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UNITED STATES AIR FORCE TRAINING MANAGEMENT 2010

Volume II: A Strategy for Superiority

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This report has been reviewed and is approved for publication.

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report is part of a US Air Force sponsored study to forecast future technologies and systems required for optimally managing training and education in the next century. The study projections are based on the review of regulations, documents and related publications, and on the interview of more than 100 key training management personnel at the Department of Defense, the Air Staff, major Air Force commands, and special operating agencies. The first volume of the study provides a comprehensive description of the existing US Air Force training management system and an assessment of the system's four major management activities. Nine significant subcategories of training are examined with emphasis on the data transfer and flows supporting management decisions. This volume of the study identifies future trends with which training managers of the next century must contend. Impacts from such developments as hyper-unstable job requirements, workforce technical illiteracy, and diminishing personnel and funding resources will seriously complicate training management and jeopardize warfighting capability in 2010.					
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Developing technologies, however, promise to abate this threat if judiciously planned and nurtured. A suggested future training management architecture and developmental roadmap is presented to resolve both chronic problems nad future concerns.

PREFACE

The Human Systems Division (HSD) of the Air Force Systems Command is the principal advocate for the human operator across all weapon and support systems. The HSD Deputate for Development Planning is responsible for studies, analysis, and long range planning to identify technology gaps, deficiencies and future desired capabilities. This requirement identification process provides the basis of guidance and justification for human systems research and development. Training is one of the human centered activities for which HSD develops technology and is a keystone in readying the human operator for mission accomplishment. (54:1-3) The overall goal of this study is to identify the technologies and systems needed to optimize the information and decision functions of Air Force training management by the year 2010.

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UNITED STATES AIR FORCE TRAINING MANAGEMENT 2010
VOLUME II: A STRATEGY FOR SUPERIORITY

I. INTRODUCTION

A. BACKGROUND

The centrality of training and education in today's US Air Force (USAF) operations and combat preparedness is described in Volume I of this study (36:--). The future will bring an even increased criticality to the achievement of warrior proficiency prior to actual combat. Training managers in 2010 will have a significantly reduced margin of error in preparing personnel for mission success.

In an Author C. Clarke projection of an early 21st century battle, a North Atlantic Treaty Organization (NATO) reconnaissance aircraft, at night and in weather, identifies a barrage of Soviet tactical missiles 3 seconds after launch. Fourteen seconds later, coordinates of the Soviet force are determined, communicated to the defending NATO division, and a counterstrike launched, just 3 seconds prior to impact of the Soviet missiles (13:254-255).

There will be no luxury of time to learn from battle experience in the next century. Within 1 minute, a battle can be engaged and culminated, out of visual sight of either force. In the just mentioned case, a miscalculation by the Soviet corps commander of the NATO response capability resulted in loss of 96% of the force, the corps command post, and the commander.

This study is intended to help determine the shape of tomorrow's USAF training management system and the best course of development toward the future. The specific objectives of this research task are to: (a) identify the problems and opportunities facing USAF training management over the next twenty years, (b) develop a conceptual architecture which maximizes the effectiveness and efficiency of Air Force training management in the year 2010, (c) use that architecture to identify critical technology and system shortfalls, and (d) provide a roadmap for resolving those shortfalls by the year 2010 (2:1).

B. APPROACH

Effort to accomplish the objectives is broken down into two individual subunits. The first subunit describes the existing training management system and assesses the management process noting problems, improvement potentials, and constraints; the second identifies, projects, and proposes solutions to future training management issues and to the chronic problems identified in the first subunit (35:--).

The first volume of this report describes the results of the first subunit of the study. Volume I depicts an expansive and diverse USAF training management system, subject to dynamic changes. Nine major training elements were found on which the four major activities of requirement management, curriculum management, student management, and resources management were performed. Managers of the nine major training elements respond with dedicated effort and innovative methods. The occupational survey program and the Pipeline Management System provide order and direction in a potentially chaotic system.

The requirements for training, however, eclipse the system's capability to respond. Managers are constantly playing catch-up to new weapon system training requirements and equipment needs. Specific task requirements for jobs are still too subjective and nonstandard to drive precise training objectives. Selection measures for high value personnel require added refinement to reduce costly attrition.

Additionally, fragmented management responsibility leads to inefficient and uncoordinated training development. Managers lack objective data to effectively direct training resources across the USAF and to convincingly demonstrate congressional funding impacts.

Opportunities exist for system improvements that lower cost, reduce personnel, and increase responsiveness. Models, algorithms, and data bases for requirement identification and prioritization, personnel selection and classification, and training effectiveness evaluation are strongly needed. Automation of outdated processes in on-the-job training (OJT) management, transcript evaluations, correspondence materials handling, and applicant pool coordination would also improve system effectiveness and efficiency. Attempts to make system improvements, however, are constrained by the fragmentation of management responsibility, unpredictable environmental changes, and restricted resources. This second volume of the report describes the results of the second subunit of the study. Developing trends that will affect training management in the year 2010 are identified. Impacts that are likely to occur as a result of changes in societal environment, government policy, and technological developments are projected. A comparison between the present and future training management situations permits identification of current training management problems that are likely to be unresolved in the 21st century. Technology needs to surmount both chronic and new training management problems are proposed.

An ideal architecture for training management in the 21st century is developed. Emerging and required technologies that would likely contribute to improve training management are depicted with the organizational entities and interfaces necessary for optimal effectiveness and efficiency.

Subsequently, a review is presented of the considerable amount of USAF research and development (R&D) in training technologies and systems. Programs such as advanced training systems, training decision systems, and artificial intelligence are examined for application to the chronic and developing problems of future training management. Shortfalls are identified between the existing R&D programs and the total technology need of 2010. Finally, a road-map is presented to chart the required technological development to achieve the optimized 2010 training management system. An evolutionary process is proposed to permit a logical transition from the current to the future structure. Estimates of cost and development times are made along with the primary offices responsible for accomplishing the necessary change.

The data sources for this analysis come from relevant literature reviews and structured interviews with key training managers and technology developers. Results from the more than eighty interviews conducted during Volume I data gathering were combined with the results from interviews with an additional twenty contacts who are listed in the Appendix. The interviews were conducted on a nonattribution basis.

II. IMPACT DESCRIPTIONS

A. ENVIRONMENTAL IMPACTS

1. The Information Society.

a. The Change.

The year 1956 marked the point in our nation when, for the first time, more people were employed in white collar jobs than in blue. Today, employment is overwhelmingly composed of occupations that either create, process, or distribute information. The heavyweights in American commerce are not typified by US Steel but by IBM, AT&T, Xerox, RCA, and CBS. This evolution from an industrial to an information society will continue well into the next century (44:2-5).

The information society will be exceedingly prolific. Today scientific knowledge doubles in less than 6 years; by the mid 1990s, it will take less than 2 years. Additionally, the telephone, television, computer, and satellite have combined to instantaneously communicate information. A letter that took several days in route by mail can now be sent electronically in seconds. In the future, as information technology permeates society, the time information spends in channel between sender and receiver (the "information float") will drastically shorten (11:211-213; 44:14-17).

Centralized structures of the industrial society will give way to decentralized organizations of the information society. Pyramid hierarchies will be replaced by networking of smaller participatory units emphasizing lateral and horizontal communication. Computer networks will keep top managers informed with pertinent data available at their finger tips (44:211-215, 221-225).

Even today, businesses are relaxing the heavy control of centralized home offices. Marketing of goods and services is being regionally directed to more meet the needs of local clientele than those of a mythical average American (44:103-106). Adopting this American concept, the Japanese have already championed the decentralized management style with great commercial success in both the auto and electronics industries (44:211-212, 226-227).

b. General Impact.

The USAF influence from the information society is demonstrated by the growth of computer programmer, systems analyst, administration, contracting, legal, intelligence, and communication job specialities. Further, the recent formation of the information systems career field is compelling evidence of how integral information creation, processing, and dissemination have become in the USAF.

All USAF personnel will have to come to grips with an increasingly information rich environment. The volume and rapidity with which information rains on the individual work center will threaten information overload. Even today USAF personnel are familiar with the "another-day-at-the-office" caricature of the fighter pilot inundated with information inputs. The major occupational task of the future will not be information supply, but information selection (44:14-18; 18:17; 27:31; 31:18; 32:6).

The thrust toward decentralization is also apparent. "Buck-stop" and "model installation program" initiatives give testimony to USAF management promotion of lower level decision making. While a basic hierarchical structure will surely endure, the realization of the benefits from an institutional network management style will require development of improved lateral communication avenues.

c. Training Management Impact.

Training and education are very much information activities, as is the management of them. Most of the occupational fields trained are, and will increasingly be, information intensive. Training managers will suffer from an exponentially growing information overload about the functions they manage.

The reduction of the information float of new scientific knowledge will fuel an increase in the adoption of new practices, methods, and technologies in the field. Rapid change in job requirements will become the norm in the USAF work environment. Career fields will rapidly evolve, challenging management response.

The decentralized character of the information society compliments today's USAF training management organization. That apparently aberrant fragmented structure identified in Volume I (36:--) need not be drastically overhauled as it emulates the future desired configuration. A conscious effort is required, however, to develop stronger lateral networking across unit boundaries and to provide necessary input to higher management.

Impacts to the four major training management activities are as follows:

Requirement Management. The swiftly changing systems and practices will spawn a growth in the need for related courses to keep personnel abreast and effective in operations and maintenance. The already requirement-overloaded training system described in Volume I (36: --,--) will get no relief in the future.

Curriculum Management. Keeping tabs on what, how, when, and where to train will become an awesome responsibility. Rapid job changes will require much more frequent occupational surveys to gauge the job and the training. Creative techniques will be required to provide accurate and timely training in this highly perishable arena (48:78).

Student Management. Knowing which modification or practice a technician has learned to perform and which needs to be trained is a problem today, particularly with transferring technicians (36:--). In the rapidly evolving on-the-job environment of the future, more required training activities will make student capability tracking even more difficult. Additionally, juggling personnel for incessant reoccurring training needs will heavily task training managers.

Resource Management. Course materials will be in constant flux in an attempt to keep pace with changes, and always in jeopardy of being outdated. Current facilities will not accommodate the training load. The limited resources for course development and redevelopment will be strapped to meet the increasing need.

d. Required Technology.

Generally, USAF training managers will require mechanisms that will enable them to select pertinent data from the plethora of available information. Aligned to this technology would be the creation of tailored management information reports that meet individual manager needs. Also greatly increased lateral data base networking among all managers will be required to effectively manage in the rapidly changing environment of 2010. To coordinate the various training element efforts, a distributed data base management system will be a necessity to rapidly communicate training responsibilities, requirement and curriculum changes, and the flow of new or modified course materials.

Decision aids to assist curriculum managers in planning the what, where, when, and how of training will become increasingly imperative. Managers must be able to quickly determine which of the ubiquitous training needs should receive top priority for limited training resources.

With swiftly changing job requirements, methods will be needed to rapidly develop, analyze, and communicate occupational survey results to curriculum training managers. Such a responsive link will be critical in managing course currency. Also, the ability to subsequently react quickly with course developments and redevelopments will be essential.

Improved techniques will be needed to track student capabilities and to match them with required job tasks so managers will know who is job qualified and who needs follow-on training. This training most likely would be an expanded task-student data base that would flow along with student assignments. A scheduling methodology for keeping personnel functional through timely exposure to available training will also be needed.

Something must be developed to increase the training system's ability to meet exponentially increasing requirements within available facility, instructor, and funding resources. Additionally, the management of training materials currency and responsive distribution will require a better technology to link the non-resident student to the information source.

e. Consequence of Inaction.

A war zone in the early 21st century will be an information intense environment with highly networked communication. The winning edge in battle for a combatant will be information generated, transmitted, received, and acted upon within mere seconds before the opposing force can respond (13:255-256).

Exotic military technology will provide the means for precise lethality and destruction. The ability of the human, however, to responsively operate, maintain, and repair that technology in a time-collapsed environment will be the determinant of victory.

Personnel in the year 2010 must possess, understand, and be able to execute the latest in techniques, methods, and equipment operations. They must be able to instantaneously react to data regarding enemy maneuvers and actions. If the training system is not developed to enable our personnel to operate in this information critical arena, then victory will go to those who can.

2. Labor Pool Illiteracy.

a. The Change.

The US Department of Education estimates that one-third of the adults over 17 cannot read, write or compute adequately enough to qualify for employment (43:8). This inadequacy is broadly impacting industry today. For example, the New York Telephone Company found that 84% of their 1987 job applicants failed a basic skills entry level test. General Motors Corporation and

International Business Machines Corporation expend more than \$700 million annually on adult basic skills training to cope with deficient entry level abilities (4:8-K).

This deficiency severely impacts minorities who have historically lacked schooling and skills to take advantage of opportunities in the labor market (46:54). The Population Reference Bureau projects that minorities will constitute an increasing percentage of Americans in the next century. Barring some early revolution in public education and social policy, literacy deficiencies will plague a significant and growing sector of the workforce for the indefinite future (47:32).

At the same time, unfortunately, entry requirements for jobs are forecasted to drastically increase. General Motors managers project that, by as early as 1995, they will have one manual skill position for each technical skill position, a significant change from their recent ratio of 5.6 manual to one technical (5:8-K). By the end of this century, the US Department of Labor estimates that post high school training will be required for more than one-half of all new jobs (37:97). This increasing technical demand exacerbates the job entry level literacy requirements for applicants of the next century.

This already ominous situation for 21st century employers will be additionally aggravated by a shrinking labor pool. Demographic data indicate that there is a significant drop in the number of youth entering the workforce. This trend will continue or stabilize at a low level by the mid-1990s as the birth rate approaches zero population growth (37:75-80). To fill their job vacancies, employers will have to dig deeper into the labor pool, encountering more skill deficient applicants.

The 18-year old workforce of 2010 will be born in just 4 years. Unless there is some extraordinary reversal in societal trends, the employee market of the next century will be bleak indeed. The specter is for a severe national competition over a shrinking pool of technically qualified entry level individuals to fill increasingly technical jobs. This competition will occur regardless of unemployment conditions, since the "skilled position" requirements will likely far exceed the "skilled personnel" availability.

b. General Impact.

The USAF is far from a closed system. As a traditionally high technology service and as an intaker of tens of thousands of personnel annually, it is quickly influenced by societal trends. It can expect to be impacted from the national literacy deficiency just as any other element of society.

Like industry, the USAF has also experienced problems with literacy. For more than a decade, it has been forced to sponsor remedial literacy programs at its Basic Military Training Center. The programs, however, have been primarily refresher courses for a small number of students who generally have minimum reading abilities but are out of practice in speed and vocabulary.

The technical literacy requirements for jobs are also increasing in the USAF (1:7-17). This increase appears to be exponentially eclipsing other literacy impacting forces. Almost all of the Air Force speciality codes (AFSCs) will require some knowledge of computer operations by the mid-1990s (30:6). New weapon systems coming online will be heavily dependent on computers with complex software and "high tech" components. The greater technical literacy needs for entry level jobs will pressure increased entry standards (53:1).

The USAF should also expect that the shrinking labor pool will result in encountering more literacy deficient applicants. A 1985 report to Congress, however, indicated that the problem is overstated. The Services have already handled a 12% decline in their target labor pool during the last 10 years and quality measures actually increased during that period (53:18,34). The Department of Labor, though, warns that organizations, such as the military, having previously hired predominate young, white males, can expect major impacts by the end of this century (37:75).

There will be several actions available for USAF response to increased labor pool illiteracy:

Buy Capable Personnel. With an enhanced recruiting effort, the USAF could offer competitive salaries and benefits in a head-to-head struggle with industry to attract capable applicants. Coupled with increased female participation and timely economic recessions, the strategy could make the difference (53:49-50).

In the austere funding environment, however, that will likely continue to exist, it is not probable that this would be a viable option. Even at this time, the USAF acknowledges that it can't hope to be successful with such a strategy in its competition with industry for the retention of pilots (20:30). Additionally, the Department of Labor forecasts that the economic cycles (recessions and booms) will moderate in amplitude, dampening a potential periodic recruitment stimulant (37:62).

A cost comparison with other literacy strategies, however, must be accomplished to confirm dismissal of this option for all occupational positions. Patriotism, uniqueness of military service, and early critical job responsibility should not be ruled out as an assist to competition for the cream of the labor pool.

Stay in School Program. Like industry, the Air Force could develop efforts to persuade high school students to finish school and increase their science and math skills (4:8-K). These efforts could be in cooperation with more generalized efforts directed to the population as a whole or could be tailored to the goal of enticing students to qualify for a military career. Additional training could be offered individuals to enable them to meet minimum skill level requirements prior to entering military service in return for longer service commitments. Program costs can be a barrier to this proposal.

Technological Literacy Reduction. Using industry example, the USAF could employ technology to reduce job literacy requirements. Equivalents to automated tellers, electronic inventory scanners, and pictographic data entry certainly have application to military occupations. Industry experience with this approach has increased efficiency, reduced overhead, decreased clerical jobs, and lowered training costs (5:8-K). The more esoteric technology of artificial intelligence promises benefits to more sophisticated applications.

Critics of this technological approach contend that the "dumbing" of jobs spawns a bimodal workforce composed of a majority who cannot progress beyond simple machine-aided tasks and a minority of highly skilled technicians. Unable to advance, morale and retention problems quickly surface among the less skilled majority (5:8-K). Like industry, the USAF requirements for less skilled personnel will decrease with system sophistication. Consequently, this approach has limited application for the USAF in the next century as a fix for literacy deficiency.

The solution for problems stemming from a significant net decrease in the applicant pool capability may be left to the USAF training system. If so, there will be strong reverberations as described in the following section.

c. Training Management Impact.

Competition from other employers will cause the USAF to delve below the thin cream of the youth labor pool to fill student quotas, encountering a growing percentage of literacy deficient applicants. Additionally, the increasing technological literacy need will enlarge the gap between job requirements and average applicant ability. Impact will be mainly experienced in requirement, curriculum, and student management activities.

Requirement Management. The increased competition for technically qualified personnel will stress the USAF ability to retain second and third term enlisted airmen. With reduced retention, the training system will have to increase the incoming pipeline flow to compensate, increasing recruit and initial skill training requirements in the out years.

Curriculum Management. Materials will have to be carefully tailored to the literacy abilities of incoming students. Lead-in strands of basic skills instruction will have to be developed to accommodate deficient students before presenting technical material. Like industry, the USAF could establish expanded basic skills training programs to bring deficient accessions up to requirements. Remedial literacy courses are conducted even today in plants and offices of such large firms as the Polaroid Corporation, Standard Oil Company, Ford Motor Company, and Liberty Mutual Insurance Group (4:8-K).

The investment, however, to resource such activities is not insignificant. On the order of \$25 billion was spent by businesses and private associations on worker education upgrading (4:8-K). With current technology, approximately 100 hours of training is required to advance a person just one reading grade level (5:8-K).

Researchers believe that the gap in technical literacy will easily outpace the growing traditional literacy concerns of ninth grade level reading, writing, and computational skill. As electronic technology becomes pervasive in the work center, new ways of mentally approaching the job must be adapted into the training scheme. Such technical literacy skills will have to be integrated into existing courses of instruction.

Student Management. The selection, classification, placement, and tracking of students will be complicated by the necessity for an expanded consideration of literacy skills. Better understanding of job literacy requirements and student abilities will be needed to optimize the job-person match. As all jobs become more technical, functional managers will argue for increased specialty entrance standards. This requirement will conflict with the increased difficulty of recruiting higher caliber personnel.

d. Required Technology.

Development of a general USAF strategy to cope with the literacy problem is strongly needed. A feasibility and cost-effectiveness study is required to allow the USAF to rationally chart a course of action which may or may not include training management responses. Such a strategy must interface quality mix trade-offs of force size and performance versus costs for recruitment, training, and maintenance. Initial research has exercised a preliminary methodology for addressing these global trade-offs in the Army (3:--). Application to an individual M60 tank company has even been conceptualized. Similar applications are required for a fighter wing, aircraft maintenance crew, or missile wing of the USAF (50:--; 53:26,51).

A resource conserving methodology will be needed to train literacy deficient job aspirants. The system must be effective without significantly lengthening the student pipeline, requiring greater instructor resources, or be prohibitively expensive.

A mechanism to determine what literacy skills are required for different jobs, and to identify and track literacy capability of individual specialists will be needed. The system must accommodate rapidly evolving occupations.

e. Consequence of Inaction.

The illiteracy issue could quietly catch the USAF unaware. Tension from both the recruiting and the job requirement directions can rapidly converge to

create a sudden new operating deficiency. Inappropriate policies could be embraced in a knee-jerk response, threatening even the viability of the volunteer force concept (39:294-295).

More disconcerting are the operational ramifications. US Army data indicate that a 15% decrease in top quality, first-term personnel translates into a 14% loss in kill rate for a combat unit (53:26). To entrust USAF combat capability to enlisted personnel who cannot do simple math, are deficient in reading, and misconceive multimillion dollar aircraft functions is a formula for defeat.

B. POLICY IMPACTS

1. Enlarged Systems Inventory.

a. The Change.

As the cost of new systems continues to escalate, the USAF is pursuing ways to extend the life of existing systems through modification and retrofit programs. Such philosophy leads to the plan for the FB-111 to be operational through 2010 (24:29). The C-5 wing modification program, the proposed A-7 upgrade, and the recent proposal to modify the B-52 for a non-nuclear, short-range missile (in support of the European conventional forces) are other examples of extending the life and mission of current weapon systems.

At the same time, new systems such as the B-1, B-2, C-17, the Advanced Tactical Fighter (ATF), and the CV-22 will be phased in over time. While some types (F-15, F-16, and the ATF) will exist in large numbers, the trend will be toward smaller production runs of these new aircraft (100 B-1s, 130 B-2s, 200 C-17s, 40 CV-22s, 30 AC-130s). Additionally, modification packages to these new systems will tend to produce major and significant variants from previous models (different propulsion systems, enlarged or modified airframes, new avionics, etc.) (22:34; 25:25,28).

b. General Impact.

The increasing variety and mix of weapon systems will severely aggravate an already resources strapped logistics system. The diversity in aircraft type and models will lead to similar diversity in operations and maintenance (O&M) skill requirements. New AFSCs or additional shreds within existing AFSCs will be sought by functional managers, but resisted by the personnel community.

c. Training Management Impact.

The increased number of O&M AFSCs and shreds with large manning variations will require a management capability geared to accurately forecasting O&M training needs and scheduling limited resources to provide the proper mix

of trained individuals. Increased flexibility and shorter response time will be essential as policy decisions will likely result in a constantly changing mix of numbers and types of weapon systems.

Impacts on the major management activities are as follows:

Requirement Management. New training courses will be required while maintaining the existing courses. The result will be an expansion of training requirements with generally fewer individuals trained per speciality. While the total number of individuals entering O&M training may not increase, the diversity in training requirements will increase. Continued manning constraints could force the USAF to expand the number of technicians with multiple O&M AFSCs to meet operational needs. Consequently an increase can be expected in upgrade and cross-training requirements.

Curriculum Management. Curriculum requirements will grow in proportion to the increase of AFSCs and shreds. Additional manning will be required for both development and currency efforts. There will likely be a drive to consolidate shreds within the core instruction to provide a trained individual for several system variants to increase the flexibility of use and assignment potential.

Resource Management. Resource management will become increasingly difficult. The increase in the number of courses to be taught coupled with the frequency, or infrequency of some courses, will increase the cost per unit of training. Training facilities will be forced to maintain a capability to provide some courses that are of the low frequency, low volume, and high technology nature. It will be difficult to maintain the desired cost to yield ratio for these courses and equally difficult to maintain the capability to offer these courses on an infrequent basis.

d. Required Technology.

Capabilities are required to provide a quick response forecasting model for O&M training requirements at the Air Staff management level. Such a model should be capable of accurately projecting actual needs versus estimates and should be capable of factoring in all variables such as current manning, current level of training, and projected manpower availability and skill level, loss rate, etc.

Needed are improved techniques for the development and use of hierarchical courses wherein core material for all system variants is identified and incorporated into a logical course(s) to permit more efficient training and reduce redundancy. Hierarchical training would also allow better definition of specific levels of training and permit the increased use of OJT aids to expand skills beyond the core training. Additionally, a technology or methodology to permit instructors to economically handle multicourse instruction in response to the smaller student loads across many courses is needed.

e. Consequence of Inaction.

Without improvements in the ability to accurately forecast O&M training requirements and refine course content to actual needs, training managers cannot expect to meet increased training requirements with stable or decreasing resource levels.

2. Expanded Services Contracting.

a. The Change.

Numerous programs are underway or being considered to contract out many functions currently being performed by uniformed personnel. These activities range from routine housekeeping duties to job specialty training and aircraft maintenance.

Contract programs that are representative of this change include training systems, materials, and instruction for the C-17 (Initial Operational Capability (IOC) in early 1990s); expanded contract support for undergraduate pilot and navigator training; T-37 and T-38 maintenance for Columbus AFB, Mississippi (freeing 810 military personnel); health-care and related services for military families (potential to privatize healthcare for approximately 800,000 families of active duty personnel and military retirees); and classroom and simulator training for the F-15 (22:33; 14:6; 12:42; 52:36).

With the military forces entering a cycle of level or reduced funding and manning authorizations, the USAF is expected to expand contract support through the indefinite future.

b. General Impact.

Contract services free up scarce manpower for reassignment to priority military duties, provide increased flexibility of operation through contract modifications, and provide a guaranteed level of performance against an established standard at a fixed price.

Contract training can create significant changes in the operational force such as the loss of military capability to perform the function, loss of ability to instill the "fly and fight" attitude in the trainees, and more cost sensitivity to unplanned requirement changes. The personnel cost savings from contracting, however, carries a very persuasive argument in the tight manning environment.

c. Training Management Impact.

The continued growth of contract services will have major implications for the USAF training community. When fully implemented, several of these efforts will eliminate the requirement for a significant number of trained

military personnel. This approach will reduce the student flow for many specialties, but not reduce many of the specialty courses as at least some qualified military individuals will still need to be trained.

The contracting for training services, specifically, adds an additional twist. Consider the Navy T-45 program requiring the contractor to furnish the aircraft, flight simulator, textbooks, instruction, computerized training management system, and maintenance for all training hardware. Widespread application of this approach will create an entirely new environment and focus for the future training manager.

Impacts on the four major training management activities are as follows:

Requirement Management. Services contracting of operational functions will, over time, reduce the trained personnel requirement. For example, aircraft maintenance and healthcare under contract will result in significant reductions in USAF training loads, but not in numbers of courses since some military personnel will still need to be trained for contingency deployment. With the exception of instructor courses, the contracting of training will not change the overall training requirements in either numbers of individuals trained or course content. It will, however, cause training to be more "dollar" driven in that any change in training requirement will directly impact negotiated contractual programs. Contractual efficiencies can best be achieved through the use of long-term arrangements which will increase the pressure to formulate requirements over a longer period, thus hampering the ability to make short-term changes in response to priority needs.

Curriculum Management. While curriculum content will not change with contract training, the responsibility for curriculum preparation will shift to the contractor. Training manager focus will evolve toward identifying course requirements to the contractor and evaluating contractor performance to ensure course objectives are met.

Contract training will inhibit the capability to initiate course changes. Training provided by military activities can rapidly adjust to changing requirements in course content, method of presentation, length of training and other parameters. Similar changes in contract training involve negotiations which require additional time and may increase cost.

Student Management. Interfacing student tracking data bases will be required to maintain student control and records. However, procedures will be required to maintain the proper atmosphere and discipline as well as to ensure the right attitudinal environment is developed and maintained.

Resource Management. To maintain a mobilization capability, the USAF will be faced with the requirement to maintain a military training capability for most all courses, but at an increased cost per student. Reduced course

loads will eliminate the efficiencies associated with large student flow. Infrequently scheduled courses will pose special problems in terms of scheduling and sustainment of capability.

As USAF delivered instruction is replaced by contract, a major effort will be required to effectively reallocate personnel and resources to other training programs. Personnel will require retraining or become surplus to revised needs; facilities management will need coordination with contractor needs when appropriate.

Contract management becomes an important function for the training manager responsible for contract training. Specification preparation, contractor performance evaluation, monitoring contract and funding status, and other contracting efforts will consume larger portions of the training manager's time. Government furnished equipment and materials will be critical to the success of some contract training and will require careful management to ensure success of the effort.

d. Required Technology.

The requirement for new contracting technology is not so much the driver in this issue as there is sufficient well-established technology available to direct and monitor USAF contracts. This new technology will be an expanded area for training managers, however, and new procedures and techniques will be required to link contractor and government data bases for training allocations, student tracking, and course evaluation. There is an urgent need, then, to adapt to the contract training arena the evolving training management technologies of the Training Decision System, the Unified Data Base, the Pipeline Management System, and the Job Performance Measurement programs. (see section V.A)

Specific procedures will be required to enable the training manager to effectively translate training requirements into contract requirements that meet USAF goals. Online evaluation procedures are required to enable the training manager to accurately gauge the contractor and student performance. In some contracted efforts, ways must be found to develop and maintain the proper military environment that is essential to create the warrior attitude essential to the military mission.

e. Consequence of Inaction.

Failure to develop the necessary technologies and procedures required to effectively manage contract training will result in the inability to control the training program in terms of both quality and cost. Contract training brings with it new partnerships and new responsibilities. In assuming its new managerial role, the US Air Force must be prepared to manage well to ensure unimpeded combat capability.

C. TECHNOLOGICAL IMPACT

The influence of technology will have the strongest of all impacts in 2010. Science will rule the future even more than it does today (13:4).

Robots will be routinely employed in manufacturing for hazardous and repetitious labor. They will respond to production surges with incredible speed and endure lax periods without boredom. For dangerous tasks requiring higher perception and situational awareness, a telepresence link will be employed for human operators. Robotic sentries and defenses already exist today and robotic tanks are scheduled by 1995 (13:60-70).

Transportation vehicles will be lighter weight, fuel efficient, and resplendent with electronic aids. They will be composed of new composite materials of remarkable strength and durability. They will also be more reliable with self-diagnosing systems for easier fault isolation (13:91;104).

Twenty-first century medical technology will create many new treatments, employ computers and robotics, and network international consulting specialists. Medical science coupled with preventive health practices will reduce the number and duration of hospital stays. A greatly expanded outpatient capability will treat ailments formerly requiring hospitalization (13:38-43).

The ability of persons in the year 2010 will be heightened by bionic and chemical technology. Potential high skill performers will be identified in early childhood via sophisticated physiological and psychological tests. Precise, superior development will be attained through video modeling and computer monitoring, using performance data from exceptional achievers. Performance enhancing substances will assist body building, age retardation, and brain wave patterning. Such ergonomic chemicals will promote the optimal mental processes necessary to surmount the heightened information complexity of the 21st century. These chemicals will aid mastery over emotion, pain, sleep, alertness, and memory (13:162-167,201-202; 41:50).

Human performance will be additionally enhanced through the use of information systems technology. The computer will completely relieve the human operator of administrative and clerical tasks. Using head-tracking devices, teleconference imaging and feedback will approach lifelike interaction. Non-intrusive, neural impulse linkage with computers will augment human memory and expand human control of data. The projection of holographic images directly into the brain will not, however, be perfected until 2020 to 2025 (13:190-194, 140-145).

With a rapidly changing knowledge base, education and training will move away from static, factual memorization and toward information creation, processing, and transmission skills. Focus will center on dynamic learning and

thinking abilities. Instructional strategies will capitalize on the information technologies of satellite communication, interactive television and computers, and optical-disc video simulations. Quality resources and instruction will be accessible to all educational agencies. Through artificial intelligence tutoring, the span of individual attention provided by the instructor will be enlarged (13:76-83).

These technology thrusts have direct influence on the Air Force. Following are descriptions of specific areas of impact.

1. Increased Systems Sophistication.

- a. The Change.

Today, virtually everything done in the aerial combat arena takes place in an electronic, electro-optical, or infrared environment (19:61). Future weapon systems will employ exceptionally complex information technology. Currently, over 100 advanced electronic technology projects are in development to provide improved capabilities across a wide range of USAF operational requirements (9:52-59).

Major systems ushering in a new generation of electronic capability include the Joint Surveillance Target Attack Radar System (JSTARS), the Joint Tactical Information Distribution System (JTIDS), the Ground Wave Emergency Network (GWEN), and the Strategic Air Command Digital Information Network (SACDIN).

As an illustration of system complexity, JSTARS will be deployed in EC-18 aircraft with as many as 15 operation and control consoles. Radar information on moving targets will be collected over a wide area behind enemy lines and dispatched to air and ground controllers. Every console will be "smart" with its own processor and have the capability to store data for historical replays. The linking of JSTARS with the Ground Station Mobile (GSM) and JTIDS will enable coordination of multiservice ground and aircraft targeting efforts (10:45-51).

- b. General Impact.

"High technology" is an issue that can be viewed as both beneficial and detrimental to USAF goals. From the weapon system viewpoint, high technology is a necessity to enable mission success and system survivability. From the personnel and training view, high technology presents a planning dilemma. Will higher skills and increased training be required for job proficiency or will the trained personnel requirement be eased through smart, self-diagnosing systems and job automation? Or perhaps some of both? Regardless of the direction, technology will play an increasingly dominant role in determining the what, who, where, and how of instruction.

c. Training Management Impact.

System sophistication will be a "driver" for almost every aspect of training. In this environment the trainer's role becomes increasingly difficult in that they must know and understand much more than how to train. First, the trainer must acquire sufficient understanding of emerging technologies and translate these technologies into appropriate training requirements (28:32). Second, the trainers must become technologists in their own right, aware of emerging instructional technologies and determining the optimum methodology to provide the training of the future to the force of the future.

Curriculum Management. As mentioned earlier, by the mid-1990s scientific knowledge is expected to double in less than 2 years. If this doubling effect is applied to the introduction of new systems or the upgrade of existing systems, training managers must develop methods to shorten the time required to introduce new technology into the training. Training development and system development will be a concurrent process forcing trainers to work at the technology level rather than at the system level. More technically qualified personnel will be required for the training function and more time will be required to upgrade instructors and course materials and keep pace with the changing technology.

d. Required Technology.

Efforts to incorporate training requirements into early stages of system concept, design, and development need to be refined and expanded to permit training managers to become an integral part of system development. Providing trainers with an early definition of the system concept and operational modes will permit the training requirements required for introduction into the operational force. A technology to generate a single USAF task list with common format across new and old systems would be a cornerstone for responsive and coordinated training development.

e. Consequence of Inaction.

Failure of the training community to become an integral part of the "high technology age" will create serious shortfalls in the ability to provide fully trained individuals to utilize and maintain future operational systems. Such shortfalls will subvert the very combat edge promised by the new systems technologies.

2. Improved Systems Reliability and Maintainability.

a. The Change.

There is a realistic promise of developing components, sub-systems, and major aircraft systems for future aircraft that will operate for long periods with no maintenance or at least minimal maintenance. Terms such as 4,000 hours of warranted component life, 3,000 hours mean time between maintenance

action, and continuous operation for 30 days without electronic failure requiring grounding maintenance indicate major changes are in the making on how aircraft will be built, maintained and supported. As an example, the ATF has a design goal of twice the reliability at half the maintenance load of current first line fighters.

b. General Impact.

Expanded adoption of new technologies such as self-diagnosis, auto calibration, and auto-reconfiguration and repair will lead to development of complex systems with vastly different maintenance requirements. The operational scenario would indicate greatly reduced maintenance activity and fewer maintenance personnel grouped in fewer AFSCs with less specialized training. The ratio between flight line, intermediate, and depot maintenance will change with the emphasis being placed on flight line and depot efforts. Most components will be "throw away" with only the most expensive units being returned for depot repair.

Consequently, the field level will require low and moderate skilled individuals trained with less theory, but with more procedural skills and broader skill breadth. Highly skilled and more specialized technicians will be concentrated at the depot level and will be limited to those personnel required for the repair function. Maintenance management will be highly automated based on predetermined decision trees with little flexibility at the operating level.

Critical systems such as navigational, target identification and selection, electronic countermeasures (ECM), and armament selection will operate on large software packages requiring large amounts of error free code. Thus, the critical maintenance effort will be systems integration down to the flight line level (22:33).

c. Training Management Impact.

As with the high technology issue, increasing systems reliability will require a closer relationship between the training manager and the systems developer to ensure timely incorporation of rapidly changing procedures into the training program. The suggested strides in reliability will probably reduce the number of courses required, the content of the courses, and the number of individuals assigned to the maintenance area.

3. Increased Instructional Precision.

a. The Change.

A tutor provides the most effective and efficient individual training to a student. Through one-on-one interaction, the adept mentor can fit instruction to mesh with the student's previous experience and adjust it to the student's learning ability, detailing where the student is struggling, advancing

where the student is excelling. Additionally, the student is constantly "on task" as the teacher drills, tests, and challenges. Training is not constrained to the lowest denominator of a group. If a student in a tutorial setting grasps the material quickly, he or she can either progress to more difficult study or be released to perform the job. As the tutor trains one apprentice after another, a single, exemplary standard of practice is instilled in the population of graduates. This method is the ideal of individualized instruction (38:15-18).

The economic practicality and the industrial society mentality has driven instructional institutions to the group-paced method of instruction. Although a great deal of research and considerable effort has been invested, individualized instruction has yet to be widely accepted or applied in the USAF. There have been some very successful individual efforts as well as some very dismal individual failures. Developmental costs, technical and administrative problems, and the natural reluctance to change have all played a part in not capitalizing on the potential benefits of individual or self-paced instruction in USAF training programs.

Interest in individualized instruction remains high, none-the-less, and research is continuing to produce improvements in all aspects of this instructional technique. Computer hardware is getting more capable and cheaper. Major advances are being made in software that will increase the effectiveness of all aspects of self-paced instruction from course development to resource management. Artificially intelligent tutors are beginning to show real promise to a wide range of training applications (1:7-10 to 7-16, 7-23).

There is an increased awareness at all levels of the potential advantages of self-paced instruction and the population as a whole is becoming more computer literate. With all these forces coming to bear on the issue, it now appears that truly cost effective, self-paced instructional systems are on the near-term horizon. Self-paced instruction will not be the solution to all the training needs and it will not achieve broad usage without problems in transition, but it will offer a means of increasing the quality and flexibility of training at a lower cost. Considering the advantages it offers over the long term, self-paced instruction will become the preferred and primary training mode of the future.

b. General Impact.

The challenge in implementing individualized instruction lies not so much in the technical aspects, significant as they may be, but in accomplishing the major changes that will be required across the broad spectrum of training requirements and non-classroom support functions.

c. Training Management Impact.

Fully implemented, self-paced instruction will integrate management and administrative functions into the overall training decision process. Efforts such as scheduling, resource allocation, student evaluation, and assignment into and out of school will be automatically controlled by the management module of the instructional system. Management functions will be more concentrated on decision making based on information supplied by the management module.

Curriculum Management. The USAF has traditionally coupled job knowledge with career progression through the 3-, 5- or 7-level skill development phases. This concept has been influential in determining what an individual is taught and is expected to know at specific career points. Individualized instruction coupled via computer-based instruction (CBI) will offer the USAF alternate approaches to determining what job knowledge an individual should have at any career point. Strategies must be developed to improve the match between job knowledge requirements and training requirements to identify what is to be taught at a specific point.

Student Management. In the idealized application of self-paced instruction, the only constraint on the student is the mastery of the course material and the ability to demonstrate competence in using the acquired knowledge or skills. Thus, scheduling should be a free flow process with each student moving through the course at a rate controlled only by the ability to master the course material.

This free flow process runs counter to most of the present USAF training management practices that are designed to group training resources (including students) in blocks and manage and control those blocks. As individualized instruction is incorporated into more of the main stream training programs, the US Air Force must find ways to apply efficient point source management concepts to resource management to optimize the advantages offered by this new capability.

III. SUMMARY OF NEED

This section portrays the technology and system gap between the current training management system and the desired system that would drive military supremacy in the 21st century. Included are improvement potentials from chronic problems identified in Volume I of this study (37:93-95). Additionally, technology needs that enable an effective response to future trends identified in this second volume of the study are included. The requirements are grouped into five categories of general, requirement, curriculum, student, and resource management. A tabular depiction of all of the training management needs is presented in Table 1.

GENERAL

Data Network
Tailored Reports
Data Selection Methods
Skill Quality Model
Job Performance Measures

REQUIREMENT MANAGEMENT

Forecast Model
MPT Acquisition Models
Prioritization Algorithm

STUDENT MANAGEMENT

Refined Selection Data
Detailed Records
Automated Records Handling
Refined Student Evaluation

CURRICULUM MANAGEMENT

Air Force Task List
Refined Task Listing
Dynamic Job Survey
Hierarchical Structures
Decisioning Models
Rapid Course Development

RESOURCES MANAGEMENT

Total System Costing
Increased Load Handling
Resource Limitation Response
Materials Currency

TABLE 1. - Training Management System Needs

1. General Management System Needs.

Several needs are common across the four basic training management areas. These general needs are grouped together here as a separate category of need that requires priority attention. The first and overriding advancement required for 2010 is the automation and networking of training management functions and databases (29:36-38). Such networking would create a training management system that could relieve the coordination disconnects of today's fragmented system management and would be the facility to handle the rich and transient information environment of the next century. When coupled with tailored management reports and advanced data selection methods, tomorrow's training managers would be able to withstand the imminent information overload.

Another general need is a model for assessing the costs and benefits of various skill quality mixes of incoming recruit populations. Many critical skill quality decisions precede and strongly effect training management of

technical literacy. A model that enables planners to flex options of force skill quality versus costs of force recruitment, training, and maintenance is required to aid informed decisioning about alternatives to recruit literacy issues (42:68-69). Decision makers need to be able to understand in combat effective terms what is lost or gained from different quality mixes. This model would be an integral part of the general training management system.

Any measures of merit of the four management areas must depend on an effective job measurement technique (42:61). Until a skill performance system of assessment is established and validated, managers will be defensive in justifying resources and proving impacts with subjective evidence. Such a training assessment system would be a key element of the general training management system.

2. Requirement Management System Needs.

An improved capability is needed to accurately and responsively forecast force training requirements. Not only better precision of the numbers and kinds is required, but also longer projections for effective planning. Models are needed to accurately scale and scope new weapon system personnel and training parameters early in development (42:69). Additionally, a prioritization policy capture model is essential to effectively process the burgeoning MAJCOM training requirements (34:13).

3. Curriculum Management System Needs.

A priority requirement for this management area is the capability to generate a single, Air Force task list to manage and coordinate the training goals across the system. The listing must be flexible to permit task regroupings in response to rapidly changing job structures. Additionally, the listing of tasks must be greatly refined to include requisite skills and knowledges, and tasks performed in war fighting environments. Such refinement will permit precision training development and objective operational evaluation. The listing must be accurately maintained by new techniques to rapidly accomplish job surveys, occupational analyses, and communication of survey results (43:14).

A cross-task analysis is needed to identify common skills, knowledges, and tasks to include technical literacy skills and military role model goals necessary to be maintained in the contractor training environment. The common curriculum elements will compose the core for efficient hierarchical course structuring (42:66).

The establishment of a detailed omnibus task list will feed the development of needed models for aiding training decisions. These models will help determine which training should be conducted at what time, at which location, and by what method. Such refined decisioning will drive top system effectiveness.

Timely and detailed targeting of training must be complemented with the means to rapidly develop instructional delivery modules. The ability to quickly react to curriculum changes will be imperative or else the system will succumb to information overload. Faster occupational survey methodology will be a necessity for responsive curriculum development (49:209). With the just mentioned subsystem capabilities properly integrated, a curriculum management system will be achieved that can respond to the rapidly changing technical information environment (6:219).

4. Student Management System Needs.

Improved student information is requisite for today's and tomorrow's training and education managers. Better selection data must be captured to detail capabilities in literacy, information processing, hand-eye coordination, physiological stress, and reaction to performance enhancing chemicals. Linkage of applicant data bases will facilitate cross-agency selection. Together, an optimized force can be selected and appropriately matched to jobs with a result of lower training attrition and superior combat performance.

Refined instructional records must be automated and matched to the more detailed job task lists to give supervisors accurate base lines for responsive scheduling of appropriate follow-on study. This need includes capture and evaluation of college transcripts for professional continuing education. Student evaluation methods need to be refined to adequately assess instruction, particularly that offered by contractors. These system capabilities scope out the dimensions of a student management system (34:15;42:61).

5. Resources Management System Needs.

Quantification, capture, and articulation of total training costs is a necessity to achieve effective system management. Tying resource commitments to the common task list will be a watershed achievement in the costing of training activities. A means to absorb the increase in training responses to rapidly changing job requirements within stable or reduced funding is needed. Efficient materials currency methods will be of paramount importance in the information perishable environment of the 21st century. Integration of the following system capabilities will provide a sound foundation for a needed USAF resource management system (34:12; 42:66).

IV. ARCHITECTURE FOR SUPERIORITY

In preparation for a 2010 close-air support strike, pilots of a two-ship flight of F-16s (block R, modification 72) are training for the encounter via combat simulation. Sitting in their cockpits on the ground, they rehearse the mission with the latest satellite reconnaissance reconstituted on their

helmet-mounted visor displays. They practice navigating alternate routes, evading or neutralizing enemy threats with a new enhanced ECM software, and delivering a new electronically guided ordinance (45:69; 21:34; 23:29-30; 17:38; 26:29-30).

Unexpected events are introduced by the squadron training officer to stimulate situational awareness and to avoid negative mental sets. Computer analysis provides performance feedback and suggested alterations in tactics. Later, they will link via a secure communications network to other pilots (F-16s and F-117s), forward controllers, and strike command to rehearse a coordinated attack (7:56).

The pilots exhibit a professional confidence that stems from an exclusive selection process and combat realistic training and experience. They had trained previously for similar mission scenarios using the "top gun performance mentor." Against performance data captured from the top pilots in the USAF they had honed their skills, reflexes, and tactics with precision prompts and feedback. The pilots knew they were as least as good as the best.

An avionics technician for the F-16s had just finished installation of the new critical ECM software modification prior to the pilot training session. Using the training package that accompanied the installation program, she completed a needed refresher on ECM software and then reviewed the modification instructions. The computer-assisted technical order guided her installation and system check. As the technician checks into job control afterwards, she uploads the training and installation results into the maintenance network system. Not only are supply and aircraft records updated, but so is her training and performance record.

She is now off to do a systems degradation check on a battle damaged F-117 that is being turned for its fifth combat mission of the day. First, however, she will have to help the maintenance crew to decontaminate the ramp area with the remote robotic Chemical-Biological Warfare (CBW) sterilizers. If the Chemical-Biological (CB) attacks continue, she will be forced to do her checks with the robotic maintenance aid. While use of the telepresence gear is annoying to her, she has developed, in training, an adept touch with the system.

This is her 18th straight hour on duty and she is as mentally and physically on task as during the first hour. She does not like to rely on the "combat alertness prescription," but she must admit to its effectiveness and that of the companion sleep aid. After just 4 hours, she awoke as rested as if she had slept 8 hours. Her controlled training with the use of these chemical aids had eased much of her concern with such substances and built confidence in their capability. These ergonomic drugs had allowed the six surviving technicians to fulfill the duties of the original ten member dispersed maintenance team.

The just mentioned vignette offers a glimpse of the combat training environment of the next century. To prepare the warrior team to triumph in the information intense and time critical environment of 2010, the USAF will have to revolutionize its present training system. The necessary structure of that 21st century system is addressed, first, in general terms and, then, across the four major training management activities.

A. GENERAL FEATURES

The major innovation for training managers in the 21st century is complete information networking as depicted in Figure 1. Centralized occupational and training data bases exist from which all pertinent information can be stored and accessed from distributed desktop computers. Artificial intelligent aids provide data priorities and manipulations at each manager's fingertips. Electronic mail permits routine crossfeed between managers across various functional domains.

The information networking enables timely alert to required attention areas and responsive action to the continuous cascade of new technology. Combat critical training responses to block changes and modifications are communicated promptly to occupational and training analysts, to curriculum designers, and to the frontline supervisors and combatants. The training management system remains decentralized, but coordinated through central information repositories.

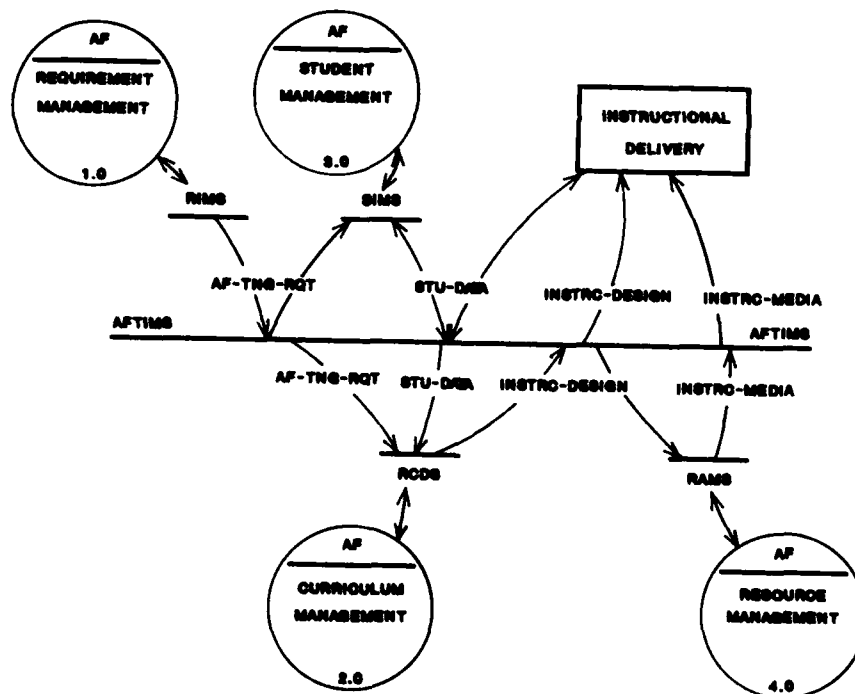


FIGURE 1. Air Force Training Information Management System.

The backbone to the network of data bases is the Air Force Training Information Management System (AFTIMS) as depicted in Figure 1. This system is composed of four major subsystems that support the four major training management activities. The Requirement Information Management System (RIMS) serves the requirement management activity, the Student Information Management System (SIMS) assists the student management activity, the Rapid Curriculum Development System (RCDS) caters to the curriculum management activity, and the Resource Accounting and Modeling System (RAMS) provides for the resources management activity. The global data transactions are illustrated with the onset of activity from the input of the USAF training requirement data. This initial data input drives student, curriculum, and resources requirements. More detailed data flows can be found in the subsequent structured analysis diagrams in the sections devoted to each individual management activity.

Several factors are working in consort to ease the competition for literate personnel. Reduced force size, expanded female representation in the force, automation of all clerical and administrative jobs, and increased contracted services have pared the requirement for young male workers (40:28). Even though salaries lag the private sector, strong recruitment marketing has maintained military service as a viable vocational alternative. The Skill Quality Model, a subsystem of the AFTIMS, now permits Air Staff managers to make trade-offs between the aptitude level of the applicant pool and the cost impact in force training, maintenance, and performance.

An innovative occurrence is an effort promoted by the Departments of Defense, Labor, and Education and the Fortune 500 companies. This consortium has made a frontal assault on the nation's ethnic ghettos. The "grow-a-technician" and "adopt-a-school" programs have identified able students in early middle school and provided modest stipends for school achievement. The programs have provided matching funds for school procurement of information systems and advanced instructional technology laboratories. Employment is guaranteed with successful graduation and an enlistment bonus for military bound graduates. The tie between education and job performance is reinforced by visits to representative job sites.

B. REQUIREMENT MANAGEMENT

The watershed for training management remains the requirement determination activity. The number and kinds of personnel and courses required still drive the other management functions. The RIMS enables requirements for all elements of training management to be worked "in system" per Figure 2.

All levels and types of management activity are able to access the system to staff their management issues. Depicted is the annual requirements determination process which responds to the congressional authorized force structure. The Air Staff and MAJCOM training managers have online access which

The training actions in the field, however, are greatly increased. There isn't the depth available to allow commanders to release personnel for TDY at resident school courses. This capability has greatly reduced the MAJCOM requirement management process. Expanded use of field training detachments (FTDs), mobile training teams, satellite communication seminars, and artificial intelligent tutors are filling the need. The FTD and mobile training still require structured management and coordination via RIMS. The advanced technology training and education, however, is not as resource constrained and is handled outside of RIMS.

The "grow-a-technician" program has expanded the accession management activities. The military components are run like the Junior Reserve Officers' Training Corps (ROTC), but focused for enlisted recruitment.

C. CURRICULUM MANAGEMENT

The major innovation here is a consolidated occupation data base for all USAF jobs as illustrated in Figure 3. The Task List Development System (TLDS) permits dynamic updating of a single, refined task list. This list is composed of every skill and knowledge element supporting each task and is cross-referenced by pertinent specialty code, weapon system, and equipment item. All training managers work in coordination with the common task base. As jobs vary, tasks can be regrouped to constitute the new specialty description.

Occupational surveying, the keystone in training development, has become a dynamic, continuous process. Equipment embedded computer aids automatically track frequency and time of task performance and pass the data through networks to the centralized data base. Out-of-system functions and task criticality assessments are captured annually through interrogative computer surveys at the local Consolidated Base Personnel Offices (CBPOs). Significant changes in task performance are automatically flagged to analysts to trigger review. New system and subsystem tasks are articulated in compatible format and entered into the task data base with associated skills and knowledges.



With identification of training requirements during early stages of system design and with task data flowing into the data base as systems develop, concurrent training development has been achieved. Design engineers use the training simulations to explore impacts of weapon system modifications. Training managers have become an integral part of system development and now can respond quickly to system changes.

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materials have augmented the electronic principles core. Instructional delivery has evolved from a classroom lecture focus to one of a media array. Presentations transmitted via satellite, television, computers, and optical disc simulation now support the instructional staff on a wide-scale basis. Computer decision aids assist training managers in deciding where, when, and how to train. Artificial intelligence-based course development provides for rapid creation of instruction.

Basic technical literacy is understood for all job specialties and correlated to tasks and equipment. Literacy training modules have been developed and integrated with core curriculum to bring basic technical communication skills up to speed.

D. STUDENT MANAGEMENT

Personnel selection involves much greater precision in the 21st century. High performance ability individuals are selected by sophisticated motor skill and cognitive measures. Reaction to performance enhancing chemicals is routinely captured and recorded. With more detailed information about job requirements and personnel abilities, the person-job match is refined with corresponding improvements to job performance. Skills and abilities of "Top Gun" individuals are captured, studied, and passed to selection and training functions to improve both activities.

The SIMS now permits a detailed track of selection parameters and completed instruction per Figure 4. The student selection agencies capture more detailed information via the Advanced Personnel Aptitude Selection System (APASS). Task correlated, individual training data are first generated during initial skill training and flowed to SIMS by way of AFTMIS to supplement the selection data. On-the-Job training supervisors subsequently access the SIMS data bank as part of their administration of further instruction.

Technicians' training records are task specific with related skills and knowledges and cross-referenced to equipment and aircraft. As the technicians move across the USAF their detailed record of training follows. Individual job requirements are correlated to past training enabling supervisors to accurately plan required position specific instruction. Additionally, the Advanced Job Performance Measurement System (AJPMS) captures job performance data that are task specific, permitting relevant feedback to curriculum managers and selection agencies via AFTIMS to SIMS. Automated training has eased much of the scheduling problems of the 1980s. Practice with actual equipment is still a necessity, but much of the maintenance activity is software related and can be practiced off of the airframe.

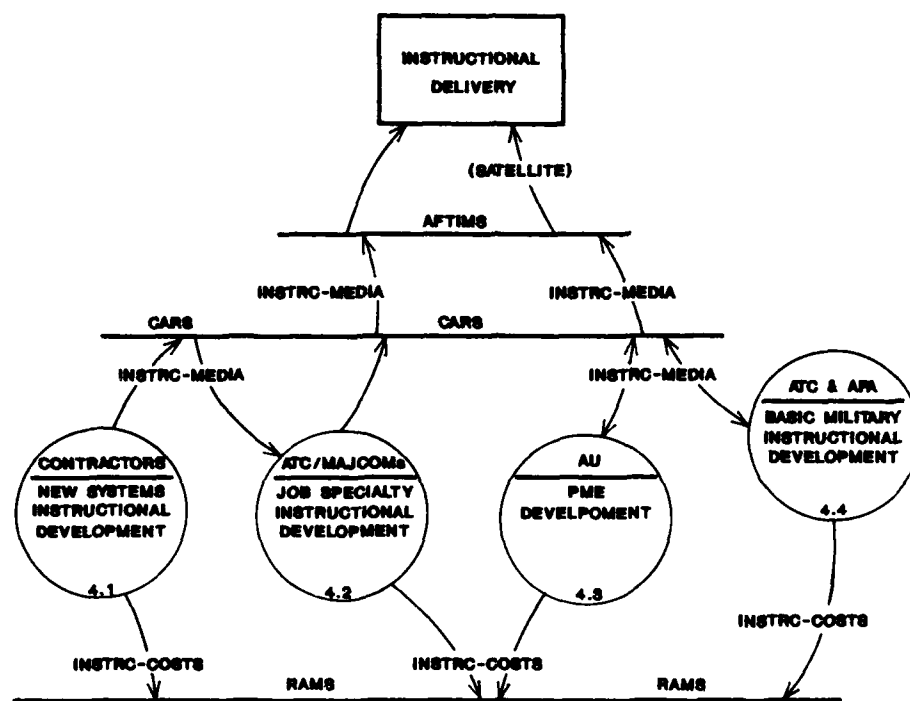


Figure 5. Resource Accounting & Modeling System

Electronic data storage and access has resolved the materials currency issue (16:16). Centralized courseware cataloguing through the Curriculum Access & Repository System (CARS) permits exchange and adoption of related materials improving system efficiency.

Expanded use of Intelligent Computer-Assisted Instruction (ICAI) has yielded a flexible response capability to training surges without increasing instructor resources. Closer ties to new systems development, adoption of hypertext technology, ICAI, and the AFTIMS have maintained curriculum currency within the technological information deluge (15:--).

V. DEVELOPMENTAL ROADMAP

A. CURRENT RELATED RESEARCH

In building a developmental roadmap to acquire the necessary elements for the 21st century training management system, consideration of current research activity provides an anchor for bridging to the future. The following is a review of ongoing research that is related to training management needs.

1. Training Decision System.

Continued long-term constraints on training resources and manpower are forcing the USAF to realize that all individuals cannot be fully trained at the most opportune time. Therefore, decisions must be made relative to how much training an individual should have at any one point of time and what should be taught in the training they receive.

These decisions are not easily made as many factors must be considered ranging from operational requirements to manpower availability to available training resources. Managers do not presently have an allocation model that contains all the restraining factors, permits an analysis of all the options, and optimizes the training allocation process. Training Decision System (TDS) seeks to develop a model whereby training managers can identify the various training options, evaluate their cost against both resources utilization and operational needs, and determine a precise training plan that provides a trained manpower pool at the lowest possible cost (8:31-32).

Four subsystems of the TDS were used to identify what should be taught (training content), where training should occur (appropriate setting), when training should occur (career opportunity), and available cost effective training options. The melding of these efforts into a workable system offers the training manager the unique capability to accurately identify training requirements, make proper decisions for optimized resource management at macro and micro levels, and to manage the trained manpower resource throughout the USAF.

a. Task Characteristics Subsystem.

The task characteristics subsystem (TCS) is used to develop Training Modules (TTM) that are clusters of tasks that share similar underlying skills and knowledge which are commonly co-performed in USAF jobs and should be trained together. A Training Setting Allocation Component (TSAC) gathers data concerning allocation of the training modules across training settings. The allocations consider variables such as the point in an individual's career at which the learned skills will be utilized, where the training module could be taught and the preferred allocation of TTM among training settings. The TCS is then used to provide time estimates for each potential training setting and to determine the most preferred training setting, alternate settings, and which setting would yield the maximum proficiency gain.

b. Field Utilization Subsystem.

The field utilization subsystem (FUS) addresses personnel flow through a particular AFSC and provides feasible alternate flow patterns. This subsystem

is specifically used to (1) identify current and alternative utilization and training patterns wherein airmen move through various training programs and proficiency levels; (2) determine training and proficiency requirements for jobs; and (3) identify current and preferred utilization and training patterns and identify the potential impacts of alternate patterns in terms of manpower, personnel and training.

c. Resource and Cost Subsystem.

The resource and cost subsystem (RCS) identifies the types and amounts of training required for each TTM in various training settings, the capacity of individual training sites to accommodate training on varying combinations of TTMs, and estimates the variable costs incurred in providing training. Using these elemental numbers, the cost of providing specific amounts of training on particular combinations of TTMs in various settings can be developed. These three subsystems are integrated through an optimization subsystem that provides analytic capabilities for delivering preferred training allocations.

2. Advanced On-the-Job Training System.

The Advanced On the Job Training System (AOTS) program is intended to develop a system that automates job site training functions and integrates the related management activities. The AOTS has five major subsystems which address management, evaluation, curriculum development and delivery, computer support, and personnel support. The initial prototype effort has three phases of design, development, and test and evaluation. This prototype is being developed in the tactical aircraft maintenance, and security policy enlisted career fields. The development is designed to provide incremental products, some of which include training requirements definition processes, task proficiency evaluation procedures, training resources identification procedures, and automated training records (8:38-40).

3. Advanced Training System.

The advanced training system (ATS) is being developed to provide a computer based training system for the Air Training Command's Technical Training Centers. While not a major factor in the training management process, ATS does have a management module that is intended to control the overall computer-based training system. This module, if properly used, could greatly improve the quantity and quality of information related to the status of technical training. Thus, ATS could impact on training management decisions made at various command levels. In addition to providing the technical curriculum, ATS addresses several critical items within the technical training environment which contribute toward the solution of training management issues regarding cost, curriculum, attrition, throughput time, evaluation, and requirements. This system consists of several major modules which are described below (33:32-33).

a. Resource Management.

This module tracks course status and resource requirements and provides an optimized resource allocation plan to meet the identified requirements at the classroom or individual needs level.

b. Course Development.

Provides advanced courseware development procedures that will reduce the time required for course developers and instructors to prepare and upgrade course content.

c. Student Instruction.

The ATS offers major advances in classroom presentation. This system does not eliminate the instructor but it does increase the use of multimedia presentation, individual self-paced instruction, self-help techniques, quick evaluation and feedback, and other techniques that have been proven to increase student involvement, reduce attrition and increase learning and retention.

d. Administrative Management.

The ATS greatly simplifies the multitude of administrative tasks associated with moving thousands of individuals through the training process by considering training and administrative needs as one continuous process and tracking these needs together.

4. Instructional Support System.

The instructional support system (ISS) is a computer based training (CBT) software package that provides both computer-assisted instruction (CAI) and computer-managed instruction (CMI) to facilitate the creation and management of training. The Department of Defense (DOD) standard programming language, Ada, and modular construction enables the user to run ISS on a variety of machines using the entire system or only portions of the system for a particular need (8:26-27).

The ISS uses interactive menus and prompts to permit non-programmer instructional personnel to create courseware. A similar set on menu-driven management editors increases program and management control. The ISS also accommodates a light pen, mouse, and touch panels as well as video disc players and graphic overlay devices. The ISS instructional capabilities also allow non-programmers to develop interactive courseware to address individual student needs in the following areas:

a. Text Presentation.

Authors using an instructional editor present text to students through a series of screen displays. Each screen represents a piece of information or asks a question and can be designed to broaden instruction options or serve the individual student's needs. The use of a graphics editor permits the use of clear, unambiguous graphics to lessen the burden of text or emphasize key points.

b. Student Interaction.

Easily developed interactive text and branching response techniques permit students to be active participants. Embedded questions stimulate student interest and reinforce the learning process.

c. Individualization.

Students can control lesson material by choosing alternative paths from branching displays to adapt the courseware to their own learning styles. Slower students can receive prompts, elaboration frames, or additional instructional material based on their individual progress.

d. Simulation.

Computer-based simulation with real-time or near real-time animation permits the student to repetitively practice without the use of expensive equipment or possibility of damaging mistakes or personal injury. Problem solving and decision-making skills are easily learned and practiced in a progressively complex technical environment.

5. Literacy Skills Technology.

The Air Force Human Resources Laboratory (AFHRL) has a significant effort focused at basic job skills. The effort defines pervasive cognitive skills that lead to competent technical performance, and will develop an instructional methodology to train those skills. The outcome of the research effort will be development of technical literacy in personnel faced with the operation and maintenance of sophisticated weapon systems (8:57-58).

6. Manpower, Personnel and Training Integration.

Manpower, personnel and training are traditionally considered late, if at all, in the system design and acquisition phases. With the continued growth in high technology personnel requirements and the shrinking skilled manpower pool, the USAF must find ways to incorporate MPT considerations and options early in the design and acquisition phase. This effort seeks to develop technology to permit MPT requirements to be incorporated into design decisions at the concept development phase. Further, these techniques could be used for

integrating forecasted requirements for new systems with other emerging systems to forecast total force MPT requirements by skill level, training, etc. This technology can also provide detailed MPT requirements early in system development to ensure personnel and training requirements are established and met prior to system delivery (8:49-51).

7. Civilian and Military Manpower Availability.

Not only must the USAF be capable of forecasting MPT requirements early in the system acquisition process as just described, it must also be able to reliably forecast manpower availability. Models are being developed that will accurately predict the available military and civilian manpower pools in terms of mental and physical qualifications and their probability of continuing or entering military service. These two efforts will improve training managers ability to forecast total training requirements, identify the quantity and quality of the available manpower pool and optimize training to meet force requirements.

8. Recruiting and Technical Training Impact Models.

Many outside factors effect decisions related to recruiting and technical training. Experienced managers can usually estimate the impact of a single factor and make recommendations for necessary adjustments. However, it is virtually impossible to accurately estimate the impact of simultaneous adjustments in several factors. Dual forecasting systems known as the Recruiting Impact Model (RIM) and the Technical Training Impact Model (TTIM) are being developed to accurately accommodate the complexity of multiple factors and provide a means of evaluating management alternatives prior to implementation.

9. Small Unit Maintenance Manpower Analyses.

The increased emphasis on combat mobility, flexibility, and sustainability causes the scope and content of maintenance occupations to be redefined so that wartime flying schedules can be met from dispersed operating locations without dramatically increasing requirements. During periods of conflict, small unit operations and air base dispersal imply broadened task training for the maintenance workforce as a key element of logistics. The Small unit maintenance manpower analyses (SUMMA) program is developing technology that can provide a computer-based decision support system useful for:

- projecting and analyzing combat workloads based on deployment scenarios,
- allocating maintenance tasks to new or redefined job specialties, and
- evaluating, through integration of logistics performance simulation and force management-policy analysis, the combat effectiveness and feasibility of desired job restructures.

Analysts will be able to use SUMMA in the definition and redefinition of maintenance occupations for new weapon systems and it will allow a fuller analysis of proposed changes in the occupational structure and the capability to judge the probable contribution of restructured maintenance specialties to success in the combat environment (8:13).

10. Integrated Maintenance Information System.

Due to the changes in weapon system technology and support concepts, the way maintenance must be done to generate tactical sorties in future wars must be radically changed. Aircraft will be more dispersed, systems will be more complex, and will require deeper maintenance on the line by fewer technicians who must master a broader range of tasks and skills. The integrated maintenance information system (IMIS) is a comprehensive information and job aiding system that will help technicians generate the needed sorties in future wars. The IMIS will consist of a portable computer for flight use, an aircraft interface panel for interacting with aircraft systems, and a workstation for use in the shop when not remotely deployed (8:23-24).

The development of IMIS is proceeding in three stages. Stage I is the Computer-based Maintenance Aids System (CMAS) which establishes basic requirements for automated Technical Order (TO) data content, presentation formats, and basic delivery system hardware-software. Stage II, the Portable Computer-based Maintenance Aided System (PCMAS), is designed to examine the TO presentation specified in Stage I on the flight line and demonstrate interactive diagnostics and aircraft battle damage repair assessment. Stage III is the full IMIS demonstration. This stage will extend the concepts specified in Stages I and II, with an emphasis on information integration throughout the maintenance complex.

When completed, IMIS will optimize the use of the available manpower, enhance technical performance, improve training, and reduce the support equipment and documentation needed for deployment. The IMIS should also serve as the technician's single, integrated source of all the technical information required to perform modern aircraft maintenance.

11. WARNET

WARNET is to design and demonstrate an interactive network of low cost combat simulators. This network of flight simulators will provide a necessary supplement to those aspects of training not possible in current flying exercises and allow much more frequent practice of those skills needed to handle peak combat workloads without saturation. The network will include logistics features and incorporate a command and control node to provide a more realistic large scale wartime environment. This network system should provide the ability to investigate all aspects of combat training (8:68).

12. Task Identification and Evaluation System.

There are several different methods in use to identify, collect, and analyze job task information, a central function in managing training development. These methods include the Logistics Composite Model, the Maintenance Data Collection System, the Logistics Support Analysis, the Occupational Survey Methodology, and the Instructional Systems Development process.

Since the several methods evolved to support different purposes, they are not particularly compatible. This incompatibility severely restricts cross-utilization, impeding development and coordination within the manpower, personnel, and training environments. The task identification and evaluation system (TIES) research program is intended to develop a means to integrate the five commonly employed task analysis methods via an interfacing format procedure.

13. Learning Abilities Measurement Program.

To maximize the effectiveness of selection and classification testing and procedure, cognitive skills research is executed by the USAF. The learning abilities measurement program (LAMP) studies the nature and organization of human learning abilities in relation to information processing, looking for relationships to USAF training and job performance. As such relationships unfold the cognitive traits become candidate measures for operational assessment systems. The ultimate goal of LAMP is to develop a new model-based selection and classification system for the USAF (8:52-54).

14. Basic Attributes Tests.

Targeted at the high value population of aircrew candidates, the Basic Aptitude Test (BAT) program combines psychomotor, information processing, and personality tests into an assessment vehicle for screening prospective pilots. As correlations between selection parameters and flying performance are established and validated, the BAT and its portable cousin, the PORTA-BAT, are being operationally employed for candidate selection and classification (8:54-56).

15. Model Aircrew Training System.

The Model Aircrew Training System (MATs) addresses the need for an integrated systems design and implementation of aircrew training components and phases. The MATs is directed toward production of development guidelines and specifications that incorporate advances in cognitive psychology and training technology. Included are proficiency-based student progression, individualized instruction, and operations-based combat training syllabi. Evaluation data are captured to aid managers in achieving maximum training system effectiveness and efficiency (8:78-81).

16. Job Performance Measurement.

As discussed in volume I of this study, the lack of objective performance measures continues to inhibit training managers' ability to determine job impacts from changes in the training system (36:96). The job performance measurement (JPM) program is directly assaulting this deficiency by developing a technology to objectively measure the job performance of airmen. This measurement technology will subsequently be used to collect performance measurement data to aid training evaluation, and validation and calibration of selection and classification standards, improving the match between persons and jobs.

17. Intelligent Computer-Assisted Instruction.

The ICAI program is one of several artificial intelligence applications pointed toward improving training effectiveness. Modular software will be developed and tested to enable rapid development of ICAI. The modular "kernels" will be capable of adaptation to different specific instructional applications and will permit rapid courseware update to respond to changing technology in the subject areas. The outcome will provide cost-effective deployment of high quality, individualized instruction (8:33-34).

18. Aircrew Training Effectiveness Plan.

The US Air Force Training Effectiveness Plan is designed to exploit science and technology to improve aircrew training effectiveness and efficiency. One of the eight thrusts of the plan includes development of a training cost-effectiveness model for MPT and media mix decisions. This effort involves design of a cost-effectiveness data base and of methodologies to generate training device mixes and is pertinent to future needed capabilities described later in this report (8:65,69-70).

19. Occupation Research Data Base.

To meet the information needs of USAF scientists and technicians in managing, monitoring, and conducting research and development, data archives are kept by the Air Force Human Resources Laboratory. The Occupational research data base (ORDB) is one data base that keeps at least 5 years of the most pertinent data readily available for access. More than 120 variables are routinely updated as well as occupational survey reports and career field aptitude histories. The ORDB is being enhanced to expand the Officer data holdings (8:48,87-88).

20. Chemical Warfare Drug Assessments.

A variety of chemical warfare protective studies and developments are underway within the Human Systems Division. The Advanced Chemical Defense Aircrew Respirator, the Personnel and Equipment Contamination Sensor, and the Quantitative Fit Test Instrument are some of the programs that collectively pull a variety of human performance measurement capabilities into an integrated physiological research base. While not directly related to training management, this physiological research base provides an important part of a needed total human assessment system that is described later (33:12-15).

B. IMPACT OF RESEARCH AND DEVELOPMENT

These descriptions provide background on research generally related to training management issues. The correlation of the research to the specific training management needs is described below.

1. General Needs.

The applicability of existing USAF research to global management requirements is depicted in Table 2. The ATS and AOTS set the foundation for an USAF-wide data network for technical training management. Both systems will capture student data for tracking, provide repositories for training objectives, and permit automation of much of the supervisory record keeping.

<u>System Needs</u>	<u>Research Programs</u>					
	<u>AOTS</u>	<u>ATS</u>	<u>IMIS</u>	<u>JPM</u>	<u>WARNET</u>	<u>MATS</u>
GENERAL						
Data Network	d	d	d	.	d	d
Tailored Reports	d	d	.	.	.	.
Data Selection Methods	d	d	d	.	.	.
Skill Quality Model	.	.	.	.	.	.
Job Performance Measures	.	.	.	d	.	.

(d = direct application)

TABLE 2. - General Needs VS. Research

Each system will aid managers in accessing and targeting information for tailored management needs. Potentially, CAI curriculum materials will reside on each system and could be exported from the resident training site to the OJT arena. The IMIS program will network the line maintenance personnel to a variety of data bases to include computer-based technical information, aids, and instruction. In many instances it could be the AOTS delivery system. The WARNET and Model Aircrew Training System (MATS) will directly contribute MAJCOM data-base networking for flying training. The JPM activity directly and fully addresses the personnel assessment need.

While there is much promise in these research and development activities, shortfalls exist. Follow-on development and implementation of AOTS is uncertain after completion of the current prototype. There is intent in principle to make the ATS, AOTS, and IMIS compatible, but to date no formal integrated design activities have been consummated. The focus is directed at near-term sustainment of the finite elements; neglected is a coordinated, strategic vision. Additionally, similar information networks for flying training and professional military education are absent in attention. Operations in 2010 simply cannot tolerate such disconnects in the information flow. Work on the difficult, but worthy, models of procurement alternatives for quality skill personnel is also unattended.

2. Requirement Management.

The TDS and the MPT effort provide peripheral help for the requirement forecasting model. The MPT program and the Task Identification and Evaluation System directly address acquisition planning models and are supported by TDS.

<u>System Needs</u>	<u>Research Programs</u>		
	<u>TDS</u>	<u>SUMMA</u>	<u>QRDB</u>
REQUIREMENT MANAGEMENT			
Forecast Model	t	t	t
MPT Acquisition Models	t	d	d
Prioritization Algorithms	p	.	.

(application: d= direct; t = tangential; p = potential)

TABLE 3. - Requirement Needs VS. Research

There is a shortfall in addressing the needed requirement forecasting models (Table 3). No development effort is underway to work prioritization of training needs, however, the TDS could possibly be extended to handle this requirement.

3. Curriculum Management.

The Task Identification and Evaluation System (TIES) directly approaches the need for a standardized USAF task format and interconnection of task data bases; the MPT effort can, potentially, encompass the need also. The Basic Job Skills (BJS) program works very much toward a more refined dichotomy of supporting knowledges and skills for enlisted tasks, although constrained to technically literacy aspects. Some knowledge engineering applications from the ICAI programs will aid rapid occupational survey building and data capture; IMIS potentially could be incorporated to host embedded surveying of task performance frequency and duration data.

The BJS program alone specifically addresses hierarchical structuring of tasks and subsequent instruction; potentially several of the other programs could also apply. The TDS directly addresses requirements for decision aids in planning instructional development and is supported by the MPT activities. Additionally, the MPT activities are directly working to advance course development lead times in the front end of systems development and is supported by TIES; the ICAI programs closely attend to rapid instructional development from the front end feeds.

<u>System Needs</u>	<u>Research Programs</u>					
	<u>TDS</u>	<u>MPT</u>	<u>TIES</u>	<u>BJS</u>	<u>ICAI</u>	<u>IMIS</u>
CURRICULUM MANAGEMENT						
Air Force Task List	.	p	d	.	.	.
Refined Task Listings	.	.	t	d	.	.
Dynamic Job Survey	.	.	.	.	d	p
Hierarchical Structures	p	p	p	d	.	.
Decision Modeling	d	t	.	.	p	.
Rapid Course Development	.	d	t	.	d	.

(application: d= direct; t = tangential; p = potential)

TABLE 4.- Curriculum Needs VS. Research

Except for approaches to decision modeling and rapid course development, the whole curriculum area of needs appears to be only nibbled at about the edges (Table 4). While many of the needs are partially addressed, there is no long range plan for expansion and confluence of efforts. A refined, total US Air Force task list is not on anyone's drawing table. A global intention to engineer techniques for rapid and continuous job surveying languishes. No follow-on to broader application of BJS hierarchical structuring to other curricula is contemplated. Simply tweaking today's business-as-usual will not suffice and threatens the effectiveness of the whole training enterprise of 2010.

4. Student Management.

The learning abilities measurement program (LAMP), BAT, and person-job match (PJM) efforts together make a strong contribution toward refining selection criteria. Coupled with ATS and AOTS, a firm foundation will be established to handle more detailed enlisted student tracking and scheduling needs. The JPM will make firm gains in refined performance assessments to support student and contractor evaluations for technical training.

<u>Research Programs</u>					
<u>System Needs</u>	<u>AOTS</u>	<u>ATS</u>	<u>LAMP</u>	<u>BAT</u>	<u>JPM</u>
STUDENT MANAGEMENT					
Refined Selection Data			d	d	d
Detailed Records	d	d			
Automated Rcrds Handling	d	d			
Refined Evaluation					d
(application: d= direct; t = tangential; p = potential)					

TABLE 5. - Student Management Needs VS. Research

Still needed will be methods to routinely capture data regarding individual influences to performance enhancing drugs. A closer link between the LAMP-type activities and the CBW evaluations will need to be nurtured in the out-years. The level of detail of task accomplishment in flying training, however, is not currently refined enough for 2010 management needs. Again, no

serious effort has been marshalled to work the tight compatibility necessary to smoothly flow student information between the ATS and the AOTS systems which will be necessary for 21st century management.

5. Resource Management.

The advance training technologies of the ICAI, ATS, and AOTS will aid both the reduction of TDY-to-school needs and the containment of site training costs. Potentially, these developments will build toward a responsive training pipeline with current course materials for technical training.

A major shortfall here is the lack of any targeted program to quantify system costs. The TDS will give some attention, but the prognosis is for a continued lack of objective data in the MAJCOMs from which funding impacts can be quantified.

<u>System Needs</u>	<u>Research Programs</u>			
	<u>IDS</u>	<u>ATS</u>	<u>AOTS</u>	<u>ICAI</u>
RESOURCES MANAGEMENT				
Total System Costing	t	.	p	
Increased Load Handling	.	d	d	d
Resource Limit Response	.	d	d	d
Materials Currency	t	t	t	t

(application: d= direct; t = tangential; p = potential)

TABLE 6. - Resource Management Needs VS. Research

C. DEVELOPMENTAL PATHWAY

With the review of pertinent ongoing research, and the identification of research shortfalls, an informed strategy for future development can be constructed. Schematics accompanying the following narratives lay out the roadmaps to future required systems. The technology and systems development efforts are depicted in Figure 6 by the horizontal bars with cost estimates noted in hundreds of thousands of dollars. The solid borders indicate efforts that are funded and under way; the dashed borders are for efforts recognized as needed, but not currently resourced; and the dotted borders are efforts neither resourced nor as yet planned. The development products which meet the identified 21st century needs are enclosed by ovals.

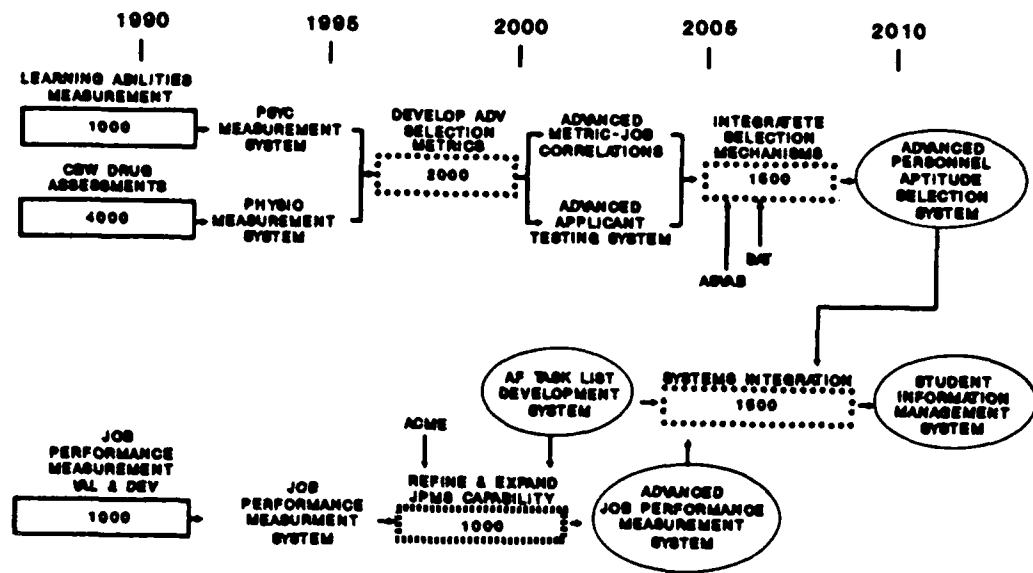


Figure 6. - General System Roadmap.

1. General System Roadmap

Achievement of the training management data-base network with tailored information selection and reporting is the pivotal development of the next century. This AFTIMS for training managers will be realized with integration of the accession training, technical training, flying training, and professional military education networks as indicated in Figure 6. Key interim developments will be the establishment of integrated technical and flying training management information systems (MISs).

The current ATS program for the resident training arena must be interfaced at the earliest opportunity with the AOTS program to permit data flows on training objectives and student achievement. The AOTS must progress beyond the technology demonstration phase to cross USAF employment. With computer support systems permeating virtually every functional area, AOTS program managers need only to staff linkage with the IMIS and subsequent embedment of software and data storage in the developing functional systems.

In the flying training realm, an MIS network has been established for Undergraduate Flying Training (UFT) in the Air Training Command's Training Resources Information Management System (TRIMS). Development of Model Aircrew Training Systems in the various MAJCOMs and succeeding networking via WARNET will provide an integrated flying training MIS.

The current Job Performance Measurement program will satisfy by the mid-1990s the basic assessment deficiency plaguing training management. It will provide a job performance foundation for ensuing development of a modeling capability to aid skill quality decisions on force recruitment, training, and maintenance.

2. Requirement Systems Roadmap.

The three major requirement management needs are enclosed by ovals in figure 7. The TDS, the ORDB program, and the SUMMA program will collectively yield the modeling tools needed to aid determination of weapon system impacts on MPT issues. To realize the capability to accurately project and forecast USAF trained personnel requirements, integration and expansion of the various MPT acquisition models will be required.

To solve the need for handling the accurate prioritization of MAJCOM training requirements, a policy capture study with a software support package would produce a prioritization subsystem. Subsequent integration would produce the RIMS. It should be noted that no effort is yet planned for the prioritization aid.

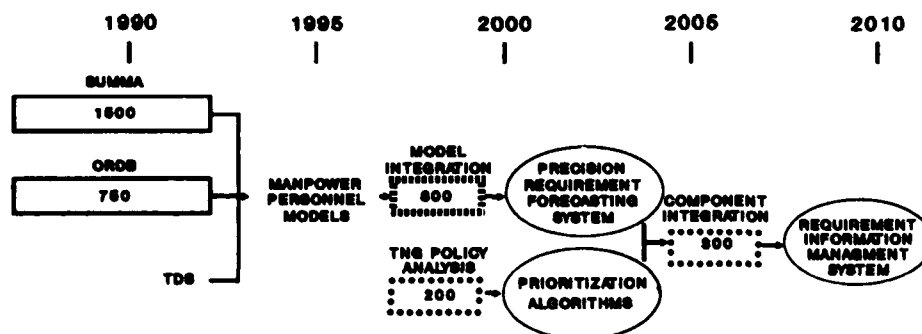


Figure 7. - Requirement Systems Roadmap.

3. Curriculum Systems Roadmap

By 2010, a capability to rapidly make curriculum decisions will drive the responsive development of training and education programs. Satisfaction of other curriculum management needs will feed this ultimate capability as depicted in Figure 8.

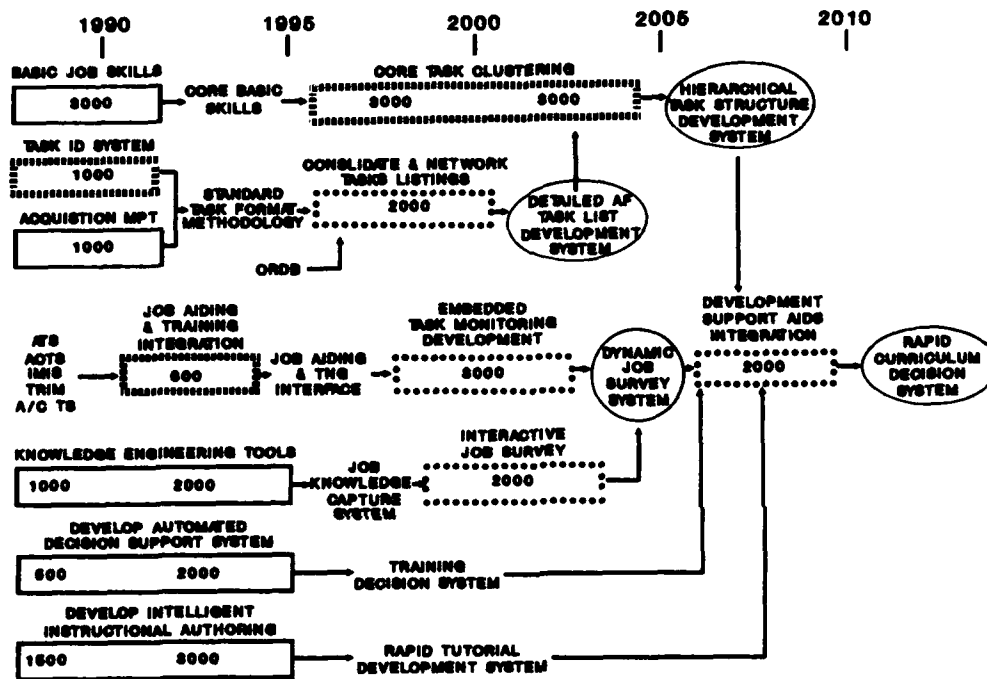


Figure 8. Curriculum Systems Roadmap.

The capability to list in detail all training and education tasks with supporting skills and knowledges, cross-referenced to USAF specialties and weapon systems will yield efficient and coordinated development, quickly reactive to personnel restructuring. The TIES and various MPT efforts will yield a methodology for standardizing task formats from the various sources. Integrating with the ORDB, expanding to include all USAF tasks into a single listing, and working the data base networking to keep the list accurate will produce the TLDS.

The equipment-embedded ability to monitor task accomplishment during job performance and the artificially intelligent ability to interactively interrogate personnel regarding non equipment related tasks will together provide an ongoing, dynamic, occupational survey system. Such a system will produce the latest in job performance data for curriculum managers.

Coupling the task list development system with development of a capability to routinely cluster tasks with related skills and knowledges will yield a hierarchical task structuring system. This system will be key to achieving efficient and prompt instructional development.

Integrating these new technologies with the TDS and the Rapid Tutorial Development System will produce the capability for rapid curriculum decision-making. Note that a significant building block for the system is currently neglected with the lack of resourcing of the TIES program.

4. Student Management Network.

An APASS will provide improved selection metrics for precise screening of physiological and psychological attributes predictive of successful 21st century combat performance. Such a system will require a much closer integration of the current physiological and psychological USAF assessment activities as shown in Figure 9. The gradual adoption of performance enhancing chemicals will also drive a tighter cooperation between the two wings of human study to develop dosages for optimal mental and physical performance.

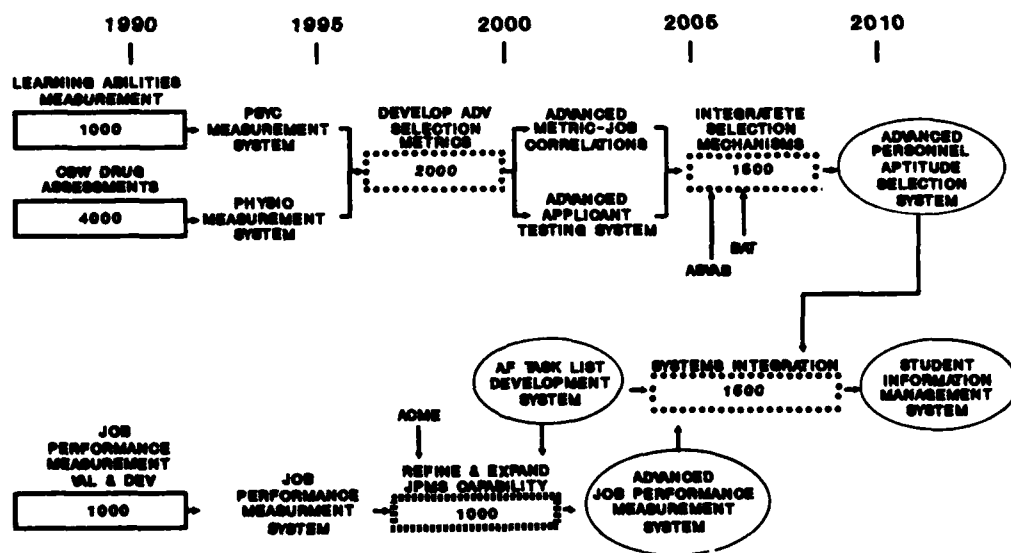


Figure 9. - Student Systems Roadmap.

Improved personnel data capture will include both more detailed information on personnel during selection, but also during their USAF tenure. Coupled with better selection algorithms, lower attrition and better performance will result from a refined personnel selection system.

Integration of the student management subsystems will produce the total USAF Student Information Management System. The lack of intent for a planned integration of the psychological and physiological assessment system research is a serious concern for development of 21st century capabilities.

5. Resources Management Roadmap.

The RAMS will provide data for informed cost management decisions. Such a system will curtail the chronic inability to show cross-system impacts to funding fluctuations of the various training elements.

The cost models from the Aircrew Training Effectiveness Plan and the TDS programs will provide strong building blocks for this system. Integration and expansion of these models, however, will be required to achieve an accurate and comprehensive costing. Particular attention must be paid to the cost contribution of MAJCOM training personnel and field equipment. Additionally, data base networking must be accomplished with the various element management information systems.

Developing a capability to standardize, capture, collate, cross-reference, and access curriculum materials will greatly facilitate the management of materials currency. Key in developing rapid and comprehensive access will be the integration of the single task data base and nonlinear or hypertext organization and manipulation of complex data bases.

The CARS will provide a cost input to round out the RAMS (Fig.10). The lack of funding of the aircrew training effectiveness modeling program and the omission of long-range planning for subsystem developments make this area the most vulnerable to failure.

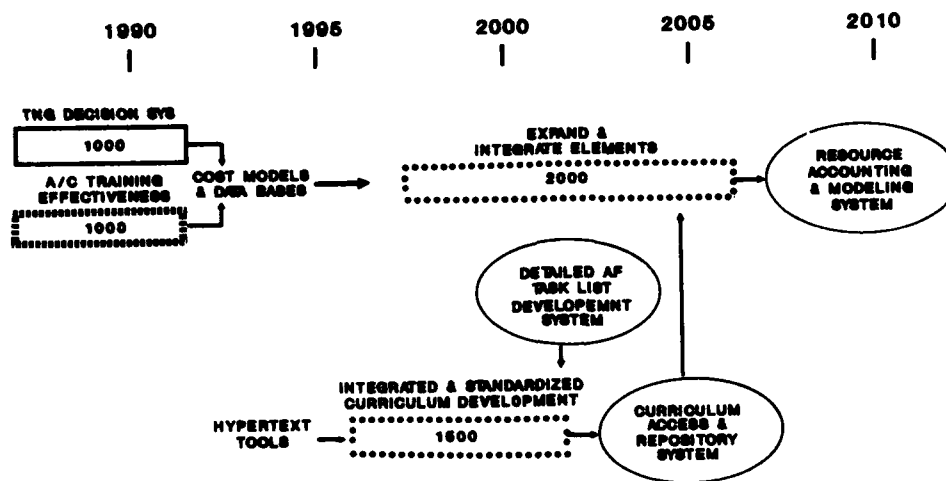


Figure 10. - Resource Systems Roadmap.

VI. SUMMARY

This second volume of the two part study describes a deliberate process of literature reviews and key training manager interviews to discern major developing trends that will affect training management in the next century. The full evolution of the information society, the growing literacy gap of the labor pool, the broader inventory of weapons to support, the expanded role of services contracting, the increased sophistication of weapon systems, and the growing capability of instructional technology will, collectively, revolutionize the training management function as practiced today.

The new training and education capabilities required to effectively manage in this 21st century environment and the capabilities needed to surmount the chronic training management problems identified in Volume I together lead to a requirement for new systems and system capabilities. These systems include an omnibus USAF training management system with requirement, curriculum, student, and resource management subsystems.

An examination of current and planned USAF research activity that is relevant to training management against the system needs reveals several shortfalls in reaching desired system capabilities. Most notable needs are the US Air Force-wide general data base network, a single task list development system, a dynamic job survey system, hierarchical task structure system, an integrated physiological-psychological student selection system, and a total USAF costing system.

The developmental roadmaps detail the pathways to bridge from current research and development to future required capabilities. The management

opportunity and challenge is to persevere over the present parochial orientations, focusing and coordinating development activity toward the future long term needed capabilities. Those managers who are able to accomplish this training function, will position their forces for combat supremacy in the 21st century.

VII. - REFERENCES

1. Advanced Technology. Assessment of New Training Technologies. Prepared for the Air Training Command (USAF). Advanced Technology, Inc., Arlington VA, June 1985.
2. "Air Force Training Management 2010." Statement of Work, Task 57, attachment to letter from Johnson, Vera, 3303rd Contracting Squadron, Air Training Command, to Universal Energy System, Inc., Subj: Request for Proposal, F41689-87-R-A421, 10 August 1987.
3. Armor, D.J., et al. Recruit Aptitudes and Army Job Performance: Setting Enlistment Standards for Infantrymen. Santa Monica CA: RAND Corporation Report No. R2874-MRAL, September 1982.
4. Associated Press. "Illiteracy: America's Economic Time Bomb: Quality of Work Force, Ability to Compete Being Threatened." San Antonio Express-News. 28 February 1988, p. 8-K.
5. Associated Press. "'Dumbing Down' Helps Firms Cope with Illiteracy Problem." San Antonio Express-News. 28 February 1988, p. 8-K.
6. Baker, Ronald C. "Agenda for the Future." The Sixth International Occupational Analysts Workshop. USAF Occupational Measurement Center, Randolph AFB TX, 6-8 May 1987.
7. Bond, David F. "The Possibilities and Pitfalls of Simulation." Air Force Magazine, Vol. 70, No. 12. December 1987, pp. 54-59.
8. Buescher, R., M. Olvera, and L. Besetsny, Eds. Air Force Human Resources Laboratory: Mission and Capabilities. Air Force Human Resources Laboratory, Human Systems Division (AFSC), Brooks AFB, TX, 1987.
9. Canan, James W. "The Software Crisis." Air Force Magazine, Vol. 69, No. 5. May 1986, pp. 46-59.
10. -----, "Electronics for the High Ground." Air Force Magazine, Vol. 69, No 7. July 1986, pp. 45-51.
11. Cetron, Marvin, and Thomas O'Toole. Encounters with the Future: A Forecast of Life into the 21st Century. New York: McGraw-Hill Book Company, 1982.
12. "Civilian Contractor to Assume Duties of Chanute's 3345th CMS." Air Force Times. 14 December 1987, p. 42.

13. Clarke, Arthur C. July 20, 2019: Life in the 21st Century. New York: Macmillan Publishing Company, 1986.
14. Carrington, Tim. "Pentagon Moves to Farm Out Some Medical Services." The Wall Street Journal. 20 January 1988, p. 6.
15. Conklin, Jeff. "Hypertext: An Introduction and Survey." Computer. September 1987, pp. 17-41.
16. "Compact Discs Studied as Information-Storing Tool." Air Force Times. 18 January 1988, p. 16.
17. "Computer to Give Pilots Advance View of Terrain." Air Force Times. 21 September 1987, p. 38.
18. "Computers to Link Commands with Budget Office." Air Force Times. 8 January 1988, p. 17.
19. Coyne, James P. "A Million Pulses Per Second." Air Force Magazine, Vol. 69, No. 7. July 1986, pp. 61-68.
20. Dalton, Pat. "Pilot Retention Rate Drops Below 50% in '87." Air Force Times. 16 November 1987, pp. 1,30.
21. Fulghum, David. "'Big Picture' Increases Pilots' Survival Chances." Air Force Times. 16 November 1987, p. 34.
22. -----. "Construction Begins on First C-17A Transport." Air Force Times. 16 November 1987, pp. 33-34.
23. -----. "New Helmet Could Replace Head-Up Display." Air Force Times. 11 January 1988, pp. 29-30.
24. -----. "Rebuilding Project Restores Life to Damaged F-111s." Air Force Times. 11 January 1988, pp. 29-30.
25. -----. "Fewer New Planes, Longer Life for F-16's Seen." Air Force Times. 29 February 1988, pp. 25, 28.
26. -----. "Future Fighters Duel in New Air Combat Simulator." Air Force Times. 4 April 1988, pp. 29-30.
27. -----. "Joint-Service Team Studying ATF Avionics." Air Force Times. 4 April 1988, pp. 29, 31.
28. -----. "Metal Aircraft Parts Giving Way to Composites." Air Force Times. 11 April 1988, p. 32.

29. Getner, Frank. "Personnel Integration and Manpower, Personnel and Training Integration." Aerospace Systems Division and Human Systems Division MPT Workshop Report by Universal Energy Systems, Inc., Wright-Patterson AFB OH, 15-17 December 1987.
30. Ginovsky, John. "Mechanics to Receive More Hands-On Training." Air Force Times. 21 September 1987, p. 4.
31. -----, "AF's \$4.5 Billion Computer Buy on Track Again." Air Force Times. 11 January 1988, p. 17.
32. -----, "AF of the Future: A Minicomputer on Each Desk." Air Force Times. 18 January 1988, p.6.
33. Human Systems Division, Air Force Systems Command. Annual Report: 1987. Brooks AFB TX, 1987.
34. Irish, Phil. "Training Research Needs." Aerospace Systems Division and Human Systems Division MPT Workshop Report by Universal Energy Systems, Inc., Wright-Patterson AFB OH, 15-17 December 1987.
35. Johnson, J.R., L.A. Damewood, and B. L. Phelps. "Research Plan for Air Force Training Management 2010." Prepared for Deputy, Development Planning; Human Systems Division (AFSC). Universal Energy Systems, Inc., San Antonio TX, 5 October 1987.
36. Johnson, James R., et al. "Current System Description." Vol. 1 of "Air Force Training Management 2010." Prepared for Deputy, Development Planning; Human Systems Division (AFSC). Universal Energy Systems, Inc., San Antonio TX, 25 March 1988.
37. Johnston, William B. and Packer, Arnold E. Workforce 2000: Work and Workers for the Twenty-first Century. Study for the US Department of Labor. Indianapolis: Hudson Institute, June 1987.
38. Kemner-Richardson, S., J.P. Lamos, and A.S. West. Computer-Assisted Instruction: Decision Handbook. Prepared by the Denver Research Institute for the Air Force Human Resources Laboratory (AFSC), Brooks AFB, TX, April 1985 (AFHRL-TR-84-46).
39. Kester, John G. "The Reasons to Draft" in W. Bowman, R. Little, and G.T. Sicilia, Eds., The All-Volunteer Force after a Decade: Retrospect and Prospect. Washington: Pergamon-Brassey's, 1986, pp. 286-315.

40. Maze, Rick. "Senators: Law Needed to Expand Jobs for Women." Air Force Times. 21 March 1988, p. 28.
41. Macomber, Frank. "Health Care for the Year 2000." The Retired Officer, Vol. XLIV, No. 4. April 1988, p. 50.
42. Martin, Edward A. "Future Technology Requirements to Support Manpower, Personnel, & Training (MPT) Design Decisions in the Weapon System Acquisition Process." Aerospace Systems Division and Human Systems Division MPT Workshop Report by Universal Energy Systems, Inc., Wright-Patterson AFB OH, 15-17 December 1987.
43. Mitchell, Constance. "Workers Wanted: A Growing Shortage Of Skilled Craftsmen Troubles Some Firms." The Wall Street Journal. 14 September 1987, pp. 1,8.
44. Naisbitt, John. Megatrends: Ten New Directions Transforming Our Lives. New York: Warner Books, Inc., 1984.
45. Newmark, Robert. "Simulation & Training Technology for the Year 2001." Defense Electronics, Vol. 18, No. 12. December 1986, pp. 69, 71.
46. Otten, Alan L. "Poor Will Find Many Jobs Will Be Out of Reach As Labor Market Shrinks, Demand for Skills Rise." The Wall Street Journal. 27 May 1987. p. 54.
47. "Profile of Tomorrow's New U.S." U.S. News and World Report. 24 November 1986, p. 32.
48. Reed, Fred. "Israelis Win by Not Being Dumb." Air Force Times. 7 September 1987, p. 78.
49. Ruck, Hendrick W. "Occupational Analysis: Past and Future." The Sixth International Occupational Analysts Workshop. USAF Occupational Measurement Center, Randolph AFB TX, 6-8 May 1987.
50. Scribner, Barry L., et al. Are Smart Tankers Better Tankers: AFQT and Military Productivity. Office of Economic and Manpower Analysis, Department of Social Sciences, United Military Academy, West Point NY, 5 December 1984.
51. Shaud, John A. "Shaping Tomorrow's Force Today." Air Force Magazine, Vol. 70, No. 12. December 1987, pp. 48-52.
52. "T-37, T-38 Maintenance Contracted Out at Columbus AFB." Air Force Times. 9 May 1988, p. 36.

53. United States Department of Defense, Office of the Assistant Secretary of Defense for Manpower, Installations, and Logistics. Defense Manpower Quality: Report to the House and Senate Committees on Armed Services. Vol. 1. Washington DC, GPO, May 1985.
54. Vitola, Nancy G. "Development Planning - HSD." Briefing to Commanders Meeting, San Antonio TX, 23-24 July 1987.

APPENDIX B - ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFHRL	Air Force Human Resources Laboratory
AFSC	Air Force Systems Command
AFTIMS	Air Force Training Information Management System
AJPMS	Advanced Job Performance Measurement System
AOTS	Advanced On-the-Job Training System
APASS	Advanced Personnel Aptitude Selection System
ATF	Advanced Tactical Fighter
ATS	Advanced Training System/Aircrew Training Systems
AT&T	American Telephone & Telegraph Company
BAT	Basic Attributes Test
BJS	Basic Job Skills
CAI	Computer-Assisted Instruction
CARS	Curriculum Access and Repository System
CB	Chemical-Biological
CBI	Computer Based Instruction
CBPO	Consolidated Base Personnel Office
CBS	Columbia Broadcasting System, Inc.
CBT	Computer Based Training
CBW	Chemical-Biological Warfare
CMAS	Computer-Based Maintenance Aids System
CMI	Computer-Managed Instruction
DOD	Department of Defense
ECM	Electronic Countermeasures
FTD	Field Training Detachment
FUS	Field Utilization Subsystem
GSM	Ground Station Mobile
GWEN	Ground Wave Emergency Network
HSD	Human Systems Division, Air Force Systems Command
HTSDS	Hierarchical Task Structure Development System
ICAI	Intelligent Computer-Assisted Instruction
IBM	International Business Machines
IMIS	Integrated Maintenance Information System
IOC	Initial Operational Capability
ISS	Instructional Support System
JPM	Job Performance Measurement
JSTARS	Joint Surveillance Target Attack Radar System
JTIDS	Joint Tactical Information Distribution System
LAMP	Learning Abilities Measurement Program
MAJCOM	Major Command
MATS	Model Aircrew Training System
MIS	Management Information System
MMTR	Military Manpower Training Report
MPT	Manpower Personnel and Training
NATO	North Atlantic Treaty Organization
O&M	Operations and Maintenance
OJT	On-the-Job Training
ORDB	Occupational Research Data Base
PCMAS	Portable Computer-Based Maintenance Aids System

PJM	Person-Job Match
RCA	Radio Corporation of America
R&D	Research and Development
RAMS	Resource Accounting and Modeling System
RCDS	Rapid Curriculum Development System
RCS	Resource and Cost Subsystem
RIM	Recruiting Impact Model
RIMS	Requirement Information Management System
ROTC	Reserve Officers Training Corps
RQTS	Requirements
SACDIN	Strategic Air Command Digital Information Network
SIMS	Student Information Management System
SUMMA	Small Unit Maintenance Manpower Analyses
TCS	Task Characteristics Subsystem
TDS	Training Decision System
TDY	Temporary Duty
TIES	Task Identification and Evaluation System
TLDS	Task List Development System
TMS	Training Management System
TNG	Training
TO	Technical Order
TRIMS	Training Resources Information Management System
TSAC	Training Setting Allocation Component
TTIM	Technical Training Impact Model
TTM	Task Training Modules
UES	Universal Energy Systems, Inc.
UFT	Undergraduate Flying Training
USAF	United States Air Force
US	United States

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