1. The deputy commissioner of operations has responsibility for all programmatic systems[2] as well as for operation of the NCC.
2. The deputy commissioner of management has responsibility for office automation and management information systems.
3. The chief financial officer has authority over financial management systems and chairs the SRB.

While such a three-way division of responsibility is rational in light of historical evolution and indeed is a workable arrangement now, in the long run it will impede the progress the agency seeks to make toward its goal of a fully integrated systems environment for the following reasons:

- Each component of the tripartite is automatically and implicitly encouraged to develop systems for itself. In general, such systems would reflect the views and needs as seen internally to the organization, not the broader needs and views of the SSA overall. Each would stand alone, so to speak, with regard to other parts of the agency.
- There are bound to be organizational and jurisdictional barriers despite the best intentions everywhere. More to the point, there might well be satisfactory cross-component discussions and agreements for full integration with the individuals presently in place, but the basic structure that divides management responsibility implicitly encourages an intraorganization point of view. With different individuals in place in the future, the essential cooperation might well decay and progress toward integration might thus be deterred.

We thus conclude that more centralized authority for information management and systems may improve decision making and the level of integration achievable and maintainable by the agency.

[2]Programmatic systems are those computer systems that are used to support the SSA programs such as old-age retirement and survivors insurance.

Divided Resources

The SSA has chosen to divide its systems development and support resources to be more closely aligned with the agency's component organizations. Prior to this decision the agency had centralized its systems resources in a single organization. This change at the SSA resulted in specific ADP responsibilities being allocated as described in the "Decision Making" section above and the reassignment of resources from one organization to essentially two organizations: the Office of Operations and the Office of Management. Such decentralization can result in overlapping responsibilities, duplication of effort, uncoordinated projects, confusing priorities, and systems that interoperate poorly. If these problems can be managed, then a separate organizational structure can serve to dedicate and focus resources for specific needs. However, in the long run the agency will be better served if its systems resources are centrally managed rather than separated. The SRB has not demonstrated that it has been an adequate mechanism for coordinating SSA components.

Cost-Benefit Analysis

We did not find that an analysis of costs versus benefits was being applied with consistent criteria by all organizational components. For example, the Office of Operations uses undiscounted costs and benefits, while the Office of Management used a discounted cost-benefit analysis for its office automation project. This does not allow projects to be effectively compared among sectors of the agency, especially return-on-investment comparisons. Consistent application of discounting at the discount rate specified from time to time by the Office of Management and Budget (OMB) will improve decision making. Furthermore, costs should be computed on a life-cycle basis that reflects the total costs to the SSA for acquisition and ownership of a system over its useful life. Life-cycle costs include the cost of development, acquisition, and maintenance. On the benefit side, the following three categories must be addressed:

1. Costs actually saved from real budget reductions.
2. Costs that will be avoided, such as those that will not be incurred because higher levels of output are achieved at the same level of budget.
3. Value of service improvements to the SSA's clients for which cost savings or avoidance cannot be readily calculated.

We suggest that the SSA also consider including social benefits in its analysis. Other agencies, such as the U.S. Army Corps of Engineers and the U.S. Department of the Interior's Bureau of Reclamation, have used this as a means for communicating to oversight authorities what they are trying to do and justifying proposed actions.

Monitoring Total Costs

The agency's practice in deciding on a project includes an initial rough estimate of total costs. At the very beginning of a major project details are not known, so cost estimates are necessarily imprecise. Later as the project begins, precise estimates of the immediate tasks are

made and adherence to them is monitored, but we found that total project costs and schedules are not updated as a project proceeds. The agency's decision makers should have ongoing visibility of the projected total costs to complete a project in addition to the incremental costs they now review. Such a procedure is warranted for agency-initiated projects as well as those that result from mandate because it gives decision makers an opportunity to anticipate problems and look for better alternatives.[3]

The SSA also needs to ensure that feedback of results from all projects, not only major ones, is routinely provided to the project manager and superiors. This will provide a management accounting tool to assess performance and improve future estimates and projections.

Systems Review Board

In operation since November 1987, the SRB was created to be an independent adviser to the commissioner. It acts as an oversight authority for the SSA's systems development operations and procurement activities. This organization provides some worthwhile checks and balances but it also consumes resources directly and indirectly. However, of even greater concern is its potential to stifle effective development by interjecting unnecessary delay. The SSA's chief financial officer, who chairs this board, should certainly be concerned with the level of operating expenses, the effective procurement of volume-driven processing capacity increases, and the benefits of a proposed development. We also agree that the chief financial officer should monitor development schedules and expenditures against the achievement of promised benefits. However, we do not believe that the SRB should review technological and systems design aspects. This function is more effectively performed as part of the design process by specialists within the organizations having such responsibility and by quality assurance and verification and validation functions applied to the design and development work products.

MANUAL PROCESSING

The SSA processes about 6 million new retirement claims each year. The effect of the baby boomers will be felt around the year 2010. At the present time about 20 percent of the retirement claims received are too complicated to be handled routinely and must be processed by the program service centers (PSCs). This fraction of complex cases referred to the PSCs creates a significant burden. The major reasons for claims requiring manual processing are as follows:

- Data are not available to complete the action and must be obtained from the client or another source.
- Some of the data are not available on computer files and must be retrieved from paper records.

[3]Refer to Chapter 2, Project Management, for additional comments on this subject.

- Data exist in computer files but are not available to the computer program that needs the data.
- The function is regarded as a low-volume special case that justifies a low priority on developing automatic processing of it.
- The processing rules are so complex that they are very difficult to execute with a computer program and so their automation is deferred.
- The processing rules are so complicated that it is not feasible to incorporate them into a computer program.

Manual processing for these reasons has a major impact on staffing and total system processing costs. The following is a list of specific instances where manual processing is necessary; the annual volume of such actions is also shown.

ACTIONS REQUIRING MANUAL PROCESSING	THOUSANDS PER YEAR
Miscellaneous benefit record corrections	8,380
Supplemental Security Income (SSI) claims	4,400
Direct entries from PSCs	1,920
Returned-check processing	1,500
Failures in benefit computations	1,440
Disability follow-ups	1,200
Subsequent claims on active accounts	720
Split overpayment recovery or beyond 1999	336
Spouses each with their own benefit accumulations	260
Corrections due to cost of living adjustment recomputation errors	240
Unusual terminations such as foreign beneficiaries or returned checks	192
Manual corrections of payment histories	192
Death lump sums	170
Foreign addresses	150
Disability claims	70
Primary insurance over- and underpayment amounts	48
Status changes due to income added	36
Errors in Medicare billing	24
Corrections for duplicate payments	24
Retirement benefits for more than 10 dependents	12
Retirement benefits for widows	12
Total	21,326

All of these predominantly manual processing tasks performed each year have a greater chance of inducing errors than those that are automated. Many cause corrections to be applied outside of the original process, accounting for much of the load in the Miscellaneous category listed above.

The cost of these manual processing tasks is considerably greater than the relative volume counts would suggest.

1. Each is intrinsically more complex than those handled by automation.
2. The cost of doing them manually can easily be 10 times greater than it would be if automation were applied.

The combination of these factors suggests that even though the aggregate of the transactions is less than 10 percent of the total transaction load of the SSA, the cost of manually processed actions is likely to be over half of SSA's processing costs. The SSA must assess the costs for manually processing transactions. The activities and costs of manual processing provide an important input to resource allocation and planning and are also the basis for cost-benefit assessments. Based on the foregoing argument, there are significant opportunities for automating more of the processing that is now done manually.

Increases Expected

Unless automation is extended to handle more of the cases that are now considered special, the percentage of manual actions will increase. Two major reasons for this are due to changing demographics where (1) the number of dual income families is increasing and (2) the number of dependents from multiple marriages is increasing. Even with a stabilizing divorce rate, the effects of social change in the last 30 years have not yet affected the retirement system; when they do the SSA will need to have extended automation to an even greater percentage of the workload cases it now handles manually. We recommend that:

The SSA aggressively carry forward to completion automation of the basic functions of the agency, including the many for which automation is currently under way or partially implemented, as well as some for which automation is not yet started.

Disability Claims

The process and decision making for handling disability claims are more complex than those for retirement benefits. The SSA receives about 1.2 million disability claims each year. After receiving a claim at a district office, the office requests from state authorities medical verification of the claim. About 40 percent of the claims are approved. Of the claims rejected, about 25 percent are appealed, with about 12 percent of the rejections being reversed in the appeals process. Because of continuous developments in information technology, automation may now be applied to processes where it was not economically or technically feasible in the past. Processing of disability actions as now done is a labor-intensive and

mostly manual process that is prone to inconsistent results and errors. Therefore, it is an area where the SSA must be on the lookout for technology that can economically and reliably automate these processes. In Chapter 4 we discuss several technologies that show promise for disability processing.

DEGREE OF FUNCTIONAL INTEGRATION

Complete functional integration means a user environment in which any computer-based action that is performed anywhere in the agency can be accomplished from the same terminal. For example,

- An employee servicing a client for enrollment or filing a claim could perform all programmatic actions, have access to all relevant data, and have available all relevant support computer-based processes through a single terminal in the same on-line session.
- An employee adjudicating a disability claim could have similar full access to all relevant data, perform all necessary programmatic actions, and be supported by other necessary processes (e.g., a capability to do arithmetic calculations, a capability to perform financial calculations such as those relevant to an annuity) through a single terminal in the same on-line session.
- An employee performing any of the actions required in the administrative and financial components of the SSA could have similar full access to everything needed for performing assigned tasks.

While this sequence of examples might seem to suggest a simple merge of three independent computer-based systems in such a way that any one could flow through a single terminal at a time, it is much more subtle. There are bound to be instances in which the user will have to concurrently function in more than one part; for instance, if a letter is necessary during the processing of a disability claim, the user should be able to recess the review of information related to the claim, move into a word processing function, compose the letter, have copies automatically routed wherever necessary throughout the administrative system (e.g., to the general counsel's office), and do so without terminating the principal session on disability claim processing. Another example is a disability claim that requires concurrent access to retirement claim data for proper processing. Or every user action might automatically forward selected detail or summary information into the administrative system for preparation of management reports. A major advantage of integration is management of the work-force assignments. A common terminal and user interface throughout the SSA facilitates the movement of people from area to area as work demands change. Training might also be reduced to some extent.

We have just described the ultimate in integration, namely, all systems within the SSA fully interconnected and serving all users. There are lesser degrees of integration that might be more cost effective and hence desirable. Another National Research Council committee (National Research Council, 1977) addressed the question of integrating telecommunications

services by asking: How completely can separate facilities and services be integrated before exceeding the optimum cost-benefit ratio? It was concluded that more integration does not naturally lead to more benefits at lower cost—particularly as the integration leads increasingly to increased complexity and counterproductive combinations.

The integration of SSA information, systems, and processes might be encapsulated, so far as the client is concerned, in the construct of "whole-person processing." An SSA employee should be able to handle any action pertinent to a client—from the simplest act of enrollment to the most complex-through a single terminal with ready access to all data, records, and processes required. The degree of integration needed to accomplish this is greater than that which the agency has achieved thus far but is much less than complete integration.

Integrating Administrative and Programmatic Systems

The second phase of an office automation project, which is discussed below, has the objective of integrating the administrative and programmatic systems. Such a level of integration can substantially increase system complexity, without an offsetting gain in productivity or avoided cost.

Thus, even though the notion of a fully integrated environment may appear attractive, we suggest proceeding with caution in planning for the integration of administrative and programmatic systems unless it can be established that the cost of technical complexity can not only be offset financially but also that such a high degree of integration is needed to support the agency's mission. Integration of just the programmatic systems and functions would be an appropriate and preferable first step.

Computer Security

Not every SSA employee is authorized to perform every action or even to access every record or item of data. Thus, division of responsibility will be essential throughout the work force. Technical, managerial, procedural, and administrative safeguards must be in place to enforce, control, and monitor performance of responsibility as assigned. In short, what is usually called computer security[4] will have to be fully in place and thoroughly implemented with contemporary approaches and technology.

The SSA already attends to the security of its computer systems but not in the context of a highly integrated work environment. The safeguards now in place will be a valuable foundation on which to build, but security must be an ab initio design and implementation issue for all hardware and software that will become part of a more integrated system. The security issue must not be regarded as an after-the-fact add-on; it could then be too awkward, too expensive, and possibly even impossible to implement. Elsewhere we have urged that workstation technology be incorporated into the overall system architecture; as such progress is made, security must extend to each workstation as well. In addition to technical safeguards

[4]In addition to physically protecting computer rooms and encrypting data links, computer security also entails protecting information from unauthorized or inadvertent disclosure or modification while providing for needed accessibility.

within the workstation, communication security is an additional requirement.

There is much experience and a growing technology base that can be exploited for system and network security. An operational system that would largely have the right technical characteristics already exists.[5] The SSA will not have to underwrite R&D projects or be the lead agency in an unknown new field, but it will have to become thoroughly conversant with current state of art, and it will have to handle a major engineering and development effort to achieve a properly secure integrated environment.

OFFICE AUTOMATION

The office automation (OA) project was presented to the committee by the SSA as a two-phase project with the objective of increasing the productivity and efficiency of the agency[6]. In its presentation, SSA assumed an 8 percent agencywide productivity increase, and projected that the overall program would produce a 245 percent return on investment. The SSA estimated that a breakeven point would occur in 19 months. A total investment of $258.2 million was estimated with $27.75 million planned for fiscal year 1989.

The first phase of procurement for the OA project began with approximately 5,550 personal computers (PCs) and a second procurement of about 8,000 more is planned. The PCs are using a modest selection of purchased software. Phase I is to include PCs functioning as individual workstations and interconnected into an administrative network. The initial effort to link the SSA's field sites using local-area networks, data modems, and a commercial electronic mail package is in process. We agree with the modest scope of the initial phase and its objective to provide an integrated administrative and management information processing environment. However, the project must involve people experienced with the impact of office automation on the work environment, on organizational structure, and on ways of doing business in addition to those having computer expertise. The introduction of office automation usually changes the culture of an organization and requires clear goals and measurements to ensure that the productivity targets will be achieved. In the absence of such considerations the outcome in industry has often been that no productivity gain is achieved and that introduction of PCs ends up only raising the level of elegance by which tasks are

[5]The Integrated Computer Network (ICN), designed at Los Alamos National Laboratory under U.S. Department of Energy sponsorship, concurrently supports users operating with classified data, unclassified technical data, and unclassified but sensitive administrative data. The ICN incorporates extensive technical safeguards to control access to various categories of information and to monitor the actions of users. It has been successfully exported to and reimplemented in a commercial organization.

[6]The term “office automation” is used loosely; and is not defined with precision. In general, it refers to the use of computer-based technology and techniques to automate the administrative processes of an organization or office. In the past its context was that of a central computer, commonly a minicomputer, connected to a number of simple terminals. More recently, it refers to the use of stand-alone, but often networked, microcomputers or other workstations for the same purpose. However, the functions performed by an “OA system” (e.g., word processing, spread sheets, electronic mail, desktop publishing) vary with the specific needs of the organization it serves. Word processing is almost always present.

accomplished rather than saving or avoiding costs[7]. We have reservations about the effectiveness of investment in the SSA's office automation project as now structured in the absence of addressing the collateral issues of clear goals, measurements, verification of results, and prior office automation experience. We suggest there be a careful evaluation and appraisal of how the present 5,550 terminals are being used and how much of this is service enhancement versus productivity improvement. We suggest that it is important to answer such questions as: How well were the Phase I original project objectives met? How many of the expected benefits were achieved? As offices began to use the terminals, how many new applications were programmed, and how much service gain versus productivity enhancement was achieved from this experimentation? We also believe that continued procurement of hardware should be delayed until this evaluation has been carried out and that future funding requested for this project be examined in this light.

The second phase of the office automation project is aimed at achieving a totally integrated processing environment in which users will have access to both programmatic and administrative functions from a single workstation. This objective raises a broader set of issues that were addressed in the preceding section on integration. As presented to us, the completion of Phase II is to be achieved by 1994. Given the considerable effort left to be done in completing the automation of all programmatic tasks (millions of transactions are still handled manually) and the priority that such work deserves, as well as the work yet to be done to complete Phase I and evaluate its results, we believe that Phase II is more than the SSA can or should strive to achieve in the time frame mentioned. Furthermore, the objective of a fully integrated computer-based information infrastructure for the SSA is unlikely to be achieved successfully given that the needed technical resources are split among several organizations and under different management responsibilities.

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[7]A study of 20 Fortune 500 companies conducted by the Massachusetts Institute of Technology, concluded that sophisticated information technology added nothing to overall productivity. The reason: whatever the potential of computers and allied technologies, it was undermined by cumbersome and inappropriate organizational structure.

4

STRATEGIES FOR THE FUTURE

In this chapter we look ahead and beyond the more immediate challenges described in Chapter 3. Since its creation by Commissioner Hardy in October 1986, the Office of Strategic Planning (OSP) began work on what is now referred to as the Agency Strategic Plan (ASP). This document (U.S. Department of Health and Human Services, 1988) was developed to move the Social Security Administration (SSA) beyond its Systems Modernization Plan (SMP) by setting forth the agency's vision and initiatives for providing services to its clients into the first decade of the next century. One of the tasks for the first phase of our study is to provide the SSA with our assessment of its ASP in light of the SMP's legacy. We were asked to assess the ASP to advise whether it provides good guidance and how it might be improved in future versions. The following section has this objective. Our other objective for this chapter is to highlight several strategic directions that we believe are most promising for the agency's information systems.

AGENCY STRATEGIC PLAN

The ASP is a 48-page document that begins by stating the SSA's mission[1] and its operating priorities. It describes the socioeconomic, demographic, economic, and technological trends and forces that affect the agency's clients and programs and provides a narrative view of the agency looking back from the year 2000. The ASP also lists 29 strategic recommendations that affect its programs, service delivery, technology, organizations, and human resources. It also provides a plan for implementing the strategic recommendations as a series of projects that can be completed by early 1991 and another set of interdependent projects that will proceed in four phases. In developing the ASP the SSA drew support from private industry, public interest groups, and its own people. The ASP is intended to be modified and expanded over time to reflect changing priorities and new initiatives.

To implement the broad initiatives described in the ASP, the agency intends to produce supporting plans that include a 5-year tactical plan and a 2-year operational plan. Such planning is consistent with private industry, which also distinguishes among its strategic,

[1]The agency's mission, as stated in the ASP is: “To administer equitably, effectively and efficiently a national program of social insurance as prescribed by legislation.”

tactical, and operational plans.

The strategic plans provide long-term direction and guidance to the organization. Its goals are based on visions toward which the organizations strive. Specific objectives to be accomplished are usually structured with time constraints in their organization's tactical plan. Detailed matters with budget figures for the next budget cycle are contained in the operational plan of the organization.

Finally, in the planning process, major projects that require more than one budget cycle are laid out in specific project plans. The tactical plans typically have a time horizon of 5 years and set objectives accordingly. Operational plans typically set plans and budget projections based on specific projects and workloads for the present year and 1 year beyond. These tactical and operational plans were still being prepared during this period of our study, so we were not able to review them. The fact that these two plans were not available 17 months after issuance of the ASP suggests that the planning process is not functioning properly within the SSA.

Our Assessment

The ASP presents a broad and sweeping set of initiatives that go beyond just the agency's information systems. These initiatives encompass the SSA's programs, client services, technology, and organization. Regarding its agency wide scope and approach, the ASP is well executed and effectively organized. The agency's mission and long-range strategic goals are succinctly stated. However, the ASP provides no real basis or justification for the goals it has chosen and in this regard, has a major deficiency. It also fails to present a broad vision of what the SSA of the 21st century will look like. Furthermore, the proposed initiatives and operating priorities are not explicitly related to the presented trends in demographics, economics, technology, and society. Future versions of the ASP should address these points.

Strategic Goals

The ASP lists six operating priorities that the agency's management selected to support the SSA's mission. Such operating priorities are effectively strategic goals that form an essential foundation upon which the subsequent initiatives proposed by the agency are based. These goals should be the basis for the tactical and operational plans that are being developed. Quoting from the ASP, the goals are listed as follows:

1. “Maintain the fiscal integrity of the Social Security trust funds”;
2. “Improve public confidence in Social Security and how its programs are operated”;
3. “Provide the best possible service to SSA's customers”;
4. “Improve management to facilitate greater effectiveness, efficiency, and accountability”;
5. “Use the best and most appropriate technology available to administer SSA programs”;
6. “Continue to insure that SSA can count on a properly skilled and highly motivated work force.”

Our greatest concern is with the third goal in that the degree of customer service is stated

without regard to cost or need. As was pointed out in Chapter 3, the SSA must clearly define and quantify the service levels it intends to strive toward. Moreover, the SSA must carefully distinguish between the number and variety of services that it offers clients and the quality of each service. Services provided by the private sector tend to establish customer expectations. The SSA can provide customer service levels that closely follow those of the private service industries without having to exceed or even equal them. In the third goal listed above the words “best possible” might be changed to “fast and accurate” in the next ASP.

Considering the first goal, a board of trustees, which by law is composed of the Secretary of the Treasury as managing director, the Secretary of Labor, the Secretary of Health and Human Services, and two public members, is responsible for holding the trust funds and for making periodic reports to Congress. The SSA, a constituent unit of HHS, has an important role to monitor the trust fund and call for changes when needed to assure fiscal soundness, but the agency's ability to directly maintain its fiscal soundness is limited. The SSA can affect the trust fund's soundness by: (1) assuring that benefits are accurately paid, (2) controlling its own operating budget, and (3) influencing the Board of Trustees and Congress. In the first, although the SSA has a prime obligation to conserve the trust fund by accurately administering benefits, the fact is that even if the legislation were to grant benefits in excess of revenues, the SSA is bound by the law and its responsibility is to determine the recipient and amount of benefit accordingly. In the second, the agency's operating budget is such a small percentage (1.5%) of the trust fund that even with exquisite control of its budget, the SSA has minor leverage on the soundness of the trust fund. In the third, the SSA reports its views on the fiscal health of the trust fund to Congress, and through the Commissioner's position as Secretary of the Board of Trustees. To support its views, the SSA has an actuarial department that tracks and projects expenditures versus income for the fund.

Regarding the fifth goal, we agree with the use of technology to administer the agency's programs, but it must not become an end unto itself. We encourage the SSA to extend its use of technology as a means to better serve its customers in the most cost-effective manner, according to defined levels of service.

We consider the second, fourth, and sixth goals to be entirely appropriate and within the agency's ability to accomplish.

Planning Approach

The SSA must clearly state a vision of what it is, where it is going, and how it plans to get there. Without such a vision of the future, planning for the application of new technology is speculative at best and without foundation. As a result, the technological choices that are made may solve immediate problems but may be inappropriate in the long run. For example, a strategic vision should address the number and location of SSA facilities and the functions performed at them, including the agency's district and regional offices, program service centers, and data processing centers.

The ASP details the SSA's overall planning approach, focusing primarily on the needs of programmatic transactions. For the planning function to be effective it will need such ongoing support and guidance from the commissioner that it becomes in effect a part of that office. The Office of Strategic Planning (OSP), established in 1986, is charged with both long-range planning and with coordinating the planning efforts of the various components within the agency. While this has raised strategic planning to the level of the commissioner's

executive staff, the challenge for the OSP is to provide leadership of the planning process agencywide and to support the other organizations in their planning efforts. This is a difficult challenge for a small and separate organization charged with a new function, but it becomes even more difficult in the long-established culture of the SSA.

Missed Opportunities

A typical strategic planning format used in private industry lists strengths, weaknesses, opportunities, and threats. For competitive organizations this format is appropriate, but for a federal agency it is more important to focus on opportunities first. While the initiatives in the ASP are broadly relevant to its goals, there are missed opportunities that should be addressed.

Telecommunications

Telecommunications is treated lightly in the ASP as a mechanism for service delivery or multi-location voice and data connectivity. Yet in the SSA's report to the Senate Appropriations Committee (Social Security Administration, 1989), the fiscal year 1990 budget requested by the SSA for maintaining its current information systems includes $64.2 million for automated data processing (ADP) and $96 million for telecommunications. Since telecommunications, including the Data Communications Utility (DCU) and telephones, is budgeted at 150 percent of ADP costs, and hence dominates this part of the budget, we would have expected that the ASP would have included a strategic initiative to find ways to lower these costs without adversely affecting service or operations.

Even without being able to precisely quantify what savings might be achievable, based on experiences of private industry, we believe that a multimillion dollar annual savings is possible by consolidating telecommunications procurement for both telecommunications and the DCU. This would best be accomplished by a central organization charged with procuring and managing the agency's telecommunications infrastructure as is the common practice for major industrial corporations. Such central management in government is embodied in the concept of total information resources management. Central management is what the General Services Administration (GSA) accomplished in its Federal Telephone System (FTS) program known as FTS 2000. The GSA recently contracted with two major long-distance carriers to provide telecommunications services to federal agencies and the agencies are obliged to procure service through FTS 2000 unless good reasons to the contrary exist. The existence of FTS 2000 neither negates nor reduces the advisability for the SSA of centralizing agencywide responsibility for requirements, procurement, and overall management of telecommunications. Among the things we noticed in connection with SSA's handling of telecommunications:

- The SSA generally procures telephone and data communications as independent services, and even sometimes procures telecommunications on a programmatic basis, rather than an overall agency requirement. The SSA must address the combined telephone and data communications requirements and where possible consider them as a single item for procurement under FTS 2000 schedules.

- For local telephone service there is no overall management of the interface between onsite equipment and the local telephone exchange. If this management existed it could help avoid buying more capacity than needed (overtrunking) and might also help avoid undertrunking, which impairs service.

With constant monitoring of local usage statistics and proper management, a better balance of office demand and trunking facilities can be achieved and maintained. With over 1,500 separate facilities the possible savings to the SSA are large. We recommend that:

The Social Security Administration consolidate voice and data requirements to take advantage of possible economies of scale in procurement and management of telecommunications facilities.

Back Up and Recovery

The SSA operates a highly centralized architecture for its data processing and storage. However, with one data center and a growing but unavoidable reliance on computer support for day-to-day operations, the agency needs to develop a strategy for dealing with the possibility of a sustained outage and needs to set goals to minimize the consequences of such an event. In this regard we note that had the agency chosen a format for its ASP that listed strengths, weaknesses, opportunities, and threats, this issue may have naturally appeared under threats. Chapter 3 addresses this issue.

Automating Disability Processes

The ASP should address increasing automation of its disability programs. For example, during our visit to the Office of Disability Operations (ODO), we found that this operation is based on moving, managing, and storing paper file folders. Modern technology clearly provides an opportunity for sharply improving the efficiency of administering the disability program. The disability program requires a disproportionate share of the agency's administrative staff in relation to the share of clients served. For example, only about 10 percent of the SSA's clients receive disability benefits, but this workload consumes about 32 percent of the administrative outlay from the trust fund. Later, in the section entitled Toward a Paperless Environment, we suggest technological approaches to address this function.

AN ARCHITECTURE FOR INFORMATION

Evolution of the Current Systems

The current architecture of SSA's systems is the result of a gradual evolution toward on-line systems from a traditional batch processing environment. Present implementations and

choices in SSA's architecture appear to have been conservatively made and carried out by an incremental modification of previous systems, with new processing modes (e.g., on-line operations and telecommunications input from 800 numbers) being introduced in an adhoc manner in response to high-level strategic initiatives.

The evolutionary heritage of past investments and decisions predisposes the agency toward centralized solutions for both its architecture and database structure. While such solutions have not been unreasonable given the past, the concomitant link to traditional ADP methodologies and attitudes has inhibited the exploration of more distributed hardware and software methodologies that would support the increasingly on-line environment for applications programs.

Most limiting, however, has been the lack of agency initiative in planning for the eventual elimination of paper-based manual operations, which continue to consume a disproportionate fraction of costs, continue to impair productivity increases, and inhibit the smooth integration of newly legislated features. With the rapidly increasing technological advances in optical storage systems and image processing, it is important that the SSA plan for a transition to a paperless environment in the coming decade.

A Framework for Future System Evolution

The progress made under the SMP is significant. Nevertheless, the agency enters the early 1990s with the data processing methodologies of the 1970s and early 1980s. Before proceeding with specific information processing initiatives based on the goals of the ASP, the SSA should conduct a careful systems analysis of its existing functions, including a comparative study of how alternative information processing methods and degrees of automation will impact the performance of these functions for different levels of federal investment. Such an analysis is essential if the cycle of “catchup and crisis” behavior in information technologies is to be avoided in the future at the SSA.

One possible way to view the factors pertinent to the analysis is to develop, for each of the SSA's major functions, a 3-dimensional matrix that displays: (1) component tasks, (2) processing requirements, and (3) possible levels of automation. For the latter there are clear groupings and a natural ranking:

- Paper-based, purely manual operation.
- Paper-based, automated tracking/control, manual processing operation.
- Computer-based, batch processing operation.
- Computer-based, on-line system input/batch output.
- Computer-based, on-line input and output.
- Computer-based, on-line input and output and retrieval, fully integrated into other services.

Every major function carried out by the SSA is actually a process made up of several subtasks, each of which may involve differing degrees of automation. As a result, the degree of automation possible for a function such as claims development or disability adjudication

might best be characterized by the mix or distribution of automation levels in these subtasks. For each of the subtasks it should be possible to also determine the personnel resources currently used, their degree of involvement, the data processing resources expended, and the average time of completion for the mix of actual jobs falling within the subtask for a standard time period. If statistics on errors that lead to delay in job completion are also gathered, and the down-line effects of such delays are evaluated, it should be possible to assess costs and benefits for the current set of subtasks within each function. Besides the degree of automation involved in each subtask, it is important to characterize processing complexity in terms of access operations and processor utilization. Most of the on-line processes of the SSA currently involve fairly straightforward storage/retrieval processing and the generation of fixed summaries for individual SSA client files. At the district office level, on-line software is already being designed and introduced that performs some routine calculations that are appended to summary reports. However, the agency can and should go much further toward automating full processes, not just tasks, and reducing its reliance on paper. The SSA should press toward fully automating "whole person" processing from birth to death, including enrollment, accumulation of contributions, health care, retirement, and survivors benefits.

A major shortcoming of current systems is that they do not permit concurrent access to several records from one functional program or multitasking of programs to dynamically generate problem-oriented files as needed. Such capability is essential for on-line handling of family groupings and claim/benefit assessments and calculations that, for example, might be determined by the nature and number of dependents involved in the grouping. In the future we expect that calculations, relationships among calculations and associated files, and operations involving multiple files all will become more complex and more often the rule rather than the exception. We anticipate that so-called rule-based expert systems will be used at local offices to handle some cases and some processing.

At the regional and central levels processing of large numbers of records can involve more computation (e.g., statistical analyses and simulations). While such processing is entirely in the batch mode at present, we expect it to evolve into a mix of on-line and batch programs as more flexibility in operational planning is demanded in the future. In order to rationally plan for the smooth introduction of new technology, the SSA must augment its analysis of existing functions by a study of the effect of introducing advanced processing methods into not only subtasks but also the overall process. It should also consider whether modifications of existing subtasks and their sequencing or the introduction of entirely new and more efficient task decompositions are feasible, or even desirable or essential as higher degrees of automation are introduced into the function.

Such analyses would exhibit and quantify the trade-offs among resources, costs, and benefits not only for the present level of automation but also for a variety of possible new process decompositions and associated levels of automation.

Toward a Paperless Environment

The process of producing, acquiring, tracking, retrieving, storing or filing, and managing paper documents consumes a major portion of the operating costs of any large paper-intensive operation. The SSA is no exception, and the introduction of on-line systems can do much to reduce the blizzard of paper. Even with the progress from the SMP, the bulk of the agency's processes still depend on paper file folders containing such items as original inquiries, internal

and external correspondence, memos, and cuff notes from users. Such an observation reinforces our previously expressed view that the agency has automated tasks not processes; and the investment of the SMP has primarily enabled the agency to recover from a crisis with the actual increase in automation largely confined to the proliferation of computer terminals. On the other hand, there has been some progress in removing paper, and the SSA even refers to folderless systems. Nonetheless, file folders and their contents together with the file cabinets to store them still exist; they are just not accessed as frequently.

Even with the progress from an all-paper to a paper-based operation supported by automation, the ODO, for example, has virtually no automation and depends on constantly moving huge volumes of paper file folders. The ODO is a challenging opportunity for automation because medical evidence and other information external to the SSA is nontextual (e.g., X-ray films). Such nontextual information requires an imaging system to store it electronically, but integrated image and data storage and retrieval systems are relatively new to office and paper operations. Ongoing experiments by the United Services Automobile Association (USAA) and the Office of the Secretary of Defense provide some data. Excitement over optical technology is widespread; certainly it is a promising part of the long-term information architecture for the agency.

For disability operations, image processing and optical storage and retrieval may be the key to any meaningful progress in providing on-line automated support to claims examiners and reviewers. The SSA is urged to undertake exploratory experiments and demonstration projects with such technology to examine relevance to ODO and to gain experience needed to guide the development of future systems.

An issue of concern in both disability and nondisability operations is the legal status of image- versus original-copy retention. While such uncertain legal issues are a societal concern, the SSA could exercise leadership here in overcoming some of these obstacles in the next couple of years.

The SSA should carry out an analysis of systems procedures and architectures needed to support paperless operations. Disability operations are a prime target for this technology.

Toward an Architectural Evolution

The SMP envisions a target architecture that represents the final stage of an advanced centralized processing system. It defined extensive on-line support to users, a well thought out and layered approach to software, and a large centralized architecture. In our view the agency should not stop at the stage defined in the SMP. Rather, it should consider the development of workstation applications to support the user and to share the workload with the centralized databases and processing facilities. We recommend that the SSA undertake the preparatory planning and analysis to select a proper scope of application of workstations that can be affordably implemented.

The SSA is evolving from a batch environment where a user deals only with paper inputs and outputs to an on-line environment where many transactions and processes can be accomplished during a single on-line computer session. The evolution of today's system to an on-line environment will provide applications and database support to the users for each of the SSA's functions. However, if the user continues to operate a terminal supported completely by a central processor, the undesirable effects include: constraints on processing flexibility, constraints on sharing of the workload, continuing concentration of equipment at

the National Computer Center (NCC), and excessive dependence on data communications. These can result in degrading overall agency performance. At a minimum, centralized support of remotely located computer terminals will be limited by capacity on the host system and by the communications network that links them. Worse, advanced features such as windowing techniques facilitating concurrent access to several client files at the terminal and user-oriented menus will be impossible or demand large increases in data communications support.

We believe that workstation technology[2] can clearly provide a broader range of user support and integration of function. It can provide local processing for applications and make possible advanced windowing and menu features. The workstation approach will focus central processing on database retrievals and updates that would make central processor workloads more predictable and stabilize the sizing of host processors and network facilities. We project that users at the program service centers and the district offices will require broader automation support, especially as the agency moves to a "whole person" level of automation.

Transition to a workstation environment will allow significant sharing of processing with the central facilities. A careful requirements analysis will be needed because the workstation must span the full functional requirements of a user or set of users. On-line transactions with the NCC should emphasize data retrieval and file updating.

Software development for workstation applications must be under central configuration control for both development and maintenance. Almost surely, local users will develop their own specialized applications, but the configuration management must assure that centrally provided capabilities are not perturbed and that locally created features do not inadvertently subvert SSA policies and procedures. This should not be a problem as long as common procedures are reviewed and issued centrally. We recommend that:

The Social Security Administration retain the present centralized database architecture but plan for the introduction of "intelligent" workstations providing increased local support to the users of the system and embodying a common user interface for performing any agency function.

Toward a Common User Interface

As part of developing and introducing a workstation environment, the SSA should also develop a human-engineered user interface environment that spans the full range of applications, exploits contemporary approaches and features for such interfaces (e.g., pull-down menus, windowing), and interacts with the central processor transparently to the user. Such an interface, common to all users, can ease the introduction of workstation software and guide a user through complicated sequences of case actions. Such a development of a rich application set will take several years, but the basic features must be present initially so that subsequent extensions do not require relearning by users.

Careful human factors analysis can identify the detailed features and suggest alternative

[2]This term is intended to refer to high-performance microcomputers with autonomous capability. Workstation technology is currently available and rapidly becoming less expensive.

man-machine configurations for specific tasks and functions. An important payoff from a common user interface is the ease of moving personnel from job to job and section to section, in turn minimizing some of the management headaches of personnel turnover.

Toward an Integrated Architecture

The integration of image processing, optical storage, and retrieval systems with workstation-based decision support systems promises to revolutionize office and paper operations in the next decade. From the standpoint of the facility manager, such a system can provide the receipt (date, time, source), routing (classification of action); tasking (assignment of responsibility and completion date); tracking (location and position in the queue); managing (past due, reassignment, repositioning in the queue); storage (archives); and retrieval of documents. It enables management to accurately measure workloads, reallocate work, or reallocate staff to complete work. Not only is management made more effective, but such systems save the additional costs of searching through piles of documents, manually filing and retrieving, and handling heterogeneous documents of different sizes. Such an integrated environment offers great promise for the SSA in all its operations, including disability workloads.

The natural progress of automation at the SSA should extend from centralized batch to centralized on-line operations, to workstation environments, and to combined workstation and optical storage-and-retrieval systems. Such systems not only help management in assigning work, tracking and locating cases, and completing overdue actions, but they also help the individual user. Workstations can bring up (or "window in") copies of all documents germane to the case at hand. The user can assemble on one screen all of the information necessary to complete a case action. The user can also manage his or her own queue of work, easily viewing assigned cases and their respective due dates and creating customized particularized management information such as cases worked on and those pending by type.

The SSA should define a target architecture (initially at the top level) that uses available and near-term technology. Because of the cost and telecommunications demand for transmitting high-quality images, we project storage of documents and other images locally at the program service centers. While this requires a high-capacity local network to link workstations with optical storage devices, the long-haul data communications would not be seriously impacted. Management workstations would perform case control, workload management, and quality assurance activities. User workstations would access the NCC through a gateway off the local area network (LAN).

Toward the Use of Expert Systems

The introduction of expert-system technology promises greater productivity and standardization of processing for areas in which there exists well-specified decision criteria or at least sufficient expertise to identify and define "norms of practice." While there are various opportunities for automating processes via expert-system technology, disability claims processing and adjudication are the major prospective targets because of the present long delays in the process and the existence of standardized rules for large parts of it. The SSA has

already projected that automating the reconsideration and appeals process would reduce delays in disability processing from an average of 515 days to 299 days. The application of expert-system technology might help reduce the verification time and also improve the consistency of rulings on such claims, thereby reducing the number of cases overturned in the appeals process. In supporting an appeal one of the strongest points that a rejected claimant can make, and one of the most common arguments, is that a similar disability was allowed in another case. Such inconsistency in ruling on medical disabilities is understandable given that these determinations are made at many offices of state-operated facilities. By applying expert-system technology to make consistent rule-based decisions for disability verification, the verification time should be reduced and the percentage of appeals and decision reversals also should decrease.

Laying the Groundwork

While potential benefits from automating processes are clear, the need for expert-system versus conventional algorithmic approaches has not been established. Nor has the feasibility of using current expert-system technology in the more complex operations been established. The precision, unambiguity, and completeness with which decision criteria are known and the level of expertise in applying such criteria need to be examined as part of an initial exploratory prototype effort. In present expert systems (sometimes called knowledge-based systems) the state of the art is adequate to build systems for the SSA if the knowledge base (criteria and experience in using them) is adequate.

There must also be a supplemental examination of present SSA functionality to identify potential applications of expert systems and, importantly, what is their likely interaction with conventional on-line and/or batch processes and with manual processes before choosing which decision areas are beneficial initial targets of opportunity. As part of this analysis, bottlenecks in the current manual paper-driven process must be clearly identified and a human factors study performed to assess the feasibility of introducing different mixes of automation, including the expert-system components.

Criteria for Applying Expert Systems

In addition to disability processing, there may be other opportunities for introducing expert systems within SSA operations. These should be pursued only in conjunction with a clear plan that first makes full use of simpler automation methods for assisting on-line decision making at the district or regional levels.

In general, the functionality of the SSA, in particular the most complex decision processes, must be inventoried and analyzed rigorously. One group of such categories is the following. As a reminder, “knowledge base” includes both the criteria for making a decision and the experience of applying those criteria.

1. Already existing knowledge bases of decision criteria that at most need some refinement.
2. Partially existing knowledge bases of decision criteria that need considerable knowledge engineering to convert to automatically usable decision rules.

3. Minimal formalized decision criteria but sufficient human expertise that can be codified into heuristics for the application and elaboration of the criteria.
4. No decision criteria but authoritative experts who claim to have consistently applicable decision heuristics.
5. No decision criteria but authoritative experts who apply a considerable degree of unformalized judgment in arriving at their decisions.
6. No decision criteria and only semiauthoritative experts who apply their judgment in arriving at conclusions.

The first category above may well turn out to be implementable with conventional algorithmic techniques if the decision logic is sufficiently simple or restatable in a simple form. Even in such a circumstance which may not justify full implementation, a knowledge engineering approach can be useful to design a prototype by flexibly suggesting alternative ways of organizing and representing the knowledge.

The second and third categories are amenable to application of current knowledge engineering techniques, with increasing degrees of investment in specialist time and knowledge engineering expertise over that needed for the first category.

The fourth category will require truly intensive knowledge engineering and should not be undertaken at the present time unless considerable investment in automating the function is deemed desirable.

The fifth and sixth categories involve ongoing research problems and should be set aside until new methodologies of knowledge representation and machine learning are developed. However, there might exist a different kind of opportunity for these two categories. The SSA might simply formalize (e.g., make explicit in a structured way) current rules of practice and decision processes that might then represent implicitly accepted methods of operation. In some cases such formalization may prove to be unproductive and may instead point to areas where legislation might need clarification or revision to change existing ambiguities or contradictions in the law. In other cases formalization may be advantageous to clarify administrative interpretations where these fall clearly under the executive jurisdiction.

Suggested Steps

We believe that the application of knowledge engineering, and in particular an expert-system approach to the business of the SSA, holds great promise; however, the agency must also recognize that this technology has limitations and should be approached in a carefully planned and deliberate manner. There has been overselling of the technology and overstatement of benefits; but on the other hand, there are many documented cases of significant improvements in productivity from relatively modest rule-based systems (Feigenbaum, et al., 1988).

Hence, we recommend that the SSA proceed in the following steps:

1. **Assess the scope of problems first in the disability functions and subsequently in other areas to identify decision-making components amenable to prototype demonstration.**

2. **Perform a cost-benefit analysis of the identified components and prioritize them as entrants in an overall Agency Strategic Plan.**
3. **Develop a prototype for test and evaluation. Goals of the effort must include (a) a clear specification of benefits expected from different levels of decision support and degrees of automation, particularly as they relate to; (b) expectations of increased levels of service and support; and (c) outreach to the increasing pool of clients who are incapacitated, disabled, or have different cultural backgrounds.**
4. **Investigate the need for and benefit from formalizing current norms of practice in the interpretation and application of possibly ambiguous statutory rules and criteria, with the view of either suggesting revisions in legislation or proceeding with the construction of formal knowledge bases when ambiguities can be resolved by administrative or executive action.**

Promising Advanced Information Technologies

The SSA requires an ongoing program of technology assessment and concomitant planning to identify many opportunities that can arise from technology not now in use at SSA. For example, voice recognition, smart cards, optical storage cards, even the esoteric neural networks at some point in the future are all advancing sufficiently rapidly that the SSA should stay abreast of their capabilities and possible application to the agency's functions.

For example, voice recognition systems could well increase productivity in the district offices but only after a full workstation capability has been installed to provide efficient and concurrent access to multiple records and programs. Voice recognition systems will eventually replace much of the computer system interaction now done through keyboard entry and also afford greater opportunities for the physically impaired in the workplace. The current technology is steadily improving the vocabulary of such systems and their ability to reliably adapt to different voices. Voice recognition systems trainable on a single user are within existing technology and should become economically feasible for incorporation into workstations by the time a workstation environment is widespread throughout the SSA.

The smart card is a technology that embeds both microelectronic memory and processing in a plastic card. Typically the size and appearance are similar to those of a credit card; the microchip memory can be read and altered electronically, and the internal processor can be used for many purposes. Smart card technology provides a convenient means for transporting large quantities of individualized client information. In the SSA context this could facilitate the processing of client queries and actions at geographically varied locations. The need for personal contact would be reduced, with resultant personnel savings. The savings would be especially significant if a client could access his or her information, of course with appropriate security and privacy provisions, from home or public access points. By combining teleprocessing and smart card technologies, a variety of options can be envisioned to improve and customize individual access and service.

Optical storage cards employ compact disk technology to store and retrieve information. They are relatively new but presently have the capacity of storing up to 16 million characters of information in a device the size of a credit card. An important difference between smart cards and optical storage cards is that the latter can readily store information such as data, image (photographs), signature, fingerprints, and X-ray images. At present, optical storage

card technology is a so-called write-once-read-many (WORM) device, so it is not currently intended for applications that require data to be readily alterable. It is an inexpensive technology to mass produce, and current estimates place the cost of a card at about 4 cents.

In the long run the neural network might also have potential for the SSA. Since the neural net acquires its capability by "being taught"—in effect watching an individual(s) perform the process that it is intended to replicate—it is conceivable that decision processes for which an ill-defined knowledge base exists might be implemented with neural nets. Neural network technology is not now as well developed as expert systems, but its progress should be monitored.

To summarize regarding advanced information technologies, we recommend that:

The Social Security Administration study and inventory its technological base with a view toward establishing the relevance and candidacy of promising new technologies to its systems and needs, identify opportunities to exploit them to reduce costs and enhance services, and incorporate the results of such studies and examinations into revised editions of its Agency Strategic Plan.

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APPENDIX A

WORK STATEMENT

PHASE I

In Phase I, the committee will evaluate the status of the Systems Modernization Plan and assess the Agency Strategic Plan for the year 2000. The committee will perform the following tasks during Phase I:

1. Review the current status of the SSA's information systems facilities. This review should establish a baseline for subsequent committee tasks and include the existing hardware and software architecture, technical personnel resources, and financial and physical resources. Early attention should be given to (1) the capability of SSA's physical and software infrastructure to accommodate present and future communication loads and (2) structural changes (e.g., distribution of functions) and fault corrections (e.g., replacing inadequate software) that may promptly improve operations and performance.
2. Examine the three phases (survival, transition, and state of the art) of the SSA's current modernization program. This examination should review the results of the completed survival phase, assess the status of the transition phase, and identify the remaining work to move to the state-of-the-art phase. The examination should also define the additional work needed to attain a state-of-the-art environment that supports the ASP.
3. Review the software engineering methods being used at the SSA. This review should assess the adequacy of the software engineering methods and their level of use throughout the development life cycles. The review should identify the work required to complete the analysis and definition of SSA's information and data requirements for current and future SSA operations. The review should also embrace the approach and status of the information flow and data analysis methods employed.
4. Review the SSA's statement of Systems Modernization Plan requirements. This effort should evaluate the adequacy of the current information architecture and database strategy to meet those requirements in light of current technology trends. This work should also identify attractive alternative information and database architectures.

5. Assess the Agency Strategic Plan. This assessment should review the overall planning approach and evaluate the plan in terms of SSA's mission, goals, and objectives. The assessment should also evaluate the ASP's proposed initiatives, its implementation strategy, and the coherence of the 2-year and 5-year detailed plans with the overall ASP and each other. The committee should recommend ways that the SSA may improve its overall planning approach and initiatives.

PHASE II

In Phase II, the committee will evaluate the technical and technical management environment in which the implementation of the Systems Modernization Plan and Agency Strategic Plan is being, and will be, performed and recommend the approaches needed to complete the Systems Modernization Plan in 1990 and to implement the Agency Strategic Plan by the year 2000. The committee shall perform the following tasks during Phase II:

1. Assess SSA's technical organization and management environment in which the Systems Modernization Plan is being implemented. This assessment should embrace adequacy of the integration management methods being used throughout the project development life cycle, the adequacy and experience (e.g., number, mix, and skills) of the technical managers and specialists required by the SMP and ASP projects, and recommend improvements through which technical workforce may better meet current and future demands.
2. Evaluate SSA's methods for maintaining a modern technical knowledge environment. This evaluation should review the adequacy of the SSA's technology training methods and other upgrades available to its employees from the entry level to senior management. This evaluation should also review the way SSA tracks and disseminates technology trends and should identify the methods and resources needed to develop and maintain a current knowledge of technology with SSA. This task should also help define an effective environment for prototype testing and evaluation of innovative technical systems and procedures.
3. Estimate the adequacy of current planning and implementation to introduce methods of assessing the impact of technology on SSA's service recipients and employees.
4. Recommend methods to improve systems integration management at the project, program, operations, and headquarters levels within SSA.

APPENDIX B

LIST OF PRESENTATIONS TO THE COMMITTEE ON REVIEW OF SSA's SYSTEM MODERNIZATION (SMP) AND AGENCY STRATEGIC PLAN (ASP)

September 8–9. 1988
National Research Council
Washington, D.C.

DORCAS R.HARDY

Commissioner, Social Security Administration

Executive Address

HERBERT R.DOGGETTE, JR.

Deputy Commissioner for Operations

An Overview of the Social Security Administration (SSA)

RENATO A.DiPENTIMA

Associate Commissioner for Systems Integration

Systems Modernization Plan (SMP)—Overview and Background

D.DEAN MESTERHARM

Associate Deputy Commissioner for Systems Support

Review of Existing Information Technology Resources—Programmatic Systems

Database/Data Administration

JAMES E.PREISSNER

Acting Deputy Associate Commissioner for Systems Operations

National Computer Center—Facility Overview, Communications Networks, Computer Configuration, and Workload Profile

CARY GREEN

Director, Office of Strategic Planning and Integration

Systems Engineering Environment—Systems Planning, Systems Integration, Project Management, and Technical Training

JOHN R.DYER

Deputy Commissioner for Management

Review of Existing Information Technology Resources— Administrative/Management Information Systems, Telephone Communications, and Personnel Development

JAIME L.MANZANO

Director, Office of Strategic Planning

Agency Strategic Plan (ASP) Overview

D.DEAN MESTERHARM, JOHN R.DYER, and JAIME L.MANZANO

Future Directions—Relationship of the Planning Process and Refocusing Effort to the ASP, Administrative Management Information Systems, Office Automation, and SSA Institute

November 9–10, 1988
Office of Systems Operations
Office of Disability and International Operations
Baltimore, Maryland

MARTIN BAER

Acting Director, Office of Computer Processing Operations (OCPO)

Distribution of Functions and Architecture

MIKE McCOY

Deputy Director, Division of Standards and Control, Office of System Support and Planning (OSSP)

Security and Confidentiality

BOB VACCARO

Deputy Director, OCPO

Scheduling

MARTIN BAER and BOB VACCARO

How Does OSO Make It All Work

DAVE TRUAX

Director, OSSP

Backup and Recovery

JOHN RITTER

Executive Program Policy Officer, Office of Disability Operations

Disability Evaluation Process

BILL NEWTON

Office of Disability International Operations, Disability Project Manager, ODIO

Workload Process in ODIO

ROBERT EMRICH

Director, Federal Disability Determination Services (FDDS)

ANN BURGAN

Director, Systems Planning Staff

Tour of Federal Disability Determination Services (FDDS), Modules 17 and 24

D.DEAN MESTERHARM

Associate Deputy Commissioner for Systems Support

Modernization Emphasis

RICHARD ANTALEK

Software Engineering Program Manager

RICHARD ECKERT

Director, Division of Data Administration

Systems Framework and Foundations

RENATO DiPENTIMA

Associate Commissioner for Systems Integration

Environmental Factors

January 18–19, 1989
Western Program Service Center (WNPSC)
Richmond, California

DONALD N.MINGS

Regional Commissioner

TREVOR EVANS-YOUNG

Deputy Regional Commissioner

Introduction of Staff

Future of the PSC

RUTH A.PIERCE

Associate Deputy Commissioner for Regional Operations

Overview of Meeting

CARLA PANCHECO

Director of Operations, WNPSC

Role of the PSC—Current Problems and Needs

JIM PERSON

Director of Management, WNPSC

PSC Organizational Structure

PAUL COFER

Operations Analyst

Workflow—Description of the Type of Work Performed in a PSC and How It Is Processed

Distributed Data Processing

DAVID BROOKES

Operations Analyst

Workflow—Description of the Systems Used in Workflow Process Systems Modernization Efforts

JOANNE PENCE

Chief, Systems Operation Management Branch

Automation Resources—Description of the Types of Hardware in the PSC

March 16–17, 1989
National Research Council
Washington, D.C.
JOHN R.DYER
Deputy Commissioner for Management
OA Is Good Business at SSA—Problems and Solutions, Productivity Improvements
KIMBERLEE J.MITCHEL
Director for Information Management
RICH GONZALEZ
Program Manager for Office Automation
OA—Planning—Architecture—Implementation
D.DEAN MESTERHARM
Associate Deputy Commissioner for Systems Support
Status of Modernization
Review of Applications Architecture
Status of the Modernization of Key Business Functions
Data Administration Status
Planning Activities
Project Management
September 5, 1989
Social Security Administration Headquarters
Baltimore, Maryland
Subcommittee
HULDAH LIEBERMAN
Associate Deputy Commissioner for Central Processing
HERBERT R.DOGGETTE, JR.
Deputy Commissioner for Operations
October 31-November 1, 1989
National Academy of Sciences
Washington, D.C.
PAUL TRACY and JOHN RYAN
Strategic Planning Staff
Status of the Agency Strategic Plan (ASP) and ASP Renewal Plan
JACK McHALE
Project Director
Issues Discussion/National 800 Number

HULDAH LIEBERMAN
Associate Deputy Commissioner for Central Processing
Issues Discussion/Capacity Planning
HERBERT R.DOGGETTE, JR.
Deputy Commissioner for Operations
Issues Discussion/Backup and Recovery
GWENDOLYN S.KING
Commissioner, Social Security Administration
Informal discussion with the committee

APPENDIX C

SSA's FUNCTIONS AND INFORMATION FLOWS

This appendix is organized by the types of services that the Social Security Administration (SSA) performs. These services are carried out through a variety of physical facilities that include:

- Approximately 1,300 district offices (DOs)
- 37 teleservice centers (TSCs), including 4 megasites
- 10 regional offices
- 6 program service centers (PSCs)
- 3 data operation centers (DOCs)
- 132 hearing offices
- The Title XVI Folder Servicing Operation
- A headquarters complex which separately houses:

- the central management/administrative/staff components
- the Office of Central Records Operations
- the National Computer Center (NCC)
- the Office of Disability and International Operations (ODIO)

MAJOR SERVICES

Most services provided by the SSA involve more than one of these facilities. The SSA also interacts with other federal and state agencies such as the U.S. Department of the Treasury, the Internal Revenue Service (IRS), State Disability Determinatian Services, and the Health Care Financing Administration (HCFA) for Medicare payments.

In the following sections we list the major services that the SSA's computer systems must support with an indication of how the task is carried out, which facilities are currently involved, and the associated volume of work. We have identified 17 different types of tasks.

Getting a Social Security Number

The process of getting a social security number (SSN) is called enumeration. The current standard method for obtaining one requires that every applicant must provide the SSA with evidence of age, identity and U.S. citizenship or lawful alien status. In addition, any individual age 18 or older must consent to a face-to-face interview with a SSA staff when applying for a new number.

Increasingly, enumeration of newborns is being done through a process by which parents elect to apply for a SSN for their newborns as part of the birth registration process. If parents choose to use this process, the states provide certain basic identifying information to the SSA electronically, an SSN is assigned, and a card is mailed to the parents. Currently, SSNs can be secured through the enumeration-at-birth (EAB) service in 38 states. EAB will be fully operational in 8 more states by early 1990. California will begin participation in 1991; the remaining 3 States are still evaluating their position.

As of 1988, the SSA had issued 326,850,000 SSNs. The typical yearly enumeration workload is 12 million to 13 million requests; approximately 40 percent of these requests are for assignment of a new SSN. In fiscal year 1988, changes in the tax laws that required enumeration of dependents significantly increased the enumeration workload: about 23 million requests for social security cards were processed that year. Workloads are expected to stabilize back to typical levels after 1990.

Getting an SSN is now done by an on-line entry of a request to a batch program. Applicants usually receive their card in 2 weeks. This function is a candidate for full on-line validation and processing of the requests, even though the actual document would still have to be mailed to the applicant's residence.

Card Replacement and Information Updates

More than half of the enumeration workload involves requests for replacement SSN cards to reflect name changes or to replace cards that have been lost or damaged. Application for replacement cards can be obtained by phone or by visiting a field office. Since the applicant's identity must be verified, the applicant must either visit a field office or mail to the office original proof of identity. Field office personnel make an on-line request for a replacement card to be issued. The requests are processed in batch mode at the NCC and the new card is mailed from the NCC within a few days.

Obtaining General Information

Information such as brochures on benefits or procedures can be obtained from field offices or by using the national 800 telephone number to reach a teleservice center (TSC). During high call periods, TSCs collocated with district offices (DOs) may use DO personnel to handle some of the telephone workload. In addition, calls received by a TSC during a period of high local workloads may be switched to remote TSCs. However, personnel at the

remote TSCs may not be as well informed about specific local questions. For example, questions about the black lung program resulted in a sizable workload in West Virginia but are rare in other states.

The demand for general information increases greatly when there are public announcements or legislative changes, but the request rate is reduced when users find the lines busy. The general information workload is difficult to predict, but it can be a significant burden to the available telephone line facilities. It can overload access circuits, increasing the rate of busy signals, which lead to customer dissatisfaction.

Crediting of Earnings Records

The SSA must maintain accurate records of an individual's earnings in order to determine both eligibility for program benefits and benefit payment amounts. At present the SSA maintains over 332 million separate earnings records in its master earnings file. Over 100 million accesses are made to this file every year for processing claims, responding to requests for earnings statements, and for other activities.

The Agency obtains earnings information by processing the data submitted by employers as required by Internal Revenue Service (IRS) form W-3, which is a summary of the information individuals received from their employers on IRS form W-2. The SSA processes all W-3 information for transmittal to the IRS including information on FICA contributions paid. The SSA records data about the wage and self employment income for which FICA contributions are due, as well as noncovered earnings, pension payments, and other non-FICA information. W-3 data may be submitted by employers on magnetic media or on paper forms. Paper W-3's are sent to the DOCs for scanning or keying to magnetic tape; the information is then transmitted to the NCC for processing. Data on magnetic media are received directly by the NCC. Approximately 235 million wage items were processed in fiscal year 1988. Of these, 148 million were reported on magnetic media, and 87 million were on forms W-3.

Wage amounts are posted to the employee's earning record on an annual basis. Earnings reports are due to SSA by January 30 of the year following the year in which earnings were paid but a 30 day grace period is permitted before earnings reports are considered late. The posting of these earnings is now accomplished by July of the same year, 5 months after the last annual earnings report is received in February. Earnings reports received late from employers may not be posted on time. In addition, earnings postings are subject to correction as past tax records are corrected. Public Law 95–216, enacted in December 1977, was responsible for changing the agency's earnings reporting requirements from quarterly to annually.

Earnings records containing yearly total earnings are accessible on-line for the years 1951 to the present. Detailed records containing a breakdown of earnings under different employers are accessible on-line for 1978 to the present. Earnings before 1951 are not on-line; however, the importance of pre-1951 information is diminishing.

Because wage amounts are posted in the year following the one in which they are earned, neither the last nor current year's earnings may be available when a retirement claim is made. If a claimant has not accumulated enough quarters of coverage to qualify for benefits unless the current year's earnings are credited to his/her record, these earnings must be documented separately. In addition, the use of current earnings levels in the computation of benefits may result in a higher benefit amount.

Determination of Medicare Part A Payments

The apportionment of monies to the three SSA trust funds—Old Age and Survivors Insurance (OASI), Disability Insurance (DI), and Health Insurance (HI)—is prescribed by law on the basis of total wages reported. Certification of total wage amounts reported is made to the Secretary of the Treasury. This information is shared with the HCFA, in effect providing them with information concerning Medicare Part A payments.

Obtaining Benefit Estimates

In order to assist individuals in planning for their retirement, the SSA provides benefit estimates on request. Generally, benefit estimates are provided through two mechanisms:

1. The Personal Earnings and Benefit Statement (PEBES)—This service provides individuals with a record of their earnings to date and an estimate of retirement, disability, and survivors' benefits. The disability and survivors' benefit estimates assume a current death or onset of disability and are based on posted earnings; retirement estimates use both the posted earnings and the requester's projected future earnings.

   The service is initiated by submitting a completed form SSA-7004-PC-OPR to the SSA. An SSN holder can request the form via the SSA's national 800 telephone number or can obtain it from any of the SSA's district offices. Completed forms are mailed by the SSN holder to one of the SSA's three DOCs. The DOC keys the information in a batch process and transmits it to the NCC overnight using a remote job entry (RJE) service. The NCC processes the data and sends the information to a contractor, who prints and mails the PEBES to the SSN holder.

   Although the capability exists for personnel in a modern DO to enter the request on-line for immediate processing at the NCC, this service is not made available to the public because of processing capacity limitations at the NCC.

   Before the introduction of PEBES, the average yearly number of requests for earnings statements from individuals was 3.3 million. In the first 7 months of fiscal year 1989, the SSA received 4.6 million requests for PEBES.
2. Pre-retirement processing at DOs—Individuals who are close to retirement age may contact an SSA office to find out what benefit payment they can expect to receive when they retire. Getting immediate complete benefit payment information is not always possible, since, as explained above, current year earnings must be documented separately and pre-1951 earnings are not on-line. However, a DO can provide an unedited earnings summary, allowing an inquirer to verify that earnings were posted correctly, and does, of course, determine the exact amount of a benefit payment during the development of a claim once one has been filed.

Initiating Retirement Benefits

This process normally begins when an applicant for OASI benefits calls or visits an SSA office. Although many individuals still prefer to visit an office for assistance, most initial OASI claims can be handled through telephone and mail contact. To establish a claim each person must file an application and submit the evidence needed to establish entitlement (e.g., evidence of identity, age, marriage, divorce, and current year earnings).

In 1988, the SSA received 3.1 million OASI applications for workers and family members. There were 38.6 million OASDI beneficiaries as of September 30, 1988; of these, 34.5 million received OASI benefits. The beneficiary population is expected to increase during the next 20 years as life expectancies increase and baby boomers reach retirement age.

All field offices have access to a modernized claims system (MCS), which provides for automated entry and control of claims data. Approximately 99 percent of all initial claims can be taken using the MCS screens. Of these 99 percent, approximately 80 to 85 percent can be completely adjudicated in MCS; that is, the SSA can collect all application data, control the development process, and trigger an award or disallowance in the Claims Automated Processing System (CAPS). The other 15 or 20 percent of claims taken through MCS require that adjudication be triggered via a paper form.

Field offices now have final authority to authorize award/disallowance on 99 percent of claims, with the other 1 percent requiring authorization in a processing center. Claims such as those involving dual entitlement are typically processed through the Manual Adjustment, Credit and Award Process (MADCAP), usually triggered via a paper input document from the processing center.

Disability Claims

Individuals who have earned sufficient quarters of coverage and who meet the definition of being disabled under Title II of the Social Security Act are eligible for benefit payments under the DI program. Because eligibility for benefits is partially based medical information, which is subject to interpretation, the adjudication of disability benefits is more complex than of OASI benefits.

As in OASI claims, an applicant for Disability Insurance (DI) applies for benefits with the SSA, which determines if the applicant's work record qualifies him or her for disability benefits. The state Disability Determination Section (DDS) requests medical evidence and makes the initial determination of disability. Once all determinations of eligibility have been made, the DO triggers payment of benefits (or a disallowance notice) via an automated system. In most cases, before entitlement to disability benefits can begin, the applicant must serve a waiting period of 5 full calendar months, during which time no benefits are paid.

Claimants who are dissatisfied with the disability decision made in their case can avail themselves of an appeals process. Reconsideration of the case by the DDS is the first of four levels of administrative appeal available to the claimant. After administrative appeals have been exhausted, the claimant may take his or her case to the appeal. The following is an approximate breakdown of the disposition of the initial claims received in fiscal year 1988:

36%	Approved
35%	Disapproved and not appealed
15%	Disapproved, appealed[1] and denied
14%	Disapproved, appealed[1] and granted
100%	

Records are established and maintained on the SSA's Master Beneficiary Record for disability beneficiaries by the CAPS and MADCAP systems, as they are for OASI beneficiaries. The paper folders that document their claims, however, are maintained by the Office of Disability Operations until the beneficiary reaches age 59, at which time the folder is transferred to the PSC. A DI beneficiary's benefits are converted from DI to OASI when the beneficiary attains age 65.

After an individual is determined to be disabled, the law requires a periodic review to determine whether the individual continues to be disabled. These continuing disability reviews (CDRs) are scheduled based on the likelihood of medical improvement. If improvement is expected, a CDR is generally scheduled between 6 and 24 months after entitlement. If improvement is possible but not predictable (most cases), a CDR is set for 3 years after entitlement. If improvement is not expected a CDR is set for seven years from entitlement. The beneficiary and medical sources are contacted for evidence, and the DDS determines whether disability continues or has ceased. If disability continues another CDR is set. When a CDR is due the case is system controlled and alerts are generated for individual states based on budgeted workloads. The reviews themselves are done manually requiring folder movement, beneficiary and medical source contact, and evaluation of evidence. In fiscal year 1989 the SSA did 337,000 medical CDRs. In addition, 29,000 work issue CDRs were performed to determine whether these individuals had returned to work at a level indicating substantial gainful activity.

In fiscal year 1988, 1.2 million workers applied for DI benefits; there were 4.1 million DI beneficiaries in the same year. Approximately 23 percent of these beneficiaries receive their payments through a representative payee.

Supplementary Security Income

The SSA also administers Title XVI of the Social Security Act to ensure a minimum level of income for needy aged, blind, and disabled people. Federal funding for this program, the Supplemental Security Income (SSI) program, comes from general revenues rather than from the social security trust funds. The federal payment rate and eligibility requirements are uniform nationwide, but almost all states provide supplements, at varying rates, to the federal payment. In fiscal year 1988 nearly 1.3 million SSI applications were taken by the SSA. At the end of that year, there were 4.5 million Title XVI beneficiaries, over 66 percent of whom were blind and/or disabled. Payments in calendar year 1988 totaled $13.8 billion; of this amount, $10.8 billion came from federal funds and $3.0 billion from state supplemental funds.

Because eligibility for the SSI program is based on need rather than a person's history of

[1]Includes all levels of appeals, beginning with reconsideration

earnings as documented in SSA's records, establishment of eligibility can be much more complex under Title XVI than under Title II. In addition, the SSA must redetermine payee eligibility on a periodic basis. This is done in a variety of ways, ranging from payee completion of a simple form to complete reverification of eligibility by field office personnel.

In the case of the needy disabled, the disability determination process is the same as that used for disabled claimants under Title XVI.

The SSI system is automated for both claims and postentitlement actions. However, input data for the claims process (and certain other processes) are still captured on paper forms and transcribed for data entry in coded format. In addition, programmatic software code has not been modernized. The SSA is currently developing the functional requirements for a modernized SSI system.

The SSI master file, called the Supplemental Security Record (SSR), is distinct from the master file of Title II beneficiaries (the MBR). A new copy of the file is sent to the Treasury Department each month. An annual crosscheck flags individuals listed in multiple payment systems.

Dependents' Benefits

If a retiree has an eligible spouse and/or children, each eligible family member can receive a payment based on the retiree's earnings. Children are eligible up to age 18 or to any age if the child was disabled before attaining age 22. Disabled widow(er) over age 50 may also be eligible on a deceased beneficiary's record. This results in a higher total payment to the family than would accrue to the retiree alone. When the spouse is eligible for retirement benefits based on his or her own earnings record as well as that of the retiree, benefits are computed on both records. If the SSA determines that the spouse would receive more benefits if entitled on the retiree's record alone, the spouse receives his or her own benefit payment plus an amount which when added to this payment will make the spousal payment equal to what he or she would have received if entitled to benefits solely on the retiree's record. This action ensures that the spouse receives the highest benefit for which he or she is eligible.

In cases such as these, where a comparison of two individual records is needed, manual processing is usually necessary through the MADCAP system. On-line access to multiple earnings records facilitates the computation.

Benefits may also be paid to eligible dependents in the case of the death or disability of the covered individual. The most common case is one in which the retiree dies and leaves a surviving wife. These cases are processed through the MADCAP system. Most of them are finally adjudicated at the DO, although some very complex cases and some involving systems alerts will be forwarded to a processing center for adjudication. The results of the processing are entered into the automated system; if changes in the status of the case arise subsequently, a manual recomputation is required.

Medicare Part B Funds Processing

The SSA withholds the premiums for Medicare Part B from the benefit payments of individuals who have chosen Part B coverage and who are in current pay status. The records are flagged, and several batch processing programs at the NCC perform funds transfer

documentation and reconciliation. Premiums from individuals who are in conditional, deferred, or uninsured status are collected by HCFA through its seperate operations for billing entitlement and remittances (SOBER) billing system.

Updating Postentitlement Personal Information

Information that affects entitlement to benefits, benefit payment amount, or receipt of payment must be reported to the SSA. Types of postentitlement information normally reported include the following:

- Changes in name or address
- Changes in marital status
- Requests for electronic funds transfer or changes in EFT account information
- Post-entitlement earnings
- Changes in status of dependents
- Notification of death

The SSA's postentitlement workload also includes responding to inquiries from beneficiaries.

Beneficiaries may contact the SSA by phone, by mail, or by visiting a field office. Most phone reports/ inquiries are received and handled by personnel at the teleservice center (TSCs). If a postentitlement event can be handled with a system input, the teleservice representative (TSR) handles it to completion. If the event will require extensive development, the TSR refers the item to a field office by administrative message.

Personnel in both field offices and TSCs make nearly all inputs to the system interactively. However, while the on-line transactions access the master files as part of the data collection process, most on-line transactions do not directly modify the SSA's databases. Rather, they update on-line pending files that feed batch update processes. Most of the SSA's master files are updated on a daily basis. The only exceptions to the batch update processes are certain critical systems that require immediate update to their databases. In addition, the DDS database is updated on-line by the states DDSs.

The SSA's automated master files are maintained at the NCC. Two backup tape copies are created: one is kept at the NCC, and the other is kept off-site in a secure facility.

Some postentitlement information reports result in documentation in the claims folder as well as modification of the database. The SSA has over 70 million active and inactive claims folders. High-activity folders remain in SSA office space (merged files) at the processing centers. Low-activity folders are maintained in SSA warehouse space or in record centers managed by the National Archives and Records Administration (NARA) (active files). Folders are maintained in merged or active file space until all beneficiaries are no longer currently entitled to benefits. At that time the folders are put in archive storage at an NARA site pending eventual destruction. Postentitlement access to low-activity files number approximately 7 million per year.

Cost-of-Living Adjustments

Nearly all benefits payment records must be modified to reflect annual cost-of-living adjustments. These adjustments, which used to take 2 continuous weeks of automated processing, are now accomplished in 24 hours. The processing is wholly performed at the NCC.

Check Production

Benefits are paid monthly to over 40 million beneficiaries. Magnetic tapes that document new payment records and changes to existing payment records to be made to beneficiaries are sent monthly to the U.S. Department of Treasury. The Treasury processes the tapes against copies of master payment tapes that it maintains. Payments are made by the Treasury in check form or by EFT, as desired by the beneficiary. The number of OASDI benefit payments made by EFT was 16.6 million in 1986, or 44.1 percent. As of July 1989, 48.2 percent of OASDI and 16.4 percent of SSI payments were made by EFT.

Beneficiaries continue to receive payments until a "delete" request from the SSA is processed by the Treasury. Should a processing failure occur at the NCC, payment tapes from the previous month would be used by the Treasury to issue payments. Since these tapes would not reflect any changes made during the current month, overpayents and underpayments would result. Such incorrect payments would be corrected as soon as updated payment tapes could be produced by the SSA.

Payment Inquiries

Inquiries regarding missing or incorrect payments are directed to the DOs or the TSCs by calling the 800 number telephone service. Because payments are made on a monthly basis and since inquiries generally are received soon after payments are made, this workload is very cyclic.

Information about Death from State Records

The SSA obtains information from states concerning the deaths of beneficiaries using an automated State death-match operation. This data exchange helps the SSA ensure that it does not continue to make benefit payments to deceased beneficiaries.

Handling of Overpayments and Underpayments

Of the over 400 million payments made in 1986, approximately 3.6 million were incorrect. Overpayments and underpayments are caused by a number of factors. Many payment amounts are incorrect because reports of changes in beneficiary status are sometimes incorrect, delayed, or not received. Chief among the types of information whose receipt affects payment amounts

are notification of death, changes in status of surviving dependents, and reports of beneficiary earnings.[2] In addition, delays and errors within the SSA's processes and revisions of disability claims determinations after appeal can result in overpayments and underpayments.

Numerous remedies for overpayments are available including offset of benefit payments (for current beneficiaries). Collection efforts for overpayments are made by debt collection staffs at the PSCs, primarily using manual collection methods. Debt collection workloads are directly dependent on the volume of incorrect payments.

[2]Legislation sets limits on the amounts a beneficiary may earn before his or her benefits are affected. The 1990 limits are as follows:

	Monthly	Annually
Age 65 and older	$780	$9,360
Under age 65	$570	$6,840

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COMMITTEE ON REVIEW OF SSA'S
SYSTEM MODERNIZATION (SMP) AND ITS
AGENCY STRATEGIC PLAN (ASP)

APPENDIX D
LETTER REPORT TO DORCAS R.HARDY

Without Attachment

April 3, 1989

The Honorable Dorcas R.Hardy
Commissioner
Social Security Administration
Department of Health and Human Services
6401 Security Boulevard Baltimore, Maryland 21235

Dear Commissioner Hardy:

The Department of Health and Human Services has contracted with the National Academy of Sciences—National Research Council to review the Social Security Administration's Systems Modernization Plan and its Agency Strategic Plan. The first of two reports due under the contract is planned to be released in September 1989. In the meantime, you have asked us to provide accelerated advice regarding: 1) progress since 1982, 2) an assessment of the agency's information processing investments, and 3) computer capacity necessary for provision of SSA services. We understand that these matters bear importantly on critical near-term decisions facing your agency.

As you would expect, we are not ready to provide a full assessment of the Systems Modernization Plan at this time. We have not completed our review and still need to deliberate our findings before a consensus can be reached. However, our review thus far has allowed us to observe several aspects of current conditions at SSA and agree upon several points which may be useful to you. We also point out that this response is offered in the specific context of only the SSA's Retirement, Survivors, and Disability Insurance (RSDI) program (Title II of the Social Security Act). We have not examined the Supplemental Security Income (SSI) program (Title XVI) for the aged, blind, and disabled in sufficient detail to be definitive about it.

WHAT WE HAVE REVIEWED

SSA staff have been cooperative in providing us with overview briefings on SSA's operations, organizations, automation resources, and information technology

projects, and have furnished the committee with supporting documents that include greater detail in these areas. A list of the topics addressed in the three briefings and a list of the documents presently on file at the NRC are attached. In addition, during the course of our meetings, we have visited and reviewed operations at the following SSA facilities:

- A modern field office (21st and M Streets, Washington, DC)
- The SSA's National Computer Center (Baltimore, MD)
- The Office of Disability Operations (Baltimore, MD)
- The Western Area Program Service Center (Richmond, CA)

Based upon a review of the information thus far provided, the committee offers you the following assessment.

PROGRESS MADE SINCE SMP BEGAN

We have noted significant improvement in several key areas of performance since the SMP was first issued in FY 1982. To evaluate SSA's progress, we relied upon the SSA to provide us with information, then and now, that we segmented into four categories: service, workforce, information technology, and workload. This information is shown in Table 1. The service and information technology categories reflect levels of performance which show significant improvement during a period when the workload increased and the workforce decreased. Even though these achievements may be impressive in a relative sense, they are not necessarily enough in an absolute sense. Given the rather low overall availability of on-line services to its employees in the facilities we visited, we expect that further improvements in operating efficiency and service levels will result as the use of automation reaches deeper and more comprehensively into the agency.

Although factors other than automation have undoubtedly contributed to improving SSA's service, the above figures lead us to conclude that the improved technology base including increased ADP and data transfer capacity has been a key factor. We believe that the downsizing of the SSA's workforce would not have been practicable had Congress not permitted a major capital investment in automation. Downsizing alone is expected to save the trust funds more than $500 million per year (House of Representatives. June 10, 1988. Committee on Appropriations Report No. 100–689). Furthermore, we noted that in recent studies conducted by the GAO and the Office of the Inspector General, HHS, the percentage of clients rating the SSA's service as good to very good rose from 78% (Social Security. January 1986. Quality of Services Generally Rated High by Clients Sampled, General Accounting Office GAO/HRD 86–8) in 1984 to 87% (Social Security Client Satisfaction Fiscal Year 1988. April 1988. Department of Health and Human Services, Office of the Inspector General, OAI-02–88–00660) in 1988.

The SSA needs to select and use a technology that will eliminate or greatly

reduce the use and handling of paper files and folders. The SSA urgently needs to progress in the storage of information and documents. Managing, storing, and retrieving paper folders are labor intensive, costly, slow, and prone to error. Micrographics has been used for years to deal with this problem and continues to be improved but newer optical and magnetic technologies offer greater promise. This is a significant opportunity to reduce costs and improve operations.

COMPARING SSA WITH OTHERS

We compared SSA to other large information based service organizations with regard to their internal data processing operations, to ascertain if the agency's investment in automation was unusual in its size or scope. Since several committee members are directly involved in the management of large ADP organizations in the private sector, and several are familiar with comparable Federal agencies, the committee drew upon its own knowledge base and concluded that the SSA is consistent with its operational counterparts in this arena.

A case in point is the ADP environment at the Travelers Insurance Company. Table 2 illustrates this comparison by examining the major information system elements employed by each organization.

TABLE 1

CATEGORY	1982	PRESENT
SERVICE DELIVERY		
• Enumeration (issue social security cards)	42 calendar days	10 calendar days
• Post annual wage reports	48 months	5 months
• Process an RSI claim	30 days	20 days
WORKFORCE		
• Total employees	80,000	65,000
INFORMATION TECHNOLOGY		
• Computer capacity	50 MIPS	400 MIPS
• Terminals installed	4,200	25,500
• Network down time	11%	2.2%
• Online transactions	400,000	7 million
WORKLOAD		
• Number of beneficiaries	35.3 million	40 million
• Post-entitlement actions (1984)	64 million	75 million
• SSNs issued/replaced	10 million	23 million
• Earnings records posted (1984)	193 million	255 million

TABLE 2

CHARACTERISTIC	Travelers	SSA
Major data centers	2	1
Mainframe capacity	449 MIPS	400 MIPS
Direct access storage	2.4 terabytes	1.3 terabytes
Transactions processed/day	6.1 million	7 million
Terminals (network-wide)	12,000	25,500
Personal computers	15,000	5,000
Fiber optic links	18	2
Satellite T2 carrier lines	2	4
LAN technology wired beginning	All maj. loc.	Pilots
Data processing professionals	2,500	3,000
Number of employees	32,000	65,000

The SSA's operations are dependent upon one data processing center. The agency has developed plans to use a back-up ADP center should the NCC operations be interrupted. However, the intended back-up center is not an SSA facility and will not sustain full operations or use of on-line terminals. We saw no means to access this back-up facility from the various SSA field or headquarters locations in order to perform transactions. Therefore, loss of the NCC for any reason would significantly reduce the agency's ability to serve the public. Furthermore, the agency has not protected its major data links and is unnecessarily vulnerable to mischief. We suggest that the SSA review its vulnerabilities and formulate decisions along with investment alternatives that will mitigate these risks. We believe that a second data center, networked and linked to normal operations, that can also serve as a back-up if needed, is one of the alternatives that the agency should immediately consider. Distribution of load is another alternative that would involve much more effort and newer technology.

COMPUTER CAPACITY

The SMP was designed to move SSA through 3 phases designated as: survival, transition, and state-of-the-art. The processing capacity acquired through the capacity upgrade program was largely instrumental in bringing SSA to the point where survival is no longer an issue. Although we recognize that adding mainframe capacity is not the only way to meet capacity requirements, we realize that often it is the fastest and sometimes the least expensive alternative. In addition, in 1982, it is likely that the adoption of a strategy using an IBM-compatible hardware and software architecture presented the least technical risk to the agency, an approach that fit with the SMP strategy of adopting proven technologies. This strategy also protected the SSA's software investment by providing a computer program compatible environment. We agree with the SSA's decision to proceed as it did in 1982 to add IBM-compatible capacity.

As part of SSA's long-range planning efforts, it seems advisable at this

juncture for SSA to revisit the capacity issue to determine if a new capacity strategy would serve the agency better in the future. Although past decisions often limit available alternatives because of sunk costs, we nevertheless suggest that SSA undertake a system architecture study to determine how best to proceed in the long term. We believe that more intensive use of cost/benefit analysis methods is necessary for selecting and prioritizing the modernization projects that the agency undertakes. Such thoughtful justification will also help communicate the goals and reasons that prompted a project. In this regard, we support SSA's developing approach to strategic management which, when fully operational, should provide the vehicle for integrating systems, identifying priorities and managing resources. We would expect that efforts to develop a modernized information architecture, as envisioned in the Agency Strategic Plan, will include the suggested reevaluation of SSA's capacity strategy.

We are also aware that SSA has identified significant short-term capacity needs that, according to the SSA, are delaying the installation and use of newly developed applications. The SSA has outlined several large scale hardware procurements that will increase capacity with appropriate consideration of federal procurement regulations. Though such a solution may not be ideal, it may be preferable in the short term to delaying the availability of applications software which has been or is currently being developed.

However, an alternate choice to continued increases in capacity at the National Computer Center (NCC) could be to off-load the mainframe cluster by transferring some of the expanding workload to additional machine capacity in the field. In doing so, the SSA may find the planned near-term configuration of the NCC to be large enough not only for the near term but for the long term as well. As a minimum, the SSA should conduct a system analysis to determine the feasibility and cost-benefit of deploying workload from the NCC to one or more field sites to determine the consequent impact on communications as well as the differential costs of such configurations. This recommendation would also respond to the observations made earlier with respect to the need for a second data center.

SUMMARY

It is difficult to imagine something that could not be improved, and that should be a goal for all organizations. As we proceed with our review and analysis of the SSA's modernization program and strategic plan, we expect to be able to identify further opportunities for improvement. Even though we have not completed our evaluation of the technical management of the modernization program nor endorsed the technical choices made therein, we believe that SSA did, in fact, make real achievements during the years when the SMP was in force and has continued to do so over the last year. The decisions made by the SSA have moved the agency beyond the survival stage to a point where it can plan for its future. Essentially, the SSA's original decision to increase its ADP resources was prudent and necessary.

A continuation of efforts to improve its technology base is now required. On this latter point, we strongly urge a fresh look at the strategies of the past to ensure that the SSA of the future is achievable and achieved.

We acknowledge that SSA's management must consider both social and economic factors in selecting approaches to systems problems as well as the severity of adverse consequences which might accrue from such decisions. We also note the administrative and budgetary constraints under which SSA and other government agencies must operate. Examples are regulations that cause unusually long procurement cycles, line item restrictions in annual budgets, controls over employment levels, legislated wage scales, high leadership turnover, and no access to capital markets. These constraints differ from those in the private sector, but we fully appreciate how they can hamper effective management. If more administrative flexibility and latitude were allowed the agency to prioritize and manage its own resources, SSA could legitimately be held more accountable for the accomplishment of its mission.

Sincerely,

Willis H.Ware
Chairman

APPENDIX E

GLOSSARY

ADP	automated data processing
ASP	agency strategic plan
BNCC	Backup National Computer Center
CAPS	claims automated processing system
CASE	computer-aided software engineering
CCB	configuration control board
CM	configuration management
COBOL	Common Business-Oriented Language
C/SCSC	cost/schedule control system criteria
CUI	common user interface
DBMS	data base management system
DOD	Department of Defense
DCU	Data Communications Utility
DDS	Disability Determination Section
DI	disability insurance
DO	district office
DOC	data operations center
EAB	enumeration at birth
EFT	electronic funds transfer
FICA	Federal Insurance Contributions Act
FTS	Federal Telephone System
GAO	General Accounting Office
GSA	General Services Administration
HCFA	Health Care Financing Administration
HHS	Department of Health and Human Services
HI	health insurance
IBM	International Business Machines Corporation
ICN	Integrated Computer Network
INS	Immigration and Naturalization Service
IRS	Internal Revenue Service
ITS	Information Technology Systems
LAN	local area network
MADCAP	manual adjustment, credit and award process

MBR	Master Beneficiary Record
MCS	modernized claims system
MIPS	million instructions per second
NARA	National Archives and Records Administration
NCC	National Computer Center
OASDI	Old Age, Survivors, and Disability Insurance
OASI	Old Age and Survivors Insurance
ODIO	Office of Disability and International Operations
ODO	Office of Disability Operations
OIO	Office of International Operations
OMB	Office of Management and Budget
OSP	Office of Strategic Planning
PEBES	Personal Earnings and Benefit Statement
PMO	project management office
PSC	program service center
PSL/PSA	problem statement language/problem statement analyzer
QA	quality assurance
RJE	remote job entry
RSDI	Retirement, Survivors, and Disability Insurance
RSI	Retirement and Survivors Insurance
SET	software engineering technology
SMP	Systems Modernization Plan
SOBER	separate operations for billing entitlement and remittances
SRB	Systems Review Board
SSA	Social Security Administration
SSDA	structured system development methodology
SSI	Supplemental Security Income
SSN	social security number
SSR	Supplemental Security Record
TSC	teleservice center
TSR	teleservice representative
USAA	United Services Automobile Association
V&V	verification and validation
WORM	write-once-read-many