AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

THE BENEFITS OF OFFICE AUTOMATION:
A CASEBOOK

Major Hoyt M. Warren, Jr. 86-2645

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~~In recent years,~~ Air Force organizations have been turning to the use of office automation (OA) technologies to improve productivity in the office environment. The Air Force experience with the implementation of OA has often been characterized by a lack of documented evidence of benefits experienced. With the competition for budgetary dollars growing, the need to take advantage of previous OA experiences has reached a new level of importance. This document presents the results of a recent review of federal agency and private sector OA experiences. The document also recommends a means to institutionalize the sharing of OA experiences by proposing a modification to current Air Force policy and regulation covering the identification, documentation and use of such experiences.

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PREFACE

In recent years, Air Force organizations, like their counterparts throughout the Federal Government and the private sector, have been turning to the use of office automation (OA) technologies to effect productivity improvements in the office environment. The Air Force experience with the implementation of OA has often been characterized by a lack of documented evidence on the actual quantitative and qualitative benefits experienced through the use of OA. With the ever increasing competition for the dwindling budgetary dollar, the need for requirements analyses and procurement justifications for the acquisition of OA systems which take advantage of the results of previous OA projects has reached a new level of importance.

The purpose of this document is to present the results of a recent review of federal agency and private sector experiences with office automation. It is intended that by better understanding how the work patterns of individuals are changed when their information work activities are automated, the productivity benefits other organizations are experiencing as a result of OA and what management issues are being addressed, the reader will be in a better position to make informed decisions regarding the planning, approval and implementation of a proposed OA system. Additionally, this document recommends a means to institutionalize the sharing of OA experiences by proposing a modification to current Air Force policy and regulation covering the identification, documentation and use of such experiences. Finally, it is intended that this document contribute to raising the general level of OA awareness and literacy by identifying additional sources of information on the subject of office automation.

The author is indebted to Major Gary Ricketts, Air Command and Staff College, and Mr. Morton H. Marks, SISC/CA, for their administrative guidance and technical assistance. The author would also like to express his appreciation to the project sponsor, Colonel Dennis C. Beasley, HQ USAF/SIB, for reviewing the draft document and providing very helpful guidance and comments. Finally, the author would like to thank the multitude of individuals whom he contacted concerning the preparation of this document and especially those who provided source material used in the document.

ABOUT THE AUTHOR

Major Hoyt M. Warren, Jr, [redacted]. He graduated from Auburn High School, Auburn, Alabama in 1967, and attended Auburn University where he received a Bachelor of Science degree in Mathematics in 1971. The degree was awarded with High Honor and was accompanied by a commission in the United States Air Force as a Distinguished Graduate of the Reserve Officer Training Program. He attended electronic-systems officer training at Keesler AFB, Mississippi, and was an Honor Graduate in 1972. He spent the next three years as Chief of the Installation Branch at Headquarters Electronic Systems Command located at Kelly AFB, Texas. Major Warren then entered the Air Force Institute of Technology resident School of Engineering at Wright-Patterson AFB, Ohio, and received a Master of Science degree as a Distinguished Graduate in Computer Science in 1977. He was subsequently assigned to the Air Force Data Systems Design Center at Gunter AFS, Alabama. While assigned to the Design Center, he served in the Directorate of ADPS Management and as the Center Executive Officer. In 1980, Major Warren was assigned to Headquarters Air Force Communications Command at Scott AFB, Illinois. While assigned to the headquarters Major Warren held the positions of Executive Officer to the Deputy Commander for Data Automation and of Chief of the Management Studies Division in the Office of Studies and Analysis. Upon leaving Scott AFB in 1984, he assumed command of the 1982nd Information Systems Squadron at Kunsan AB, Republic of Korea. Major Warren is a Distinguished Graduate of the Squadron Officer School resident program and also a graduate of the Air Command and Staff College (ACSC) seminar program. He is currently a course officer in the ACSC resident program.

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EXECUTIVE SUMMARY

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REPORT NUMBER 86-2645

AUTHOR(S) MAJOR HOYT M. WARREN, JR., USAF

TITLE THE BENEFITS OF OFFICE AUTOMATION: A CASEBOOK

I. Purpose: To present the results of a recent review of federal agency and private sector experiences with the benefits of office automation (OA) in a case study format, to recommend a means to institutionalize the sharing of OA experiences within the Air Force and to raise the general level of OA awareness and literacy of the reader by identifying additional sources of information on the subject of office automation.

II. Problem: In recent years, Air Force organizations, like their counterparts throughout the Federal Government and the private sector, have been turning to the use of office automation technologies to effect productivity improvements in their office environments. The Air Force experience with the implementation of OA has often been characterized by a lack of documented evidence on the actual quantitative and qualitative benefits experienced through the use of office automation. With the ever increasing competition for the dwindling budgetary dollar, the need for requirements analyses and procurement justifications for the acquisition of new OA systems which take advantage of the results of previous OA experiences has reached a new level of importance. No effort has been made within the Air Force to collect and present the results of past OA

experiences in a single document and to institutionalize a process by which such experiences could continue to be made available to an Air Force-wide audience.

III. Review Methodology: The methodology for this review consisted primarily of contacting representatives of a number of federal agencies and private organizations concerning their experiences with office automation. Prospective contacts were identified by word-of-mouth, through professional contacts and through The United States Government Manual 1984/85. The focus of the discussions with each of these contacts was their experiences with the benefits of OA as documented in baseline productivity studies and post-implementation audits of their systems. Additional information was gathered from federal agency policy and regulatory documents, available professional and popular periodicals, vendor literature and personal experience with OA system management and use.

IV. Observations: During the collection of the material presented in this document, I observed that the accessibility to information within the Air Force and the Federal Government on past OA experiences is very limited. I also observed that the number of organizations which have conducted the initial baseline productivity studies and subsequent post-implementation audits necessary to develop benefit or productivity data appears to be extremely small across-the-board. Finally, I observed that almost everyone contacted was extremely interested and supportive of the idea of the collection and use of past OA experiences in the planning, approval and implementation processes of new systems.

There are two apparent reasons for this lack of information on the benefits of OA and the difficulty that exists in obtaining that information that is available. First, there is no commitment on the part of senior management to devote the resources needed to conduct the baseline productivity studies and post-implementation audits necessary to develop the productivity data. Second, there is no central office or agency within the Air Force

or Federal Government to which a manager or an OA systems planner can go to review and hopefully benefit from past OA experiences of offices or organizations with similar missions and information work profiles. The task facing the Air Force Administrative and Information Systems communities is the development and implementation of policy and regulation directing the performance of post-implementation audits of all OA projects and the establishment of an automated Air Force-wide data base of Air Force office automation experiences.

V. Recommendations: To aid in the accomplishment of the above task, Section 5 of this document first provides the content of a proposed change to paragraph 9-2 of the draft AF Regulation 4-4, How to Determine and Justify Automation Requirements. The proposed change establishes the policy and regulation necessary to direct the performance of post-implementation audits of office automation projects. Next, Section 5 contains the recommendation that the Air Force Assistant Chief of Staff for Information Systems, HQ USAF/SI, with the support of the Air Force Acquisition Logistics Center (AFALC) establish an Air Force-wide Office Automation Lessons Learned Program. The objective of the program would be to give Air Force managers involved in the planning, approval and implementation of OA projects the benefits of past OA experiences and the results of past technical and management decisions for application to their current or future projects. The OA Lessons Learned Program would take advantage of the functioning Air Force Lessons Learned Data Bank, an automated, permanent central repository of Air Force lessons learned located at AFALC/PTL, Wright-Patterson Air Force Base.

1. INTRODUCTION

1.1. Background

Currently, well over half of all workers are information workers and almost half of these are in management, administrative support and professional staff positions (6:275-325). An "information worker" can be considered to be anyone who handles information rather than physically handling things or providing services (4:4). The Bureau of Labor Statistics has just changed its occupational definition from the "white-collar worker" category to the "information worker" category (12:A-21). Information work has become the dominant economic activity in the United States (6:275-325). It accounts for a much larger portion of work-related time and costs than most economic statistics indicate. An ever-increasing proportion of the total cost of a product is due to information work activities (4:28).

The fastest growing application of technology to these information work activities is that of office automation (OA). Over the past few years the trickle of interest in OA has grown to flood proportions. We are experiencing an unprecedented proliferation of OA technologies and resources; we are seeing the rapid invasion of almost all aspects of our work environment. The placement of more than 200 million electronic workstations in offices world-wide is forecast by the year 2000 (4:xvii). The United States Air Force alone will soon have over 25,000 Zenith Z-100 microcomputers in place for OA support (24).

In contrast to industrial workers whose productivity has been shown to grow with the introduction of automation, the productivity of information workers has appeared to remain relatively flat (2:4-8). This can be attributed to the undercapitalization of information workers in relation to the other types of workers (2:6). In recent years, numerous studies, reports and articles have agreed that the use of a variety of computer and communications technologies could contribute to the efficient and cost-effective preparation, distribution, storage and retrieval of general office information work products. However, up to now, the general experience with OA has been primarily to the implementation of word processing equipment and documented evidence of the benefits received from these installations has not been produced or is not readily available for review. A 1979 General Accounting Office Report (13:i) stated that within the Federal Government

"... most agencies can neither demonstrate that they have increased their productivity nor that their word processing systems, are, in fact, cost effective."

The report concluded that this was because there is no major commitment on the part of senior management to conduct thorough feasibility studies (including the determination of a productivity baseline), cost-benefit analyses and, most importantly, post-implementation performance audits (comparing new productivity data with baseline productivity data) (13:21). While the GAO report is five years old, indications are, that a similar condition currently exists within the United States Air Force with regard to the use of all office automation (OA) technologies. This scarcity of data on the actual benefits experienced through the use of different OA technologies by Air Force organizations has contributed significantly to the elongation of the planning, approval and implementation processes associated with new OA projects (24).

The task facing the present-day Air Force organizational commander is to conscientiously implement the existing policies and regulations which require that an organization conduct extensive advance planning prior to the implementation of OA systems. That is, planning which requires the performance of feasibility studies (including the determination of a productivity baseline) and cost-benefit analyses. The task facing the Air Force Administration and Information Systems communitties is the development and implementation of policy and regulation directing the performance of post-implementation audits of all OA projects. Additionally, action should be taken at Air Force-level to direct the establishment of an automated Air Force-wide data base of OA experiences.

1.2. Purpose

The purpose of this document is to present the results of a recent review of federal agency and private sector experiences with the benefits of OA. It is intended that by better understanding how the work patterns of individuals are changed when their information work activities are automated, the productivity benefits other organizations are experiencing as a result of OA and what management issues are being addressed, the reader will be in a better position to make more informed decisions regarding the planning, approval and implementation of a proposed OA system. It is additionally intended that this document recommend a means to institutionalize the sharing of OA experiences by proposing a modification to current Air Force policy and regulation regarding the identification, documentation and use of such experiences. Finally, it is intended that this document contribute to raising the general

level of OA awareness and literacy by identifying additional sources of information on the subject of office automation.

1.3. Scope

This document contains a small collection of case studies of recent (last five years) OA experiences in which both formal and informal baseline productivity studies and post-implementation audits have been conducted. This collection is not intended to be in-depth or comprehensive or statistically valid. While it is extremely difficult to determine with any degree of certainity the extent of OA activity within any given organization, and while the number of organizations which have conducted initial baseline productivity studies and subsequent post-implementation audits appears to be extremely small, it is believed by the author that the picture that emerges from this collection of case studies is sufficiently representative to be of value to the document's audience.

1.4. Document Audience

The intended audience for this document includes all those who are interested in the productivity benefits of office automation (OA) and want to benefit from recent experience. These include those who: 1) approve and fund OA systems, 2) determine OA policy and regulation, 3) specify OA requirements, 4) evaluate, select and procure OA systems, 5) use OA systems, 6) manage large numbers of OA users, and 7) expect to manage and to use OA systems. While the focus of this document is toward the United States Air Force community, it should also be of value to those in other organizations who are dealing or plan to deal with OA systems.

1.5. Review Methodology

The methodology for this review consisted primarily of contacting representatives of a number of federal agencies and private organizations concerning their experiences with office automation. Prospective contacts were identified by word-of-mouth, through professional contacts and through The United States Government Manual 1984/85 (17). The focus of the discussions with each of these contacts was their experiences with OA as documented in baseline productivity studies and post-implementation audits of the systems. Additional information was gathered from federal agency policy and regulatory documents, available professional and popular periodicals, information services (including bibliographic retrieval, electronic bulletin boards and other electronic discussion groups), commercially prepared OA system audits of private sector systems, vendor literature and personal experience with

OA system management and use. The results presented in this document represent a synthesis of the information gathered from these sources.

1.6. A Caveat

To use this document appropriately, it is necessary to understand that many aspects of the information work environment are changing very rapidly. The information technology marketplace, the types of products and the pace at which they are announced and made available, the costs of OA systems, and the level of user and organizational awareness and activity are undergoing constant evolution. As a result, some care must be exercised in interpreting this limited review of a very dynamic environment. However, the underlying issues, considerations, concerns and lessons learned in this review are still valid and will continue to be in the near future.

1.7. Overview of Document

The remainder of this document presents the results of the review of recent federal agency and private sector experiences with office automation (OA) systems and of related information gathering efforts. In order to help the reader focus on relevant concerns, the following section addresses the specifics of determining baseline office productivity. Section 3 then focuses on the specifics of conducting the post-implementation audit of an OA system. Selected OA experiences are presented in Section 4. Observations and recommendations on the collection and use of OA experiences are made in Section 5. The bibliography contains valuable pointers to other sources of information.

1.8. Sources of Information

The OA environment is changing rapidly and useful specific information frequently experiences a rapid rate of decay. Many sources of information exist, but the person seeking such information is often overloaded with data, but starved for information that is useful to the specific need. The task at hand is one of understanding what current sources of information exist and how to access them -- and how to interact with others who have similar problems and potential solutions. In this context, special attention should be paid to the related sources portion of the bibliography of this document. It can provide the reader with an initial road map to sources of information about the use of OA and the resulting quantitative and qualitative benefits.

1.9. Disclaimer

Because of the nature of this document, it is necessary to mention vendors and commercial products. The presence or absence of a particular trade name product does not imply criticism or endorsement by the author, nor does it imply that the products identified are necessarily the best or the only ones available for the purpose discussed.

2. DETERMINING BASELINE OFFICE PRODUCTIVITY

2.1. Introduction

In recent years, Air Force organizations have been turning towards the use of office automation (OA) to effect productivity benefits in the office environment. The general experience with such systems, however, has more often than not been characterized by an inability to produce documented evidence of the actual benefits received from their implementation. With the ever-increasing competition for funds, the need for thorough requirements analyses and procurement justifications for new and different types of OA systems has taken on new importance. To fulfill this need, senior management must be committed to an OA system implementation methodology that provides for the detailed determination of the feasibility and practicality of implementing OA and provides a means of evaluating post-implementation results. The foundation for such a implementation methodology is the determination of the office's baseline productivity. It is against this productivity baseline that productivity benefits are projected, implementation results are compared and actual productivity benefits are determined.

2.2. Applications and Benefits

Office automation systems are applicable to three principal information work activities (3:20-35):

* Information Processing (e.g., data base management)

* Document Production (e.g., word processing)

* Communications (e.g., electronic mail)

Office automation systems may address different combinations of these three categories of information work activities depending on the particular office tasks to be accomplished.

The objective of OA is to improve the productivity of individuals and organizations (5:74). In general, productivity is an efficiency ratio of input resources (i.e., manpower and materials) to output results (i.e., finished products); productivity is improved whenever the ratio decreases (5:74-79). In an office, productivity is measured relative to the labor and materials (time and costs) expended in the accomplishment of a particular information work activity. Office productivity improves whenever the quantity or quality of an office's

information work activities increases relative to the labor and materials applied.

Improving office productivity through the use of OA is generally expensive. A typical office automation (OA) system represents a significant initial and recurring expense to an organization. This expense is justified if the value of benefit exceeds the costs to achieve it (including the costs of designing, installing and operating the OA system). These benefits may be realized in any of the following ways (5:77):

* A reduction in personnel or materials costs.

* An ability to handle an increased workload with little or no increase in personnel costs.

* Improved mission performance through improved quality of support products and services.

In all three cases, the current level of office productivity is the standard or baseline against which changes must be measured. Thus, the baseline must be measured before the feasibility of installing any proposed OA system can be analyzed.

2.3. Productivity Study Methodology

Recently, OA researchers have concerned themselves with measuring the impact of OA on individual and organizational productivity. They have developed a number of procedures or methodologies for collecting and analyzing office information work productivity data (1,2,14,15,16,20,22). These methodologies can be distinguished from traditional word processing study techniques in that they emphasize improvement of professional staff productivity as well as that of the support staff. Because professional staff generally earn significantly higher salaries than do support staff (i.e., their man-year costs are higher), the major benefits of OA will be realized only when professional staff productivity is improved (15:9).

To measure productivity improvements, similar procedures must be followed during the initial baselining of existing office productivity and the subsequent post-implementation audits of the automated office. These procedures are generally applicable regardless of the size of the office under study. The magnitude of the study effort should also be proportional to the size of the OA project itself (i.e., the cost and effort required to conduct the study should reflect the overall cost and effort of the OA project). If, however, the study is being

performed for a newly established office or one that is significantly expanding its mission ,baseline productivity may have to be estimated through comparisons with similar size offices performing similar types of information work activities. A data base of past OA experiences is extremely helpful in performing these organizational information work activity comparisons and baseline productivity estimates.

2.4. Productivity Data Collection

Baseline productivity data are divided into two categories (3:128). Each category addresses both professional and support staff information work activities. The first and principal category is specific information work activity oriented and the second addresses general office information work activities (3:128-129). Both of these categories should be assessed in terms of the level of effort (i.e., manpower) required and the materiel costs to the organization.

2.4.1. Specific Information Work Activities

A specific information work activity can be defined as one which results in a regularly produced output, either as a written document or as a customer service, contributed to by one or more individuals and requiring significant expenditures of manpower and materiel (3:128). For example, the preparation of a major air command's Program Objective Memorandum (POM) normally involves inputs from numerous individuals with different responsibilities ranging from initial preparation to final review and approval. Each individual may not be continuously involved in the preparation of the POM, but his or her contribution towards its completion must be incorporated into the final POM submission. The two advantages of using specific information work activities as the primary units of analysis are that, 1) they remain relatively constant within an organization from year to year, and, 2) they provide a common reference point for all members of the organization (3:129).

2.4.2. General Information Work Activities

Office workers may also be involved in information work other than that which directly contributes to specific information work activities (3:129). For example, training and organizing work. It is important to gain some understanding of the distribution of this type of general information work activity as well as the specifically oriented activity. Not all of the general office information activity can be addressed through office automation (OA), but some of it can be. General office information work activity data also serves to validate and refine the specific information work activity data (3:129).

2.5. The Productivity Baseline

The productivity baseline developed from both the specific information work activity and general office information work activity analyses, serves three purposes (15:11-32). First, it serves as the basis for designing the OA system and for identifying potential procedural and organizational changes to improve productivity. Secondly, it is used in evaluating the cost-benefit analysis of the OA system. Finally, it is used as a basis of comparison in examining the post-implementation audit results.

2.6. Summary

Traditionally, productivity studies analyzed office automation (OA) needs, justifications and results primarily focused on the singular use of word processing to directly benefit the support (i.e.,clerical and secretarial) staff. When viewed in the context of the overall cost to the organization however, it becomes apparent that in many cases the major benefits of OA will be realized only when OA directly supports the professional staff. Thus, studies of OA systems must go beyond word processing and the traditional emphasis on support staff. They must, in fact, address themselves to the impact of a wide range of professional staff applications (e.g., word processing, information storage and retrieval, information sharing, electronic mail, personal calendars, ect.) that can affect all aspects of office information work activity from the generation of ideas through the distribution of finished documents. The data collected from such studies are analyzed and used to create a baseline profile of existing office productivity. This productivity baseline becomes the basis for subsequent system design, cost-benefit analyses and, most importantly, post-implementation performance audits.

3. CONDUCTING THE POST-IMPLEMENTATION AUDIT

3.1. Introduction

The primary objective of conducting a post-implementation audit of an office automation (OA) system is to compare projected benefits to the actual benefits realized through system implementation (8:VI-1). The post-implementation audit report resulting from these efforts should also include recommendations to management for either discontinuing or proceeding with the existing system, or fine-tuning the system to achieve enhanced results (8:VI-1). In each case, a commitment must be made by senior management to continually stimulate productivity improvements and to do so at minimum cost.

An extremely important secondary objective of the post-implementation audit is to build up an organizational data base of the benefits realized through the application of different OA technologies (8:VI-1). With the exception of word processing, reliable data on the productivity improvements to be expected from different OA technologies is very limited and is not readily accessible. By carefully collecting data on the organization's own OA experiences, future OA projects can be planned, approved and implemented with a higher degree of confidence in the results. These results can and should also be shared with other organizations which may be planning similar OA projects (8:VI-1).

3.2. Timing the Post-Implementation Audit

The timing of the post-implementation audit is an important factor in obtaining valid audit results. If the audit is performed shortly after system implementation, the results will not be valid because of system break-in time (15:55). To accurately determine system performance, the first post-implementation audit should be conducted after the system has been operational for a period of six months to a year(8:VI-3).

Vendors can often assist in determining adequate system break-in time for their specific equipment and systems. This information should not be relied upon exclusively. Other organizations can also be used to identify potential implementation problems, problem solutions and benefits (15:56).

3.3. Audit Activities

Post-implementation productivity data collection activities

are identical to those performed during the initial productivity baseline study(2:158-159). The specific office information work activities analyzed during the baseline study are re-examined to determine any changes that might have occurred as a result of system implementation. A general office information work activity analysis is also performed in the same manner as during the initial baseline study. Once these reviews have been completed, the necessary data is available to compare the post-implementation audit results with the initial productivity improvement expectations. The actual benefits of the OA system are determined by the system's ability to achieve or surpass these expectations. Differences in the projected and actual benefits will inevitably occur and must be resolved. Such differences generally result because the system may have been implemented differently from its original design (2:159). Factors to be considered when determining the causes of such differences include: 1) any changes in administrative procedures associated with both specific and general information work activities, 2) the reaction of staff personnel to the new system, and 3) the accuracy of the data collected during the productivity baseline study as well as the post-implementation audit itself (15:57). Once the causes of the differences between the projected and actual benefits are identified, corrective actions must be identified which will enable the system to meet it's expectations.

3.4. Summary

The conclusions reached from the above comparisons form the basis for the post-implementation audit report to senior management. Recommendations concerning the correction of system deficiencies or the further development of the office automation system are included in the report. The quantitative and qualitative effects of these recommendations are clearly identified for review by senior management. The post-implementation audit effort, once completed, provides senior management with a full assessment of current system status effectiveness and provides a data base of valuable information for use in the planning, approval and implementation of future office automation projects.

4. SELECTED OFFICE AUTOMATION EXPERIENCES

4.1. Introduction

The fastest growing application of information technology involves office automation. Over the past few years the trickle of interest in office automation has grown to flood proportions. We are experiencing an unprecedented proliferation of information systems technology and resources; we are seeing the rapid invasion of almost all aspects of our office environments. This section presents a collection of three case studies of recent (last five years) office automation experiences in which both formal and informal baseline productivity studies and post-implementation audits have been conducted.

The first case provides an example of a carefully observed and documented office automation experiment. It illustrates a wide range of office automation applications. The remaining two cases are selected from the federal workplace and illustrate some of the quantitative and qualitative benefits achievable through office automation.

4.2. Laboratory Office Network Experiment

4.2.1. Background and Scope

The Laboratory Office Network Experiment (LONEX) was an Air Force Systems Command Directorate of Laboratories study to determine the impact of office automation technologies on information work activities in the Air Force research and development environment (11:8). Although the experiment was conducted at the Rome Air Development Center (RADC), Griffiss Air Force Base, New York, the results can serve to guide the future application of office automation technology by other organizations within the Air Force.

4.2.2. Experiment Objectives

The primary objective of the LONEX program was to explore the impact of a wide range of office automation technologies on individual and organizational productivity (11:8). The LONEX system design and the assessment approach were designed to accomplish the following (11:8-9):

* Test the limits of off-the-shelf automated office technologies in the test environment.

* Gain experience in the use of office automation tools to develop specialized applications.

* Provide hands-on office automation experience for professional and support personnel.

* Assess the impact of the system on organizational information work activities.

* Provide a basis for estimating the costs and benefits of a fully automated office environment at RADC.

* Provide an environment in which to study the sociological aspects of selected office automation technologies.

It was also anticipated that the leasons learned from LONEX would be made available to other Air Force and Federal Government organizations and that the results of the experiment would be helpful in the planning, approval and implementation of their future office automation projects.

4.2.3. Assessment Plan

The overall LONEX program was managed by RADC personnel. The system installation; maintenance of the system hardware; software and communications capabilities; implementation of required training; and the development of operations and procedures were performed by an integrating contractor, Bunker Ramo. Booz, Allen, and Hamilton, Inc., and the American Institutes for Research combined to form an independent assessment team to estimate costs and benefits (11:9).

The focus of the assessment team's efforts was to determine the extent to which productivity improvements were possible through the use of office automation. Although the assessment team's efforts were specifically designed to address the cost-benefits for RADC, it was expected that their findings could be generalized to other organizations with similar information work activities and staffing profiles.

4.2.4. Cost-Benefit Analysis

The cost-benefit analysis provided estimates of what could be expected from a full-scale implementation of office automation at RADC. This subsection describes the approach taken during the analysis and its limitations.

4.2.4.1. Approach

The analysis approach made use of the Product Methodology developed by Booz, Allen and Hamilton (11:11). It is very similar to the productivity data collection methodology described in section 2.4.. The methodology focused upon the analysis of selected paper products or information work activities accomplished by an organization. Specific products were selected which were, 1) labor intensive, 2) important to mission accomplishment, and 3) lended themselves to automation (11:11). Six products were selected for the test. The products were correspondence, briefings, proposal evaluations, technical reports, program status reports and weekly activity reports (11:11). Baseline productivity data were collected at various levels within the organization. The same productivity data were collected again during the post-implementation audit and were compared with the baseline data in order to quantify the difference in the manpower and materiel required for manual and automated processes. In addition, qualitative comparisons of manual and automated processes were made based upon user and assessment team observations.

The size of the test population was scaled down from the entire RADC organization to a single RADC mission division. Product data for the cost-benefit analysis were provided by 6 managers, 18 engineers and 16 secretaries (11:12). These individuals estimated and logged the time, steps and problems involved in the manual and automated processing of the six targeted products.

This product data provided the detailed basis for the computation of benefits for the cost-benefit analysis; however, the assessment involved several other steps. First, after the organizational products were identified, the level of effort expended annually on these products was calculated. Then data were gathered on the manual productivity baselines and the automated production processes of each of the products. Next, the quantitative and qualitative differences between the manual and automated processes were determined and the changes in the levels of effort required to produce the sample products computed for managers, professionals and secretaries.

To project annual manpower savings, an average change factor (based upon the differences between manual and automated processes) for each of the three catagories of personnel was applied to the RADC personnel profile (11:14). Only the manpower resources expended on the creation of products was considered. The total value of these manpower savings was then calculated using average wage rates for each category of personnel. This provided an estimate of the total economic

benefit possible from a full-scale OA syatem at RADC.

4.2.4.2. Limitations

The experimental system results were used to estimate the impact of a full-scale OA system; however, it is important to note that the results of this analysis were affected by certain fundamental differences between the test system and the projected operational system. The most significant of these differences was the user-to-terminal-ratio. During the test, an average of 4.6 people shared each terminal. It is projected that an operational system would have a higher terminal density with an average of 1.6 people per terminal (11:14). It is generally believed that the higher the terminal density the greater the potential benefits.

4.2.5. System Description

This subsection describes the configuration of the LONEX test system and that of the full-scale office automation system projected for RADC. The office automation system is designed to provide all levels of RADC professional and support personnel located at Griffiss and Hanscom Air Force Bases with access to basic communication, text, and information processing capabilities for the support of conventional management, engineering, financial, contractual, clerical and secretarial activities associated with RADC research and development efforts (11:16-17). The operational system will consist to the extent possible of commercially available equipment with proven capabilities. The architecture, equipment, software, and personnel components for both the test and the projected full-scale systems are detailed in the following subsections.

4.2.5.1. Architecture

The full-scale system architecture will be primarily an expansion of the LONEX test system. The primary elements will be the Building Systems (systems which will support personnel in the various RADC buildings at both Griffiss and Hanscom Air Force Bases) and a Central Facility (11:16). Each Building System will consist of video display terminals, graphics terminals, large screen displays and character printers. The Building Systems will be linked by a communications bus with the Central Facility. Through the Central Facility, each Building System will have access to other Building Systems and to external scientific and research computer resources as well as internal RADC data bases. To maintain the efficient operation and use of the system, specialized support and training facilities will be provided at both Griffiss and Hanscom Air Force Bases.

4.2.5.2. Equipment

The equipment requirements for the operational system have been sized to support all RADC personnel and to meet RADC's geographically dispersed mission. The main difference between the test and the full-scale systems will be in the number of terminals. The operational system will provide a 1.6:1 personnel to terminal ratio as compared to the 4.6:1 ratio of the LONEX test system (11:18). As stated earlier, it is believed that the lower the personnel to terminal ratio the greater the overall productivity benefits will be.

Managers (i.e., chiefs and assistant chiefs from the commander down to the section chief level) and all secretarial personnel will have dedicated terminals. Professional (i.e., scientific and engineering) staff will have access to terminals on a 2:1 basis. All other professionals and support staff will have access to terminals on a 4:1 basis (11:18-19). Terminals are also to be provided to system support and training facilities at Griffiss and Hanscom Air Force Bases. In general, the equipment requirements of the operational system will be two to three times greater than those of the LONEX test system.

4.2.5.3. Software

The test system provided and the full-scale system will provide a basic set of off-the-shelf capabilities to each user including the following (11:19-20):

* A general office applications package to include text processing, spreadsheet, graphics, electronic mail, document transfer, desk calculator and calendar management capabilities.
* A data management system providing conventional file management and data handling capabilities.
* BASIC Compiler
* COBOL Compiler
* FORTRAN Compiler

It was assumed that some tailoring of these off-the-shelf capabilities would be necessary to meet specific individual user and organizational requirements.

The BASIC, COBOL and FORTRAN Compilers were provided to support the development of individual and organizational specific application programs by user personnel and were not

intended to satisfy the scientific programming and analysis requirements currently handled by other computer systems.

4.2.5.4. Personnel

The implementation of a full-scale office automation system at RADC will require personnel to maintain the system and to provide the necessary training for user personnel. It is assumed that government personnel will provide most of the training and maintenance support. It is estimated that a total of 38 government system support and training personnel will be required (11:21).

4.2.6. Benefit Data

The benefits of office automation are comprised of quantifiable benefits expressed in terms of manpower saved and of qualitative improvements in the output of the various information work activities (5:74). The LONEX experiment provided information on both types of benefits. Over half of RADC's total personnel are devoted to the creation of paper information products (e.g., correspondence and statements of work). Office automation capabilities are directly applicable to supporting these types of paper-oriented information work processes; therefore, the focus of the analysis of both the quantifiable and qualitative benefits of LONEX was upon paper product producing information work activities (11:43).

Data was collected on each of the previously selected information work activities and level of effort involved in the development of their associated paper products under both manual (i.e., without LONEX) and automated (i.e., with LONEX) conditions. Man-hours saved by managers, professionals and support personnel and the related qualitative improvements were determined and projected across all RADC information work activities to determine the theoretically possible benefits of a fully operational OA system at RADC.

4.2.6.1. Quantifiable Benefits

The benefits projected from the LONEX test system to a full-scale OA system at RADC indicate that 130 professional and 85 secretarial man-years would be made available each year for other work (11:43). Based upon the study average, time savings for managers was 2 percent, professionals, 27 percent and administrative support staff, 55 percent (11:3). Another way to view these benefits is in terms of an annual value-of-benefits. That is, what the costs in salaries would be if an additional 130 professional and 85 secretarial personnel were hired to perform the work that the newly available man-years of effort

would permit (5:78). Taking the average wage rate of professional and secretarial personnel at RADC as a basis for projection, the annual value of benefits for a fully operational system would be approximately $6.6 million (11:46).

4.2.6.2. Qualitative Benefits

The automation of the various selected RADC information work activities resulted in a number of significant qualitative benefits (11:47). Although these benefits are not expressed in the quantifiable terms of value-of-benefit dollars, they are an important aspect of office automation and can sometimes be of more value to the organization than the quantitative benefits (19:14-15). Under conditions where costs and quantifiable benefits are estimated to as being essentially equal, qualitative benefits can rise to become the determining factors in decisions about system implementation and use (4:117-135). Some of the more significant qualitative benefits of the LONEX test are summarized below (11:47-64).

Improved Quality of Products. Office automation can impact the quality of information work products can in two ways: appearance and content (3:129). Although it is easy to observe that office automation can improve the appearance of a document, it is more difficult to judge if the content is improved (3:129). The comments of LONEX users provided insights into these two areas.

Seventy percent of the LONEX users surveyed by the assessment team indicated that the use of office automation had led to improvements in the appearence of the documents they produced (11:48). Fifty-three percent of the users reported that the quality of the contents had also improved (11:48). Professionals and secretaries alike reported that the ease of making changes using word processing permitted them to be more particular about document format and the correction of minor typographical and grammatical errors. Some professionals found they were less inhibited and could communicate more clearly when they realized that the documents they prepared for review by superiors could be easily changed. They also found that they tended to focus less upon anticipating higher-level management wording preferences and to be more concerned about the content of the document they were preparing. The documents were usually more complete because information could be easily added, and they were more meaningful because the statements they contained were frequently more direct. Finally, they stated that the final documents were superior to those prepared prior to office automation.

Improved Worker Satisfaction. The majority of LONEX users were favorably affected by the use of office automation. Over half

reported that the experimental system was highly suitable for their information work activities (11:49). Seventy percent indicated that their offices were more efficient as a result of office automation and that they were interested in using an expanded system (11:49).

The professional staff found that office automation provided them a level of control over their information work activities which improved the general quality of their jobs. The ability to easily create and change documents and the option to elect how the system would be used to support their information work activities, freed professionals from the burdens imposed by the sharing of and competition for scarce secretarial resources. The option to personally keyboard drafts rather than create them in longhand for draft or final typing permitted the creation of legible drafts capable of being reviewed and edited without undue concern about the implication of proposed changes on the secretarial typing workload or turnaround time requirements. For example, engineers and scientists interested in publishing technical reports and papers indicated that the use of office automation had raised their hopes of becoming more prolific since they were no longer held captive by the typing queue. All the professional staff indicated that they were more relaxed and confident about meeting deadlines given the increased flexibility that office automation provided to them in the scheduling and the distribution of their workloads. They also reported that they were able to organize and perform their work in new ways; memos and messages could be sent quickly without secretarial support; the scheduling and accomplishment of work no longer had to be driven by secretarial lead time requirements; and overall, less energy was spent on checking on the status of typing requests to insure work would be accomplished on time.

Secretaries found that office automation significantly increased their satisfaction with the quality of the documents they produced and that it relieved some of the pressures of their job. Last minute changes or repeated changes to documents were manageable with far less effort and irritation. Repetitious work having a standard format; record keeping; and required office documentation, such as file plans, were made easier and less burdensome. Most secretaries stated they would no longer be satisfied working in an office which did not have at least a good stand alone word processing system.

Reduced Turnaround Time. The ability to reduce the amount of time required to handle a document provided several additional qualitative benefits. Even if automation did not reduce the level of effort required to produce a document, reducing the turnaround time in handling the document helped in several other

ways. It maintained the momentum of the originator's train-of-thought by reducing the periods of inactivity due to typing. Reduced turnaround time also served to enhance outsiders' perceptions of organizational and individual competency and responsiveness.

The ability to reduce turnaround time is a function of both the type of information work product and the level of effort required to produce it (4:127-128). During the LONEX experiment, the turnaround time for some documents, such as internal correspondence and memos, automatically became shorter as a result of reducing the amount of time required to create and to transmit them. Other products, such as the technical review of proposals, were controlled largely by external schedules and information work activities which were not affected by LONEX. Under such conditions, the turnaround time of these types of documents was not significantly reduced.

Increased Availability of Information. The ability to rapidly retrieve information improves product quality and enhances decision-making (4:121-124). The professional staff found that access to external scientific data bases and to the internal RADC management information system permitted them to expand the information base from which they worked and thereby improve the quality of their output. For example, engineers were able to conduct more extensive document searches of archived research materials and managers had the capability to check more frequently on the status of project schedules or funds with less effort and support by others.

Reduced File Cabinet Requirements. Electronic file storage decreases the need for conventional document storage facilities (4:169). The clerical staff found that the use of electronic files for storing office working files and archiving infrequently used documents decreased physical file requirements, provided quick and universal files access to all the users and reduced the occurrence of lost documents resulting from the user's failure to return the only copy of the document.

Summary. In summary, the information work activities of both the professional and support staffs were significantly enhanced by the qualitative benefits of office automation. Additionally, the overall perception of RADC mission support improved in the eyes of its customers.

4.2.7. Conclusions

The LONEX study was a four-year experiment to gather information on how office automation could be used to increase organizational productivity. The specific purpose of LONEX was

to gather productivity data, document lessons learned and produce a comprehensive set of specifications that other organizations could use to increase productivity through office automation (OA).

The quantitative benefits of OA were evaluated by their effects on information work activities, potential time savings and the value of the time savings. Six representative information work activities to which OA was applied were studied and manpower savings factors established to quantify the value-of-benefit for managerial, professional and support personnel. Based upon average results, time savings for managers was 2 percent, 27 percent for professionals and 55 percent for administrative support staff. Extrapolating the LONEX test results to the entire RADC organization, the value-of-benefits was estimated to be $6.6 million per year.

Intangible or qualitative benefits were also assessed during the LONEX study. Qualitative benefits consisting of improvements to the quality of information work activity products and enhancements in the quality of the information work environment were shown to have a potentially significant impact on the overall productivity of the organization.

Based upon the LONEX experience, the decision was made to pursue a full-scale OA system for RADC and selected Air Force Systems Command organizations. The system design of the new LONS (Laboratory/Office Network System) will be an expansion of the current LONEX system and will incorporate the lessons learned from the LONEX study.

4.3. Pilot Test of Office Automation in the US Senate

4.3.1. Background and Scope

In December 1982, the Senate Committee on Rules and Administration authorized the pilot test of office automation equipment in the offices of twelve Senators (18). Office automation equipment was to be leased from not more than six vendors at a cost not to exceed two thousand dollars per month per office. A report on the results of the test was to be submitted to the Committee at the end of nine months (18).

4.3.2. Test Structure

The following Senators and vendors participated in the test (18:5):

SENATOR	VENDOR
Armstrong	Sperry
Baucus	Sperry
Bradley	Digital Equipment Corp.
D'Amato	IBM
DeConcini	Xerox
Dole	Honeywell
Huddleston	Wang
Kennedy	Honeywell
Mattingly	Xerox
McClure	Digital Equipment Corp.
Stevens	IBM
Warner	Wang

During the course of the test some of the vendors provided more equipment than their two thousand dollar allowance covered. Therefore, no comparisons of vendors was possible.

The criteria for participating in the pilot test included the following: 1) prior interest in the use of office automation, and, 2) the support of the affected senator and his administrative assistant. Prior experience with office automation equipment was not a criteria.

4.3.3. Pretest Activities

Prior to initiating the test, each of the participating Administrative Assistants (i.e., administrative office chiefs) were asked to rank potential applications in order of anticipated importance. Word processing was identified in all the rankings as the most important potential application (18:5). The test later confirmed this. The second and third choices for potential applications varied with scheduling and electronic spreadsheets being the most popular choices. A basic requirement of the test was to distinguish between those applications that would be useful to all users in their day-to-day work and those that would fall into disuse after their "fad factor" wore off (18:6).

A basic assumption of the test was that the amount of office automation (OA) equipment to be installed was not enough to handle the workload of the Senate's centralized Correspondence Management System (18:6). However, the test revealed that the types of office automation systems used during the test could be used to update mailing lists and to create the text of letters which could then be transferred to the Senate's central computer for printing on the high-speed page printers.

4.3.4. Test Evaluation

Each office was visited weekly by a liaison team consisting of one person from the Senate Computer Center, Educational Services and Support Division, and one person from the Technical Services Staff of the Committee on Rules and Administration (18:6). The visits continued until the use of the equipment leveled off and few, if any, new observations were made with each new visit. The visits had two purposes: 1) they gave the offices an opportunity to share any complaints or favorable comments they had about the test, and, 2) and more importantly, the visits allowed observations of the various users reactions to the introduction of office automation (18:6). With respect to the hardware and software placed in each office by the various vendors, the liaison teams generally played the role of a neutral observer. They refrained from offering advice, suggestions or technical information, so as not to interfer with the real focus of the test that being to evaluate how the users themselves would learn the office automation techniques and apply them to the information work activities of their respective offices (18:6). Extensive assistance was provided, however, on the use of the Senate communications network and various programs on the Senate central computer system.

4.3.5. Observations

4.3.5.1. Word Processing

All the offices quickly learned word processing and were able to use it to produce letters, speeches, press releases and floor statements (18:6-7). In some offices, the OA equipment was used exclusively by the secretarial staff. In others, the professional staff soon adopted it for their daily use. Their experiences reflected those of other professional users, such as professional writers, who find a major benefit of office automation to be the enhancement of their creative powers at the time of intial document composition (4:121-124). In only a few instances was OA tried and rejected by professional staff members.

4.3.5.2. Electronic Spreadsheets

While electronic spreadsheets may eventually prove useful to the Senate staffs, the results of the pilot test were inconclusive (18:7). This was attributable to two factors: 1) the greater complexity and subtlety of using spreadsheet applications programs in comparison with using most word processing programs, and, 2) the comparatively far greater requirement of most staff members to produce textual material versus conducting complex numerical analyses (18:7). In

general, a very small proportion of the staffs saw enough relevance of the electronic spreadsheet to their work to invest the time necessary to gain proficiency in its use.

4.3.5.3. Automated Scheduling

A few of the offices used the test systems to automate the management and publishing of their office schedules. One office, Senator Kennedy's, used the schedule feature extensively and judged it to be their most useful office automation feature (18:7). They printed monthly and weekly schedules on letter size paper and daily schedules on 3 by 5 inch cards. As the schedule changed, they updated the electronic file containing the schedule and produced updated copies of the Senator's schedule. Only events for which firm commitments were made were entered into the system. Additionally, the system was modified by the vendor to accept the scheduling of multiple activities during the same time period.

4.3.5.4. Office Communications

A number of the staffs recognized at the very beginning of the test that communications among terminals within the Senator's Washington office and between the Senator's Washington office and the various State offices was highly desirable (18:7). The test supported this view. Other offices, which were provided with stand alone microcomputers and some minicomputer systems where communications were not available, eventually found the lack of these communications capabilities quite frustrating. Following the completion of the test, the consensus among all the test participants was that any future Senate-wide office automation system should include a communications capability and that it should be able to support centralized staff calendar management, office message switching, transfer of draft documents from one worker to another, input to the Correspondence Management System and transmission of press releases, speeches and other material between the Washington and State offices (18:7-8).

4.3.6. Benefit Data

The pilot test results indicated that a person whose full-time job was to type textual material could achieve an overall productivity increase of about 20 percent when upgraded to more advanced office automation equipment from such less sophisticated equipment as a System/6, a Memory Typewriter or a Mag-Card Selectric Typewriter (18:G.4). If the upgrade was from a manual method, such as an electric typewriter, the gain was estimated to be 30 percent (18:G.4). Professional staff members who spent a major portion of their time writing achieved

productivity increases of about 10 percent (18:G.4). Additionally, persons who were not users of the equipment themselves increased their own productivity through its use by the persons supporting them. This was because as reviewers of a document they no longer had to re-read the revised document in its entirety to review changes, and because the shorter the turnaround time between drafts of the document meant they needed less time to reorient themselves to its subject. Such productivity gains were estimated at 5 percent (18:G.4). These productivity improvements were given an annual dollar value-of-benefit as a percentage of the users' annual salaries. On the average, the estimated annual dollar value-of-the benefit exceeded the costs of the office automation equipment by three times (18:9).

4.3.7. Conclusions

The Committee on Rules and Administration recommended that the offices that had participated in the pilot test be allowed to retain the office automation equipment they had used during the test until a Senate-wide replacement system became available. The Committee also drew several general conclusions regarding the use of office automation (18:H.3-H.8). They determined that there is a danger that a demand for new equipment is often the result of a cultural fascination with gadgetry and that claims of potential productivity increases can be exaggerated. They also determined that since it is unlikely that staff manning will be reduced or that the quantitative benefits of office automation will be passed on to the members of the staff by reducing the hours in a work week with no reduction in salary, justifications based upon qualitative improvements (i.e., quality of documents, responsiveness), cost avoidance (i.e., performance of additional work without hiring additional staff) and increased job satisfaction will be necessary considerations (18:11-12). Finally, they determined that the need to benefit from the rapid advancements taking place in office automation technology and to respond to diverse needs of the various users calls for obtaining equipment from more than one vendor (18:11). However, in the interests of, 1) providing effective training, service and support, 2) transferring staff skills from office to office, 3) realizing financial savings through large procurements and 4) preventing the accumulation of one-of-a-kind discards, the number of vendors should be severly limited (18:H.3-H.4).

4.4. Automated Contracting System Pilot

4.4.1. Background and Scope

The Automated Contracting System Pilot was initiated in May

1984 with a research and development contract between the Navy Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania, and Xerox Corporation (21:1). The goal of this pilot project was to develop an automated contracting system that would reduce Administrative Lead Time (ALT) and improve the productivity of a selected group of buyers in the SPCC's Contract Department (21:1).

The project grew out of the need to provide relief to the SPCC's contracting function which was experiencing a significant growth in workload without a corresponding growth in manpower resources (21:2). The potential benefits of office automation were highlighted by the inherent inefficiencies of the repetitive, manual processing techniques employed in contracting.

The groundwork for the pilot system was established through another cost-sharing research and development contract with Xerox Corporation signed in June of 1981 (21:2). The intent of this initial contract was to provide office automation capabilities to the manpower-intensive areas of contract document preparation and administrative support. This initial installation underwent several configuration changes from stand alone word processors to networked multi-function workstations over a period of three years. At the conclusion of the initial contract in May of 1984, the base system configuration was in place. This base system consisted of twenty-seven 10/29 MB Workstations, three 29MB Print Servers and two 300MB File Servers (17:2).

The significance of this base system was that it validated the concept of "electronic foldering" of contract documents (21:2). Proving the feasibility of this concept was the impetus for pursuing the pilot project itself and for focusing future efforts on the contracting professional instead of the clerical support personnel. During the duration of the second contract, the base system expanded into the final pilot system configuration of thirty-six 10/42MB Workstations, three 42MB Print Servers, one 300MB File Servers, three 10/42MB Communications Servers, one Xerox 9700 Electronic Printer and one Xerox Model 150 Graphics Input Station (21:4-5).

4.4.2. System Design Requirements

The SPCC's May 1984 contract with Xerox to develop the pilot system specified the following design requirements as being necessary to achieve the desired pilot system objectives (21:3-4):

* Download of Supply Demand Review and other automated

buy recommendations from the central computer system to the pilot system.

* Download of pertinent file data necessary to support procurment actions from the central computer system to the pilot system.

* Merge all related data (i.e., contractor responses and correspondence) into electronic procurement folders.

* Distribute the procurement packages to the buyers and technical review personnel, as appropriate, based on the need for technical referral.

* Provide the capability for the buyers and equipment specialist to prepare procurement documents (e.g., solicitations, purchase orders, contracts, etc.) and enter them into the central computer system.

* Provide the file maintenance capability necessary to control document flow, financial management, contract administration and general procurement management.

* Provide sufficient document production capability to meet the on-demand printing requirements of the Contracting Department.

* Provide the capability to store and retrieve the entire electronic contract folder. This included the ability to add correspondence and other documentation, graphics and text as required.

The functionality of the pilot design was demonstrated by Xerox and the contract deliverables were accepted in July of 1985 (21:4).

4.4.3. Test Methodology

4.4.3.1. Staffing

The pilot project was staffed with four Navy personnel serving as Project Manager, Functional Manager, Network Administrator and Systems Administrator (21:5). As needed, functional specialists from the various offices to be supported by the pilot system assisted with system design and development. The strategy was to promote extensive user involvement with requirement determination so that the end-product, the pilot system itself, would reflect the needs of the functional areas

supported. This strategy also increased the degree of acceptance and support the pilot system received from the functional users.

In addition to the Navy project management team, a consulting team from Xerox consisting of three analysts and a project manager were on-site on an as-required basis throughout the duration of the contract (21:5). The total project team also included analysts from the local Xerox office who took on a more active role as the pilot system moved into the maintenance phase.

4.4.3.2. Implementation

During the early stages of planning, it was decided that the pilot system would not only be a test to evalute the effectiveness of the "electronic folder" concept, but it would also be used to determine the appropriate hardware and software configurations for office automation support of the entire Contracting Department's buying function. Two buying branches were selected for the test based upon the type of information work activities they performed and the perceived acceptance of the office automation by branch personnel. In one branch the workstations were installed on a one workstation to one buyer basis. In the other, however, the workstations were installed in a one workstation to two buyers ratio (21:6).

4.4.4. Functional Description

To achieve the objectives described in section 4.4.2., design specifications were developed through a study of existing manual workflows (21:6). Some procedures were automated closely paralleling manual operations in order to promote user acceptance, while others required innovative changes in functional procedures in order to allow their automation.

The pilot system was designed to download data from the central computer system and transmit selected purchase requests to the buyer. By forwarding the requests electronically, they could be moved more rapidly through the procurement pipeline with less probability of error. In addition, hard-copy output of procurement documents was possible using a high speed, laser printer. Buyer productivity was enhanced through the system's capability to provide real-time document tracking, customized forms display, advanced text processing features and document generation from their workstations (21:6-7). Upon contract award, the contract document could be printed on demand with a digitized signature to improve document distribution time, and the contract award data could be uploaded to the central

computer system for files maintenance.

Of special interest to SPCC management was the fact that a workstation was installed in the office responsible for conducting Small Business Administration (SBA) reviews (21:7). This workstation allowed documents to be passed electronically between the SBA office and the affected buyer, thus, significantly shortening the time taken up in the SBA review process. Additionally, two standalone workstations were installed in the limited screening and packaging sections to experiment with the idea that "electronic folders" requiring technical review and action could be retained in electronic format on disks and physically transported, reviewed and returned to the buyer (21:6-7).

4.4.5. Benefit Data

4.4.5.1. Quantifiable Benefits

The results of the post-implementation audit indicated that significant quantifiable savings resulted from the implementation of the pilot system. This evaluation concentrated on what were considered to be the two most critical measures of contracting efficiency; Administrative Lead Time (ALT) and buyer productivity (21:7).

For ALT, a quality assurance audit was conducted for a period of six weeks in the two test branches (21:8). The time it took to process a purchase request folder was compiled from data on the folder jacket as it was logged out of the buying branches following contract award. Both small and large procurement requests were examined. Historical data maintained by the staff on department-wide ALT were also used. The results of this audit revealed that ALT had been significantly impacted by the implementation of the pilot system.

Basically, prior to pilot system implementation, the entire Contracting Department experienced an average of 131 days ALT in July 1984, whereas, the test branches measured 133 days average ALT for the same period (21:A-2). In April 1985, following pilot system implementation, the department-wide average ALT was 148 days, whereas, the average for the test branches was 123 days (21:A-2). The bottom-line result of pilot system implementation was that the ALT decreased by 10 days in the test branches, while it increased by 17 days for the Contracting Department as a whole for the same period. Translated into dollars and cents this represented a savings of $18 million with ALT being valued at $1.8M per day in the FY85 SPCC budget (21:11).

For buyer productivity, historical work counts by type of document were used for the March to May 1984 and the March to May 1985 periods (21:8). Because the pilot system had been designed around the processing of procurement requests which were under $10 thousand, the small purchase category was used for measurement. The department as a whole showed a small purchase productivity decrease of 10 percent for the period (21:A-3). Small purchase productivity for the test branches, however, showed a dramatic increase of 19.3 percent (21:A-3). This represented a potential savings of 24 man-years of labor or an annual value-of-benefit of $672 thousand (21:10).

During the post-implementation audit, functional areas which might have experienced side benefits as a result of pilot system implementation were also evaluated and their benefits quantified. A total savings of $45 thousand was documented due to the change of printing purchase requests on the 9700 Electronic Page Printer instead of on the computer center system's line printers (21:9). Additionally, besides providing marked improvements in the quality of the purchase request document, processing improvements (i.e., 0.5 man-year savings for document assembly due to a 37 percent productivity gain, elimination of decollation/bursting for purchase requests, change from preprinted forms to bond paper) which made manual operations easier for folder assembly were evident from the start of the pilot test (21:10-11).

Finally, the fact that more legible documents were being produced resulted in a reduction in the number of modifications issued due to processing errors (21:9). With higher quality printing and less handwriting involved in the preparation of modifications, there was also less probability of transposition errors or interpretation problems with the modifications themselves. Based on a recent quality assurance sampling, the modification volume for FY84 and an estimate of $250 per modification for administrative costs, the annual cost avoidance for modification administration was estimated at $226 thousand (21:9-11).

4.4.5.2. Qualitative Benefits

It was the unanimous opinion of all the personnel participating in the pilot test that even if hard dollar savings could not be assigned, the benefit of the multi-function workstation to the buyer was of worthwhile significance (21:9-10). The advantage of having an easy to use tool for the buyers to accomplish their routine information work activities was considered to be of the utmost importance.

Beside providing the needed capabilities for pilot system

implementation of the "electronic folder," the standard system software gave the buyers simultaneous access to as many as six different data bases at their workstations (21:9). This allowed for the rapid cross-referencing of a number of essential working data bases residing on the central computer system.

Other software features such as an electronic spreadsheet and a files management utility provided very effective evaluation and tracking tools for the buyer. In addition, the advanced text editing capabilities of the workstations gave the buyers a great deal of flexibility in document preparation. This feature was especially important for exception-type documents which were difficult to handle under a previous, more rigid menu-driven system (21:10). For example, the buyers were able to create contract documents including digitized signatures. They could issue modifications in the correct number of copies ready for final distribution. They could access standard forms and clauses in electronic format and create custom forms for contract documentation (21:9-11). These capabilities served to improve the job satisfaction and the quality of performance of the buyers by increasing their level of independence and by providing them the time and the tools to be more creative and thorough in their work (21:9-11).

4.4.6. Conclusions

Based upon the results of the pilot system, the decision was made to implement a full-scale system throughout the SPCC Contracting Department (21:13). The decision was also made to apply the "electronic folder" concept across the department to all buyers. The initial focus of the full-scale system would be on small purchase processing due to the fact that this category comprised over 80 percent of the Contracting Department's workload and that the test branches had experienced a 19.3 percent productivity improvement in the processing of small purchase requests (21:13-14).

4.5. Summary

The cases presented in this section illustrate some of the economic and behavioral benefits of office automation systems. The most valuable lesson to be gained lies in a greater respect for the intricacies involved in successfully introducing information system technology into the workplace. Finally, the case studies themselves serve as examples of the type of information that is extremely valuable and often times not available to those involved in the planning, approval and implementation of office automation projects.

5. CONCLUSION

5.1. Introduction

In recent years, Air Force organizations, like their counterparts throughout the Federal Government and the private sector, have been turning to the use of office automation (OA) technologies to effect productivity improvements in the office environment. However, as Ms Amy Archambeau, manager of organization and manpower planning for GTE's human resources staff, has said, "Productivity is up there with apple pie and motherhood as something that everybody says he likes, even if he knows very little about it" (7:21). The Air Force experience with the implementation of OA has also often been characterized by a lack of documented evidence on the actual quantitative and qualitative benefits received from the use of office automation.

With the ever increasing competition for the dwindling budgetary dollar, the need for requirements analyses and procurement justifications for the acquisition of OA systems which take advantage of the results of previous OA projects has reached a new level of importance. The scarcity of data on the actual benefits experienced by Air Force organizations as well as other organizations has contributed significantly to the elongation of the planning, approval and implementation processes associated with new OA projects as well as the failure in some cases to approve and fund new OA projects (24).

5.2. Observations

This document contained a small collection of case studies of recent OA experiences in which both formal and informal baseline productivity studies and post-implementation audits had been conducted. During the collection of these case studies, I observed that the accessibility to information within the Air Force and the Federal Government on past OA experiences is very limited. Particularly, those experiences having to do with the actual benefits resulting from the use of OA. I also observed that the number of organizations which have conducted the initial baseline productivity studies and subsequent post-implementation audits necessary to develop benefit or productivity data appears to be extremely small. Finally, I observed that almost everyone associated with the area of OA is extremely interested and supportive of the collection and use of past OA experiences in the planning, approval and implementation processes. However, the discipline and the logistics of the problem have in most cases appeared to be overwhelming. The above observations also appeared to hold true for the private

sector as well.

There are two apparent reasons for this lack of information on the benefits of OA and the difficulty that exists in obtaining that information which is available. First, there is no commitment on the part of senior management to devote the resources necessary to conduct thorough baseline productivity studies and post-implementation audits. Quite often, senior management views the baseline productivity study and the follow-on post-implementation audit as unnecessary consumers of scarce and expensive resources. While this may be, at times, the expedient view to take it is in all cases a very short-sighted view. Second, there is no central office or agency within the Air Force or the Federal Government to which a manager or an OA systems planner can go to review and hopefully benefit from past OA experiences of organizations with similar missions and information work profiles. Currently, the obtaining of such information is very much a "catch-as-catch-can" proposition with the sources either unknown to the seeker of the information or unaccessable by virtue of location or affiliation.

The task facing the present-day Air Force organizational manager is to conscientiously implement the existing policies and regulations which require that his or her organization conduct thorough advanced planning prior to the implementation of an OA system. This planning requires the performance of feasibility studies (including the determination of a productivity baseline) and cost-benefit analyses. The task facing the Air Force Administration and Information Systems communities is the development and implementation of policy and regulation directing the performance of post-implementation audits of all OA projects. Additionally, action should be taken at Air Force-level to direct the establishment of an automated Air Force-wide data base of Air Force OA experiences. Recommended changes to the draft AF Regulation 4-4, How to Determine and Justify Automation Requirements (23), and the proposed development of a new 700-series, information systems, Air Force regulation which establishes an automated Air Force-wide OA Lessons Learned Program are presented in the following section.

5.3. Recommendations

5.3.1. Changes to Draft AF Regulation 4-4

The draft Air Force Regulation 4-4 explains how to quickly determine and justify office-related automation requirements. The stated objective of the draft regulation is to help managers increase the probability of operational mission success and decrease the cost of mission support through improved information management (23:1). The draft regulation outlines

what it calls an Automation Requirements Analysis (ARA). The ARA is defined as a step-by-step analysis method that can be quickly used by a manager to identify ways to improve his organization's support of the operational mission through the use of automation and at the same time decrease the cost of that support. These objectives are achieved by streamlining information management procedures and by identifying and justifying requirements for automation of information processing (23:6).

The draft regulation then specifies in detail the procedures and information needed to accomplish the identification and justification of automation requirements for presentation to the base Information Systems Requirements Board (ISRB). Chapter 9 addresses the "Continuing Benefits of ARA" and paragraph 9-2 deals briefly with evaluating the success of automation efforts. The paragraph further directs that a letter containing the results of the evaluation be sent to the local wing/base Director of Administration (DA) and Director of Information Systems (SI). The draft regulation does not specify what these two organizations are to do with the evaluation results contained in the letter.

I recommend that paragraph 9-2 be changed to read as follows:

"9-2. Evaluate Your Success. The primary objective of evaluating your automated system following installation is to compare the projected benefits (i.e., the increase in probability of operational mission success and the decrease in cost of mission support) to the actual benefits realized through system implementation. The evaluation report resulting from these efforts should also include recommendations to management for either discontinuing or proceeding with the existing system, or fine-tuning the system to achieve the expected results. An extremely important secondary objective of this post-implementation audit is to build up your organizational data base of the benefits realized through the application of different automation technologies. By carefully collecting data on your organization's own automation experiences, your future automation projects can be planned, approved and implemented with a higher degree of confidence in the results. These data can also be shared with other wing/base organizations which may be planning similar automation projects.

a Timing the Post-Implementation Audit. The timing of the post-implementation audit is an important factor in obtaining meaningful audit results. If you perform the audit shortly after system installation, the

results will not be valid because of system break-in time. To accurately determine system performance, you should conduct the first post-implementation audit after the system has been operational for a period of six months to a year.

b. Audit Activities. You should perform the post-implementation audit using the identical procedures used to initially identify and justify your automation requirements. Once you have reviewed each of the tasks and transfers that were automated, you have the necessary data to compare the post-implementation results with your initial expectations. The actual benefits of the system are determined by the system's ability to achieve or surpass these expectations.

c. Differences in the Projected and Actual Benefits. Differences in the projected and actual benefits will inevitably occur because the system may have been implemented differently from your original design. Factors to consider when determining the causes of such differences include:

(1) Any changes in administrative procedures associated with the automated tasks.

(2) The reaction of personnel to the new system.

(3) The accuracy of the data collected during the initial requirements identification and justification processes as well as the post-implementation audit itself.

Once you identify the causes of the differences between the projected and actual benefits, corrective actions must be identified which will enable the system to meet its expectations.

d. The Post-Implementation Report. The conclusions you reached from the above comparisons form the basis for the post-implementation audit report to senior management. Your recommendations concerning the correction of system deficiencies or the further development of the automated system are included in the report. The quantitative and qualitative effects of these recommendations are clearly identified for review by senior management. The post-implementation audit effort, once you have completed it, provides senior management with a full assessment of current system effectiveness and provides a data base of valuable information for use in the planning, approval and implementation of future automation projects. Copies of your report should be provided to the wing/base DA and SI."

Incorporation of the above change into the draft AF Regulation 4-4 would establish the policy and regulation necessary to

direct the performance of post-implementation audits of office automation projects. It would also serve to standardize the procedures associated with the conduct of such audits and thus produce audit reports that would be somewhat standard in format and content.

5.3.2. OA Lessons Learned Program

Once the wing/base OA user has completed the post-implementation audit and copies of the final audit report have been provided to the local wing/base DA and SI, the question of access to the report by others arises. In response to this question, I recommend that the Air Force Assistant Chief of Staff for Information Systems, HQ USAF/SI, with the support of the Air Force Acquisition Logistics Center (AFALC) establish an Air Force-wide OA Lessons Learned Program. This program would be established by a new Air Force 700-series regulation and would be structured along the same lines as the AFCC and the Joint AFLC/AFSC Lessons Learned Programs (9,10). The objective of the program would be to give Air Force managers involved in the planning, approval and implementation of OA systems the benefits of past OA experiences and the results of past technical and management decisions for application to their current or future OA projects. The goal of the program would be to improve the way we do the OA business, thus improving the performance of the Air Force mission. For, if the results of past OA experiences can be retained and effectively applied, the user can avoid repeating mistakes and spending precious time and money unnecessarily.

The OA Lessons Learned Program would take advantage of the Air Force Lessons Learned Data Bank, an automated, permanent central repository of Air Force lessons learned located at AFALC/PTL, Wright-Patterson Air Force Base. The majority of lessons currently contained in the data bank are on acquisition and logistics management topics; however, lessons on topics such as safety, communications-electronics and automation are becoming more numerous. Documents kept in the data bank include individual lessons and their associated source or backup materials. All lessons are kept in hard copy and in electronic form. An abstract of lessons or individual lessons may be requested by any Air Force activity. Packages tailored toward a specific area of interest may be requested from AFALC/PTLL using keywords identifying a system, topic or funtional area.

Thus, the copy of the post-implementation audit report submitted to the wing/base SI by the OA user would be entered into the Air Force Lessons Learned Data Bank by the SI in accordance with the procedures contained in the new AF Regulation 700-xx. The potential user of the individual OA

lessons would request the lessons in accordance with procedures contained in this same new regulation.

Of course, application would be the focus of the OA Lessons Learned Program. The key to the program would be the user's becoming aware of applicable lessons and putting them to use in a current or future OA project. This could be partially assured by placing in Chapter 2 of the draft AF Regulation 4-4 the requirement to review applicable OA lessons learned as part of the Automation Requirements Analysis (ARA) preparations process.

5.4. Summary

In recent years, Air Force organizations have been turning towards the use of office automation to effect productivity benefits in the office environment. The general experience with such systems, however, has more often than not been characterized by an inability to produce documented evidence of the actual benefits received from their implementation. Evidence that can be used to build up an organizational data base of the benefits realized through the application of different OA technologies. For, by carefully collecting data on the organization's own OA experiences, future OA projects can be planned, approved and implemented with a higher degree of confidence in the results.

This characteristic inability to produce documented evidence of actual OA benefits and the resultant inability of Air Force organizations to benefit from such evidence in support of their own OA efforts is the result of Air Force managers failing to conscientiously implement the existing policies and regulations which require that an organization conduct thorough advanced planning prior to the implementation of OA systems. It is also the result of the absence of Air Force-level policy and regulation directing the performance of post-implementation audits of all office automation projects. Finally, it is the result of the absence of an effective mechanism for collecting, storing and retrieving the results of such post-implementation audits.

The recommendations contained in paragraph 5.3. above provide the structure necessary to support the collection and use of office automation experiences. They do not provide the commitment on the part of senior management that will be required to make effective use of the structure. Senior management support must be forthcoming if the primary objective and goal of an Air Force Office Automation Lessons Learned Program are to be achieved.

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