STRATEGY RESEARCH PROJECT

THE RESERVE COMPONENT AUTOMATION SYSTEM (RCAS) -- A CASE STUDY IN THE EVOLUTION OF AN INFORMATION MANAGEMENT SYSTEM

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ABSTRACT

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The Reserve Component Automation System (RCAS) is a Wide Area/Local Area Network system designed to provide automation support for the Reserve Components' mobilization management and sustaining-base operations. Current system design was developed by Boeing Information Services, Inc., using commercial off-the-shelf (COTS) hardware and software from a variety of vendors. RCAS is the information management (IM) link between the Reserve Components, other DOD organizations, and the world wide web. Such access will provide a vital link in the sustaining base, tactical, and strategic environments. Unlimited information will be available from the network which will allow units to operate more efficiently. Even though RCAS has had its problems in the implementation phase, it has the potential to evolve into a truly functional and cost saving system. This paper is a study which analyzes the planning, procurement, and implementation process of RCAS. This paper has two purposes: (1) Identify distracters that can hamper the planning, procurement, and implementation process, and (2) Provide lessons learned and recommendations that could improve the process of future information management (IM) and information technology (IT) systems.

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PREFACE

During the 1984 U.S. Army Signal Conference, Major General Thurman D. Rodgers, then the Commanding General of the United States Army Signal Center and Fort Gordon, captured the imagination of the audience during the opening ceremonies by introducing the commercial-off-the-shelf concept as the future of procurement for the Signal Corps. I for one was amazed as General Rodgers spoke of how we would obtain the latest communications devices and repair parts from local vendors; an almost "shopping at Radio Shack" plan. No longer would the Army have to spend countless years in the developmental and procurement stages of acquisition to provide field commanders and troops with communications technology that was outdated by the time it entered service. The Army signal community would simply decide what was best for operations and we would buy it. Ultimately, we would cut out many of the costs in the acquisition process.

In retrospect, great strides have been made in acquiring newer technology for the military in a shorter period of time. The Mobile Subscriber Equipment (MSE) initiative, as a non-developmental program, certainly provided field units with modern equipment. The MSE initiative, however, is not a COTS program and does not provide the benefits of the concept. So where does COTS stand as far as being a major player in providing the Army with the latest technology? Most assuredly the commercial automation industry is our key to future information management support and COTS is one of the prime catalyst to ensure we stay abreast. The Reserve Component Automation System (RCAS) is one program taking advantage of COTS. However, the theoretical advantages of COTS, namely speed of program implementation and cost savings, have not been exploited by RCAS. The evolution of RCAS has extended over a period of nineteen years with budget overruns.

RCAS is not necessarily a bad concept. Nor does it contain flaws that can not be overcome. The program is, in itself, a massive undertaking. Once it is completed, every city, town, and rural community within the United States, its territories, and Europe with a Guard or Reserve Center will be connected to a world wide network. This system has the potential to provide a tool that will not only support day-to-day operations but also will provide initiatives to support other National interests such as emergency operations, education support, and home defense contingency planning and operations.

Today's automation and telecommunications technology, however, is a primary product of the free enterprise system. To paraphrase; "there is always someone trying to build a better mouse trap." Automation and communications technologies are growing at

such a geometric rate that, at best, only the most profitable individuals and organizations are able to possess the latest technology all of the time. To further complicate matters, the business world's competitive nature to attract and keep customers creates an artificial rate of supply and demand. Today's commercial advertising will convince potential buyers that if they do not have the newest hardware or software products they will be "buried" by the competition. Our children will become outcast because they cannot "surf the web" at light speed with the newest interface device. The truly great information managers of today and the future will be those that are able to first distinguish true needs from advertising "hype" and correctly determine the best and long lasting solutions to their customers' needs.

The evolution of RCAS will provide the much needed services that it is designed to provide. It is hoped that the lessons learned from this project will contribute to streamlining our acquisition and implementation process. Such contributions will assist in building a seamless information management network for the DOD community.

LIST OF ILLUSTRATIONS

"The flies have conquered the flypaper"

—Steinbeck - The Moon is Down

I. INTRODUCTION

The future of information resources management (IRM) for the Army National Guard and Army Reserve rests with the development and evolution of the Reserve Components Automation System (RCAS). Final installation of the primary system will offer its users a link to the world wide network. Further, they will benefit from the advantages found in wide area/local area network (WAN/LAN) operations. While the RCAS concept originated in 1979, complete implementation of the primary system has not yet reached all of its perspective users. Rather, RCAS experienced several false starts and setbacks which impeded the modernization of the Reserve Components' (RC) information management (IM) assets. Since the restructure of RCAS in 1995 and contract modifications with Boeing Information Services, implementation of the program has experienced definite advances. The use of commercial-off-the-shelf (COTS) hardware and software, government-off-the-shelf (GOTS) software, and Boeing's system design, has improved the process considerably. Improvements still come with risks. As a user of off-the-shelf material, the RCAS program has to contend with rapid advances in technology which are exploited in a highly competitive commercial market. RCAS is an excellent example of how rapid technological

advancements can almost destroy a program before it is fully implemented.

The intent of this paper is threefold. First, it will demonstrate how distracters and their consequences can hamper the development and implementation of automation initiatives. The RCAS Program is used as the primary focus of this paper because of its long and turbulent history and its migration to a COTS supported system.

Second, it will show how the use of commercial products by RCAS and other DOD initiatives have to contend with the rapid growth of the automation industry. The affordability advantage of using commercial products is often negated due to this growth phenomenon.

Also, this paper will offer observations and recommendations to improve program implementation. These comments should be considered when planning the acquisition of future COTS related DOD programs.

II. BACKGROUND OF THE RCAS PROGRAM

A. HISTORICAL CONTEXT

The requirement for RCAS was realized in the 1970's when the Army became an all volunteer force. This new Army came to rely more and more on the units assigned to the reserves. By the late 1970's, military leaders realized the success of this nation's military operations depended on the rapid mobilization of its reserve forces. To assist in this process, U.S. Army Forces Command identified the need to establish an automated information system which allowed all levels of command to exchange readiness

and mobilization data of the reserve components.[1] In 1979, FORSCOM developed (and the Secretary of the Army approved) a Mission Element Need Statement for the system.

From 1981 to 1985, the Army initiated the process to design, develop and field the desired system. The program was named the Continental Army Management Information System (CAMIS). In 1985, the Army canceled CAMIS for further evaluation to include incorporating the program with the Army's sustaining-base automation architecture.[2]

The reevaluation confirmed the need for such a system. In 1988 the program was renamed the "Reserve Component Automation System" to further clarify its support of the RC forces. Congress and the Secretary of Defense also mandated that the sponsorship of the program be transferred to the Chief, National Guard Bureau (CNGB).[3] Since the reevaluation, RCAS has evolved in three phases.

Phase one of the program was a competitive demonstration by several contractors. Boeing Computer Services (now Boeing Information Services) was awarded the RCAS contract. Phase two was the initial installation of RCAS by Boeing. Phase two's system design was a "Unix-based, multi-level secure (MLS), client-server architecture using compartmented mode workstation (CMW) technology."[4] By 1995, Boeing had successfully fielded a portion of the system to 2,000 sites in 14 states.[5]

Budget overruns due to software development and changes to the contract baseline resulted in another evaluation of the program. A

group of Army National Guard, Army Reserve, and active Army leaders, called the "Red Team," conducted a thorough review of the program and proposed many changes. These recommendations led to the restructure of the RCAS contract in 1995.[6] This restructure was designated as phase three of RCAS.

Phase three began in 1996 and is presently under implementation. States and territories that were not fielded in phase two will now receive RCAS equipment. States that were outfitted in earlier phases are being retrofitted with new equipment. The system design during this phase is called "a system of choice" and incorporates the latest in commercial technology. This program was designed to be more cost effective in supplying the RC with their automation needs.[7]

B. EARLY SETBACKS AND RESTRUCTURING.

The above stated history of RCAS does not reflect the dynamic changes that occurred in the automation community during RCAS's life cycle. The current version of RCAS is itself a product of evolution. RCAS's early development (CAMIS) evolved during a period of transition from a mainframe environment to the stand alone personal computer (PC) environment. The initial program was not necessarily flexible or "user friendly". Today, RCAS has evolved to an environment using COTS components found in both the personal and professional worlds.

Neither does the history take into account the ramifications of combining multiple automation requirements into one design.

Initially, RCAS was designed as a database management system to maintain relevant mobilization material. As the system evolved, the RC's sustaining base automation requirements were included as part of the design to save dollars and create less confusion. Routine office automation support suites were also included as part of the sustaining base requirements. Not only did merged requirements further complicate the program and delay the acquisition of modern Personal Computers (PC's) for sustaining base operations, but it also increased program costs and extended the installation time frame.

Funding issues drew a sharp response from Congress who took several measures to ensure proper use of program resources. This included a six year mandate, beginning in FY89, on spending to preclude the RC from buying equipment that duplicated RCAS efforts.[8] In 1990, Congress allowed special provisions to purchase automation equipment for units that did not possess PC capabilities.[9] By 1995, Congress still placed stipulations on the use of RCAS funds but the constraints were relaxed to allow the Reserves to purchase vital items that would be included as part of the existing RCAS design.[10] While Congress' intentions were good, the mandate stifled RC automation growth during the most progressive period in the history of the industry.

Congressional displeasure with the progress of RCAS in the late 1980's also resulted in a shakeup in program management. Congress openly attacked Army leadership of the program in 1988 and demanded

full responsibility of RCAS be turned over to the Chief, National Guard Bureau (CNGB). By 1989, the DOD Appropriations Act precluded the use of RCAS funds unless certain criteria were met, to include CNGB control.[11] Many of these requirements remained in effect when RCAS was reevaluated in 1995.

Congress continues to monitor the progress of RCAS to include the Army's involvement with the program.[12] Congress has been quick to expound the success of the program since they stepped in and turned control over to NGB.[13] NGB, however, can not claim success because they too have not completed the system. NGB is quickly reaching the ten year threshold that was the Army's demise. If the program does not experience any further delays it will take NGB 13 years (1989 to 2002) to install a complete system.

C. THE CURRENT DESIGN.

Phase three of RCAS began in 1996 after the restructure of the RCAS contract in 1995. The restructure was established to "constrain costs, establish a realistic requirement's baseline, and leverage new information technology."[14] These changes were approved by the "RCAS General Officer Steering Committee (GOSC), Office of the Secretary of Defense (OSD), Major Automated Information System Review Council (MAISRC), and Congress."[15]

The mission of RCAS remains the same - to provide sustaining base/office automation needs to the reserve components' peacetime chain of command so they can accomplish their mobilization planning and support functions. As with earlier phases, the system supplies

equipment throughout the entire RC chain of command. In addition, this phase includes active data exchange within the Standard Army Management Information Systems (STAMIS). Further, the system will be able to exchange data with all related Army and DOD Information Systems.[16]

The phase three design allows users to perform their duties at their normal work area using a desktop workstation (Personal Computer (PC)). The system contains "state-of-the-art commercial --off-the-shelf (COTS) office automation (OA) hardware and software, and government-off-the-shelf (GOTS) application software."[17] Individual users will perform routine maintenance and trouble-shooting. Selected individuals at various levels will perform system administration and security support functions. Help desks will be established to support users and the system.

The new system is based on a commercial wide area/local area network (WAN/LAN) design. Boeing's design established different criteria for each site. The number of workstations and server placement is established by the type and number of units located at the site.

Classified Capable Workstations (CCW) are placed at all units which are separate mobilization entities. The CCW's use a removable hard drive to store classified information. While in the secure mode, the CCW operates as a stand alone workstation which interfaces with a secure network via a "Type-I National Security Agency (NS) approved, Secure Telephone Unit, Version III (STU III),

Secure Data Device (SDD)."[18] During routine, non-classified operation the classified hard drive is removed and the workstation connects to the appropriate LAN.

Telecommunications support is provided through leased lines and varies according to site size. Connectivity includes the use of contracted Asynchronous Transfer Mode (ATM), T1, T3, and POTS (Plain Old Telephone Systems) circuits. Approximately five months prior to final installation, the RCAS program manager provides ARNG State Area Readiness Commands (STARCs) and Major US Army Reserve Commands (MUSARC), referred to as gaining commands, funds to lease necessary circuits. In 1999, funding responsibility for telecommunications will be transferred to Chief, National Guard Bureau (CNGB) and the MUSARCs.

In order to speed up the installation of RCAS, several installation criteria changes were interjected during the reevaluation of 1996. These include a "mini-hub" installation at the STARCs and MUSARCs, and site preparation and installation of equipment by the gaining commands at sites containing 16 or fewer workstations.

The RCAS mini-hub installation is an effort to connect the STARCs and MUSARCs to a functioning system prior to total fielding of units within their command. This will give these commands additional time to become familiar with system operations. More importantly, it gives them "across command functionality at a very early date."[19]

Under the reevaluation, site preparation and equipment installation at small sites became the responsibility of the States and MUSARCs (gaining commands). Small sites are those locations containing 16 or fewer workstations. Workstation installation and electrical upgrades to support RCAS at all locations also became the responsibility of the gaining command. Boeing retained the responsibility to install the network servers and telecommunications services at the sites with 17 or more workstations.

Since the beginning of phase three, initiatives have also been offered to gaining commands to install more of the system. The accelerated government installed sites (GIS) initiative allows ARNG organizations that are scheduled to be fielded in FY99 or later to volunteer early to perform site preparation and installation of 16 or less workstation sites. The USAR has an option called horizontal fielding. Under this initiative, fielding is performed in three phases. These phases are divided by the number of workstations. USAR unit priority is according to the number of workstations at the location instead of regional installation. Another initiative available to both the ARNG and USAR is the site preparation and installation initiative for all locations except the telecommunications hub room at the STARC and MUSARC.

The Directorate of Information Management (DOIM) or the Deputy Chief of Staff for Information Services is responsible for RCAS operations within the gaining command. Work force and personnel allocations to these offices did not change due to the redesign.

In fact, personnel requirements have not changed significantly since the inception of these offices which coincided with phase one of the original RCAS design.

Training is also an issue of the reevaluation. Boeing is providing a listing of recommended courses to assist receiving commands with training.[20] CNGB and the USAR are providing funds until 1998 to the gaining commands in order to train command level representatives. Office automation training for end users will be provided by contractor developed software. Training for GOTS software will be supported by government provided materials and/or training.[21]

D. CONTEXT OF OTHER DA AUTOMATION INITIATIVES AND RCAS

The original development of RCAS began as a requirement for an automated mobilization management structure but changed in the mid-1980's as the information management structure within the Army began to mature. Until 1989, RCAS's mission was to provide databases in support of mobilization efforts. New mission guidance after the program was turned over to NGB included mobilization support and sustaining base operations as well. The Department of the Army's concept of sustaining base operations includes a wide realm of automation operations to include "information resources outside the area of operations."[22] This environment includes office automation support. Further, "it encompasses the information resources and activities that have the responsibility to raise, organize, train, equip, and eventually, deploy and sustain Army and

other assigned forces in the accomplishment of their missions in operational theaters -- the theater/tactical environment."[23]

Unlike RCAS, the Army decentralized the purchase of sustaining base automation equipment and has only recently placed emphasis on creating a seamless IMA environment. Army installation DOIM's are accountable for monitoring the purchase and use of automation equipment, including establishing automation standards. Organizations and other installation tenants use organizational funds to purchase, install, operate and maintain (IOM) their needs. Telecommunications connectivity for installation tenants is provided by the DOIM.

RCAS, on the other hand, remained a centralized program throughout its life cycle. RC DOIMs/MUSARCs are dependent on the RCAS program manager for most of their automation needs. Funds provided for RC DOIMs adequately support operational maintenance on current automation assets. New equipment will be provided through the RCAS contract. Telecommunication budgeting only provides funds to support telephone services.

III. THE DECISION TO USE COTS TO SUPPORT RCAS

A. CONTEXT OF RCAS AND THE INFORMATION MANAGEMENT EVOLUTION

The origin and evolution of RCAS paralleled one of the most dynamic changes in the automation industry -- the migration from mainframe computer technology to personal computer (PC) or work-station technology. There were half million computers in use in

the United States in 1979. By 1996, the United States Government alone had 2 million PCs in use while local and state governments were using 2.8 million PCs. In 1997 there were 94.9 million installed PCs in the United States.[24]

The failure of the early stages of RCAS (1979-1989) to provide an operating system is partially due to the rapid growth in both automation and telecommunications technology. Pre-1989 efforts were based on automation technology that was easily overtaken by more efficient and economical designs. The newer computer designs were faster, and operated software that was more user friendly and required less training time for end users. By the mid 1990's IBM compatible PCs with Intel Processors and DOS based operating systems dominated the industry. In fact, in 1997, 92% of the PCs in the US used DOS or a Windows based operating system.[25]

The use of COTS products in phase three of RCAS is an attempt to close the gap between earlier RCAS initiatives and the technological advances available through the commercial market. In addition, current RCAS initiatives have the potential to take advantage of low commercial automation costs.

However, even the latest RCAS design has not kept up with industry's pace. Its shortcomings are related to the problems associated with rapid advances in IT and IM. These problems are international in scope and are experienced by the private and government sectors alike.

B. COMMERCIAL CONTEXT OF THE AUTOMATION INDUSTRY

Businesses and industry, as with RCAS, have experienced the turbulence associated with the rapid growth in automation and telecommunications. The manner in which businesses deal with this growth varies quite differently, however. Their approach contains several implied and built-in mechanisms that have allowed them to take advantage of the automation evolution and create artificial guidelines to cut costs and improve productivity.

The strategy used by the business community is actually based on the theoretical pattern of automation growth due to the complexity of integrated circuits - known as Moore's Law. In a 1965 article published in *Electronics*, Gordon E. Moore, then head of research at Fairchild Semi-conductor, noted that "the most cost-effective integrated circuits had roughly doubled in complexity each year since 1959."[26] Moore's observations became Moore's Law which predicted that the number of transistors per chip doubles about every 18 months.[27] This law set the standard for chipmakers to gauge productivity.

In 1977, "Apple Computer Inc., Radio Shack, and Commodore all introduced mass-market computers, beginning the PC era and the microcomputer race."[28] By 1979, which coincides with phase one of RCAS, the productivity model established by Moore's Law was established and created a marketing trend for new and improved machines. Introduction of more complex chips by manufacturers definitely established a pattern of geometric growth. Figure 1[29]

below is an overview of Intel microprocessor production from 1978 to 1999. As the chart demonstrates, transistors per chip geometrically progressed with a new Intel microprocessor entering the market approximately every 3.1 years. Increased memory size also grew geometrically to meet the needs of CPU performance.

In the 1990's, during phase two and three of RCAS, microchip companies began to decrease the time to market for new and more complex CPUs. Figure 2[30] below demonstrates that as the timeline of microcomputer CPUs increased, the time to market faster and more complex chips also increased.[31]

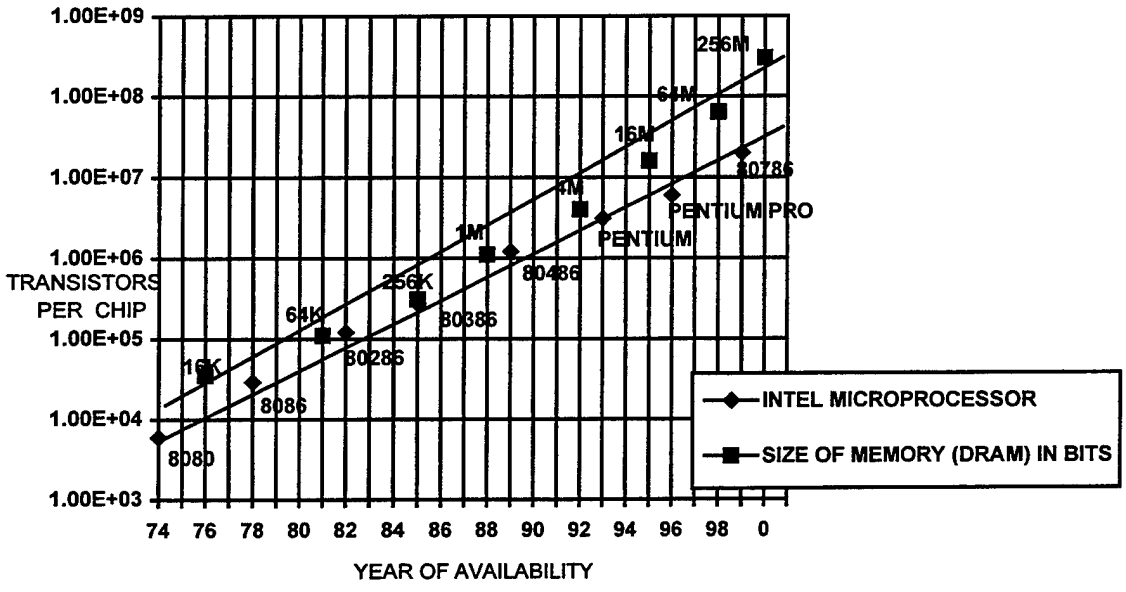

Figure 1 - TRANSISTOR DENSITY

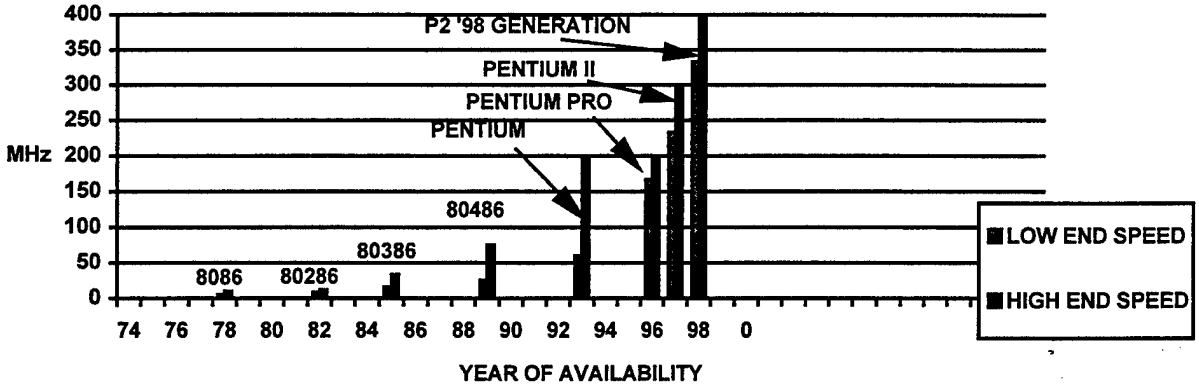

Figure 2 - INTEL CPU SPEED

While advertisers project these innovations as new technology, the automation industry has not depended on new discoveries to increase computer performance. Rather, the increased performance is due to more efficient engineering redesigns than new discoveries. Redesigns have their limitations, however. Current chip designs depend on circuit patterns etched on the silicon wafer using lithography.[32] Industry has predicted that the use of lithography for chip production will soon become ineffective because the wavelengths of the ultraviolet light used in lithography will become larger than the "smallest features on the chips".[33] However, industry also predicts that this crisis will not reach a critical level until the second decade of the twenty-first century.

In order to cope with the environment described above, businesses have learned to constantly analyze trends associated

with the automation industry and their impact on total company costs and operations. The three most important trends that commercial users monitor which are also related to Army users are: (1) the total cost of ownership (TCO) of their information management system, (2) the best method to determine when to upgrade the system, and (3) dynamic changes that will have a catastrophic impact on the way they conduct business operations. The importance of these trends to RCAS and the Army's IM programs warrants further discussion.

It is estimated that the "total cost of ownership" (TCO)[34] of a company's desktop is "four to 10 times the annual depreciation expense."[35] Cost categories used in estimating the TCO includes: "capital cost, technical support cost, administrative cost, and end-user operations cost."[36]

> Kirwin says that typically, 15% to 25% of total cost comes under capital expense. The remainder is labor-of which 15% to 20% goes for technical support (everything IS professionals do to support the users), about 10% goes to administration, and 40% to 55% is for end-user operations.[37]

While all categories are important, the major concern of businesses is the direct and indirect costs associated with end-user operations. Direct costs involve user training and is based on the primary automation knowledge of the user and program upgrades and changes. Indirect costs are those found in organizations without properly trained individuals or the resources available to maintain a level of IM competence.

> Included in end-user operations, which incorporates the cost of learning how to use the system, is a cost component that Kirwin calls "technical support underground." This is peer-to-peer support - one or more people in the department or immediate work area informally providing advice or repairs that are otherwise officially handled by a help desk or a technician from IS. Gartner's consultants have found that users count on peer-to-peer support 2:1 over formal technical support services.[38]

Peer-to-peer support seems to enhance the "team building" concept, however, the supporting peer's productivity concerning their assigned responsibilities normally declines. The more important the supporter's responsibilities, the more critical is the loss of productivity. Also, the assistance may or may not provide professional support needed and may cause additional problems.[39]

The second trend - the best method to determine when to upgrade the system - has tormented businesses for the last 20 years. If businesses are lucky, they can capitalize on the full depreciation schedule of their equipment before it becomes obsolete. "The Gartner Group now suggests a 36-month depreciation schedule for desktop PCs, while others say 48- or 60-month schedules still are okay."[40] Some further contend that once equipment has depreciated, companies should purchase new machines incorporating the newest technology. Others (IBM for instance) believe that companies should purchase *N-1* technology: "*N* meaning the very next hot technology such as Pentium II, and *-1* for the one right before that."[41]

By using the capital equipment depreciation schedule as a timeline for upgrading/purchasing and a policy for determining which N-*x* technology to acquire, some businesses have formulated a standard for their IM operations. However, distracters, such as advertising "hype" and the introduction of new systems, impair organizations from strictly using this standard.

The third trend - dynamic changes having a catastrophic impact on the way they conduct business operations - is similar to the second trend but is based more on a company's long term planning cycle. Businesses that developed their long term IM and IT plan on LAN/WAN technology are totally dependent on standards set by a volatile market. They also placed their trust on a system whose design catalyst is a component developed for personal use and as a stand alone instrument -- the personal computer.

While businesses were drawn to the low cost of PCs and LANs, the uncertainty of the business PC's future and their lack of dependability when compared to mainframes have already caused corporate leaders to look to alternate methods for IM and IT support. Future prospects for LAN/WAN replacement are Network Computer (NC) Systems and corporate networks. These systems combine all automation assets including mainframes, super-computers, and internal and external networks. While short term costs for initial procurement of these systems are high, the long term savings in standardization and personnel requirements outweigh the risks.

The dynamics of these business trends are also relevant to RCAS and the Department of the Army's IM and IT operations. Their consequences in relation to the Army environment will be discussed in succeeding sections.

VI. CONSEQUENCES OF RCAS EVOLUTION AND IMPLEMENTATION

A. CONSEQUENCES OF DEVELOPMENT BETWEEN 1979-1989.

CAMIS (1979 - 1984) and the initial RCAS design (1985-1988) were not able to evolve into a mature system for two reasons. First, CAMIS was one of the automation programs caught between the transition from mainframe to PC technology. Mainframe dumb terminal access and basic workstation (word processor networks) technology was available when CAMIS was initiated, however, both were inappropriate to provide nationwide coverage to the reserve components down to the unit level. Mainframes offered two way access to a wide array of information, however, they did not offer the flexibility or the cost savings found in early word processors and PCs. Word processors and PCs were still too primitive to offer the speed and storage capabilities to handle the required information. Also, while data processing departments had developed dependable modems for networking mainframe operations, the first modem for use with PCs was not introduced to the commercial market until 1979. Dependability and speed of PC modems are still questionable today.

Second, when the initial RCAS program (1985-1989) was under development, commercial PCs were beginning to reach RC units.

Software standardization was volatile, however. Software interface development was not a popular business venture because everyone was trying to capture the PC operating system (OS) and office automation software market.

There were positive consequences in the early development phases. The most important was the determination that IM services would require personnel resources to manage these services. This resulted in IM departments such as installation (STARC/MUSARC) Directorate of Information Management (DOIM). For the Army Guard and Reserve, this is the only time in the evolution of RCAS that personnel requirements and authorizations were equitable to the duties they were required to perform.

Ultimately, the failure to field an effective nation wide mobilization support system for the RC resulted in no such support for units during Operation DESERT SHIELD/DESERT STORM: the largest mobilization and deployment of reserve forces by this country since World War II.

B. CONSEQUENCES OF RCAS DEVELOPMENT DURING PHASE ONE AND TWO OF THE BOEING CONTRACT (1989-1995).

During this phase of RCAS evolution, the PC industry stabilized to the extent that operating software was dominated by DOS, and personal computers (workstations) were standardized to meet IBM compatible criteria. Businesses were beginning to use more robust operational software (OS) offered by the industry. Reliable commercial-off-the-shelf equipment reached an affordable

rate and networking was becoming more dependable. It was the ideal time frame for transition to a COTS system using internal resources to design and install the system. Instead, RCAS was contracted out to Boeing Services who developed a system based on a rigid and non-user friendly system (UNIX).

While Boeing was working on a rigid system to cover a multiple IMA environment, other DA agencies migrated to COTS as their provider for sustaining base and office automation needs. RC commands, by law, were restricted to purchase automation equipment unless certain criteria were met. Some commands strictly adhered to Congressional mandates, while others came frightfully close to breaking the law. Even when commands could legally justify purchasing equipment, funding to support automation purchases for the RC was channeled mainly to RCAS. The small stipend given to States for automation funding barely covered the cost of maintenance and supplies of decaying technologies purchased in the 1980's. At best, commands were able to maintain approximately 18%[42] of their equipment at *N* (most current) standards. Support for networking and the emerging use of the Internet was worse.

Meanwhile, other DA agencies, including NGB and OCAR, continued to develop initiatives that assumed the majority of RC commands and units were at the *N* level or at least at their level of automation. Standardization of hardware and software across the RC spectrum receded instead of advancing during this period. For example, by 1995, DA was handing out Force XXI information on CD's. In the

Alabama Army National Guard there were only approximately three computers with CD-ROM capabilities in their entire inventory. None were at the tactical level (including 2 Major General and 2 Brigadier General Commands). In 1995, Alabama was the third largest Army Guard Organization in the nation, with over 18,000 soldiers and 120 "AA" entity units.[43] Needless to say, the FORCE XXI Story was not disseminated via CD in the Alabama Army National Guard.

By the end of this phase of RCAS, most gaining commands lost their enthusiasm in the program. Not only were they deprived of a mobilization support system, they also did not possess adequate office automation components and Internet access to perform their day-to-day operations. Directorates at CNGB level began to independently develop "stovepipe" software to accomplish their missions because RCAS software development and integration was far behind.

Most important, no active efforts were made to update manpower requirements to support RCAS. During the 1990's, management did not take into account the fact that a growing dependence on more robust automation systems requires a larger and technically qualified IM/IT work force. While businesses came to realize that the "technical support underground" (See Page 17) was becoming a major resource problem, military personnel initiatives to support this demand remained dormant during this and the next phase.

C. CONSEQUENCES OF RCAS DEVELOPMENT DURING PHASE THREE OF THE BOEING CONTRACT (1996-PRESENT).

The transition of RCAS to a COTS intensive program in 1996 is one of the most progressive steps toward the effective and efficient installation of a sustaining base automation network for the Reserve Components. The reevaluation of security restrictions and software development combined with COTS has certainly put the program back on a schedule that reflects a credible completion date. The program has failed, however, to take the lessons learned from businesses and capitalize on their trends.

First, the importance of total cost of ownership (TOC - see page 16) has not been taken into account during this phase primarily in the area of manpower. Management often mistakes automation as a means of personnel replacement instead of personnel enhancement. Management's continued reliance on the technical support underground has affected both inter-office and IM directorate operations. The ARNG Information Management Action Council recognized this and has proposed a variety of IM positions that will ultimately fix this problem. However, manpower constraints imposed by military reductions have made this a "turf war".

Second, the decision to use COTS components have allowed developers to upgrade in a more timely manner. However, by choosing a schedule where the level of installation varies from state-to-state (ARNG) or region-to-region (USAR), the program

manager has created the potential to create a non-standard environment between early and final fielded organizations. This was the case with phase two fielded units. In fact, some states are opting not to take advantage of current fielding initiatives so they will receive the more *N* compatible equipment of later fieldings.

RCAS managers have not established a clear *N* standard for the entire system. For example, units fielded RCAS computers in 1997 received Pentium 166mhz workstations (*N-2* standards when compared to a Pentium II). Computers fielded in 1998 received Pentium 200mhz MMX workstations (*N-1*). Near future fieldings will be Pentium II machines (*N*). While current software purchases will operate on all three levels, the evolutionary hardware and revolutionary software theory have proven that peek performance begins to falter when *N* software is expected to run on *N-2* hardware. An example is a "Windows 95" operating system with the "Office 97" suite running on a 486 generation computer.

While businesses often rely on depreciation schedules as a determinant to upgrade systems, government-owned equipment is not affected by such incentives. However, business experiences have shown that anyone can create an artificial depreciation schedule that will suffice. Trends, including Moore's Law, marketing, and hardware and software development projects an acceptable depreciation schedule between three and four years. RCAS management has yet to pick up on this trend.

Third, businesses are realizing that moving from a centralized, structured mainframe system to a decentralized, unstructured PC IM system has not saved as much money and has not provided as much productivity as originally projected. Some larger corporations are beginning to look at the "network computer system" which combines all automation and telecommunications assets and does not necessarily use the stand alone workstation as the basis for its IM support. This system allows a more structured and centralized operation with the flexibility offered by a desktop workstation. Such a system, in terms of PC based LANs/WANs, would be catastrophic to the current RCAS design. If the business networks evolved to the network computer design and RCAS followed prior program tendencies, its evolution will, once again, hit a dead end. Simply stated, even current improved RCAS initiatives have yet to prove they can withstand radical changes in the automation industry. RCAS will constantly lag behind in comparison to the business community that, by regulation, they are designed to emulate.[44]

V. RECOMMENDATIONS

The evolution of RCAS to a COTS system has been a long and volatile transition. Even with the risks involved COTS is still the best method to deliver the desired program. Phase three of the current RCAS contract and installation initiatives offered to gaining commands have enhanced progress, but more has to be done to

make RCAS a true IM provider. Listed below is a list of recommendations that will strengthen RCAS and future automation initiatives:

1. Provide a basic backbone system for all users simultaneously. Time phase overall installation by tasks (site prep., equipment installation, etc.) instead of geographical location.

2. Maintain constant command support of the system.

3. Allow gaining commands to "buy" into the system through active participation in its installation. Decentralize the process.

4. Provide States/MUSARCs with adequate personnel resources to support automation initiatives.

5. Standardize the system. Maintain *N-1* standards as a minimum. Create an artificial depreciation/replacement schedule. Trends are mature enough to be dependable. This provides a foundation for building a valid budget requirement.

6. Allow the system to evolve and plan now for the next catastrophic change.

7. Exploit the industrial and business world and their practices. Even with a shrinking budget DOD is still a valued customer.

RCAS is not the only program in the Army that has undergone this metamorphosis. Information management will evolve as the automation industry itself evolves. It is in the best interest of

the country for DOD to use COTS to support their automation needs. Research and production costs involved in producing exclusive automation systems are too much for any government agency to fund on a reoccurring basis. To do so would be like funding research and development for a better typewriter. Only when there is a clear threat to the Nation's security, which disallows the use of existing products and services, should research and development funds be used in this fashion. In the meantime, the Army must rely on and exploit America's free enterprise system to provide their needs.

ENDNOTES

[1] "History of RCAS," extracted from the RCAS Home Page; available from http://guardnet.ngb.army.mil/; Internet; accessed 15 October 1997.

[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] U.S. Public Law 100-202, 101.Stat. 1329-82, 22 December 1987. Also found in Section 8084 of the FY 1989 DOD Appropriations Act.

[9] U.S. Congress, House, Report of the Committee on Appropriations, Report 101-822 (to accompany H.R. 5803). *U.S. Department of Defense Appropriations Bill, 1991*, 101st Cong., 2d. session., 1990.

[10] U.S. Congress, House, *Department of Defense Appropriations Bill, 1995*. 103rd Cong., 2nd session. Section 8025, H.R. 4650-24 - H.R. 4650-25 (Public Law 103 335, 30 September 1994).

[11] Ibid. Congress was quite specific in the wording of the bill to insure CNGB had control of the funds. This bill prohibited the use of RCAS funds: (1) except as approved by the Chief of the National Guard Bureau: (2) unless RCAS resource management functions are performed by the National Guard Bureau: (3) to pay the salary of an RCAS Program Manager who has not been selected and approved by the Chief of the National Guard Bureau and chartered by the Chief of the National Guard Bureau and the Secretary of the Army: (4) unless the Program Manager (PM) charter makes the PM accountable to the Chief of the National Guard Bureau and fully defines his authority, responsibility, reporting channels, and organizational structure: (5) to pay the salaries of individuals assigned to the RCAS Program Management Office unless such organization is comprised of personnel chosen jointly by the Chiefs of the National Guard Bureau and the Army Reserve.

[12] Congress, House, Committee on Appropriations. 1989. RCAS Appropriations. Hearing before House Appropriations Committee. 100th Cong., 2nd session., 3 May. Dialogue is primarily between Representative AuCoin and LTG Harris. In this dialogue, Representative AuCoin attacks LTG Harris for allegedly moving $140,000,000 from the RCAS program without LTG Temple's (CNGB) approval. Representative AuCoin further questions the Army's competitive bid process and basically belittles all of General Harris's actions concerning the RCAS program.

[13] Congress, House, FY89 House Appropriations Committee Report (100-681). Reserve Component Automation Systems (RCAS). 100th Cong., 1st session., 1988. Also see, U.S. Congress. House. Report of the Committee on Appropriations, Report 101-822 (to accompany H.R. 5803). *U.S. Department of Defense Appropriations Bill, 1991*, 101st Cong., 2d. session., 1990.

[14] Reserve Component Automation System Material Fielding Plan, prepared by the Program Management Office, Reserve Component Automation System, XX February 1998.

[15] Ibid. p. 1-2.

[16] Ibid.

[17] Ibid.

[18] Ibid. p. 2-4.

[19] Ibid. p. 1-4.

[20] Ibid. p. 4-5.

[21] Ibid. p. 6-2, 6-3.

[22] Department of the Army Regulation, AR 25-1. *The Army Information Resources Management Program*, 25 March 1997, 1.

[23] Ibid.

[24] Robert D. Kobler, ed., *The Computing Dictionary: The Illustrated Book of Terms and Technologies*, 1997 ed. (2nd ed.), 11 & 37.

[25] Ibid. p. 11.

[26] W. Wyat Gibbs, "The Law of More," *Scientific American*, Special Issue vol. 8, no. 1, 1997, 62-65.

[27] "The Middle Age of the Transistor," *The Economist*, 3-9 January 1998: 77-78.

[28] Kobler, ed., "1977", 36.

[29] G. Dan Hutchenson and Jerry D. Hutchenson, "Technology and Economics in the Semiconductor Industry," *Scientific American*, Special Issue vol. 8, no. 1, 1997, 66-73.

[30] Ibid. Figures were extracted from "Technology and Economics in the Semiconductor Industry" and *The Computing Dictionary*.

[31] The Pentium Pro, for example, entered the market in 1996; just barely two years after the Pentium. In 1997, Intel presented their latest improvement, a multi-media chip upgrade that also could improve performance, called the "MMX" chip. The same year, Intel released the Pentium II which incorporated MMX technology and provided a much faster operating speed than the Pentium Pro (300mhz). At the time of this report, Intel announced a 333mhz chip would be ready for sale in January 1998 and a 350mhz and 400mhz chip would be released this April. Two days after Intel's announcement, *The Austin American Statesman* ran an article announcing that IBM had demonstrated a 1000mhz chip.

[32] Ibid. Lithography is the process of "shinning ultraviolet (uv) light, which chemically alters the chip surface, through a mask with the patterns traced on it."

[33] Ibid.

[34] Jim Cope, "Keeping up to Date," *PC Today*, vol. 11, issue 10, October 1997, 81-83. TOC was a model designed to handle the cost side of IT. This model was developed by the Gartner Group in the early 1990's.

[35] Ibid.

[36] Ibid.

[37] Ibid.

[38] Ibid.

[39] Ibid. p. 82.

[40] Cope, "Keeping up to Date", 82.

[41] Ibid.

[42] This percentage is based on the number of PCs provided by States for the current RCAS design divided by the total number of PCs used in RCAS. These figures are based on the ARNG portion only.

[43] Alabama also mobilized over 5,000 soldiers during Desert Shield/Desert Storm, without any RCAS related support.

[44] Department of the Army Regulation, AR 25-1. *The Army Information Resources Management Program*, 25 March 1997, 8, paragraph 2-1.

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