APPENDIX

Statement by Congressman Ike Skelton, October 1, 1997, Congressional Record-House, (H8269-H8271)

MANPRINT for the U.S. Army

(Mr. SKELTON asked and was given permission to address the House for 1 minute.)

Mr. SKELTON. Mr. Speaker, today, it is my pleasure to share with my colleagues a good news story, one about our Nation's military and, in particular, our Army. It involves a materiel acquisition program first developed in the 1980's for Army soldiers. It is called MANPRINT, which stands for manpower and personnel integration.

The MANPRINT program objective is to improve the performance of Army weapons and equipment through a man-machine total systems approach. That is, MANPRINT focuses on the interrelationship of the soldier and his or her weapon or equipment and the human requirements for maximizing system performance. In a nutshell, it does not make any difference if there is a tank that is capable of firing 10 rounds per minute if its crew can only operate it at three rounds per minute. Regardless of its technical capabilities, the tank is a three-round-per-minute tank due to the human factors that limit its output. This is the kind of problem MANPRINT addresses.

MANPRINT is an umbrella term that refers to seven disciplines that are critical to optimizing the man-machine, total-system approach. They are manpower, personnel, training, human factors engineering, system safety, health hazards, and soldier survivability. The central idea is to integrate considerations of these domains continuously into the acquisition process.

Thanks to MANPRINT the Army now has a vastly increased confidence that its new systems will perform as expected in the hands of its soldiers-and, at the same time, save lives and dollars. As I will explain later, MANPRINT has, in fact, already saved hundreds of soldiers' lives and billions of dollars. It has returned thousands of percent on a trickle of investment dollars. It is, or should be, a governmental downsizer's dream come true. Moreover, in this day of increased reliance on technology, we are only beginning to explore the ramifications the Army's concept could have for our entire society.

There is an element of urgency associated with this Army program, however, and the very real danger that we could repeat mistakes of the past—the type where U.S. inventors or progressive thinkers create great ideas which we fail to appreciate and implement. Instead, other countries capitalize on them. You will recall the Dr. W. Edward Deming's ideas on quality were ignored in this country in the 1950's and then successfully adopted by the Japanese. We may be on the verge of committing such a mistake with the Army's MANPRINT program. The Army resources devoted to MANPRINT have been continually slashed during the drawdown. At the same time, the United Kingdom has picked up on the U.S. Army's idea and is already in the process of implementing it throughout all services in the royal force. Moreover, as the Japanese recognized, Deming's quality ideas applied to all technology, not just defense. Not surprisingly, the British are starting MANPRINT programs in the Departments of Trade and Industry as well.

In order to reduce the likelihood of our making the same error with MANPRINT as we did with Deming's quality management, I want to make sure my colleagues are familiar with this highly successful soldier-oriented concept for the design, development, manufacturing, and fielding of the Army's newest weapon's systems.

Handbook of Human Systems Integration, Edited by Harold R. Booher.
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ARMY ACQUISITION PROGRAMS LED TO ADOPTION OF MANPRINT

I am sure that many of you recall the manpower and readiness problems that plagued the Army force modernization program in the early 1980's. It seemed that whenever a new system was put into the hands of the soldier, actual field performance often failed to match the standards predicted during its development. The Stinger anti-aircraft missile, for example, was designed to hit incoming aircraft better than 6 percent of the time. But if it had been placed in service as originally designed, it would actually have achieved hits only 30 percent of the time when operated by soldiers in combat units. The Stinger's problems were eventually corrected. But the problems of soldier utilization were so great in the Division Air Defense Gun, known as the DIVAD or Sergeant York, that the program had to be canceled. In the case of the Dragon antitank missile, that soldier's nightmare is still in the Army's inventory.

In addition to unacceptable performance from new systems, the Army experienced problems in crew performance. When the Army replaced an existing system with a newer, more technologically complex system, the newer system often generated requirements for soldiers of a higher level of skill and for more soldiers per system. The Army personnel system simply could not provide enough soldiers of the caliber required to operate and maintain such sophisticated systems.

The Army's first study on what to do about the disappointing performance and unaffordable manpower costs of new weapons systems and equipment was conducted by retired Generals Walter T. Kerwin and George S. Blanchard in 1980. In examining the Army's concerns about the mobilization, readiness and sustainability of new systems, the report concluded that it was primarily a lack of consideration of the human in the system that was causing the problem. Human performance assessments either were not done or were too late to influence weapons design. Supporting the Kerwin and Blanchard findings, the General Accounting Office [GAO] published reports in 1981 and 1985 attributing 50 percent of equipment failures to human error. GAO, too, stressed the need for integrating into the acquisition process human disciplines, such as, in particular, manpower, personnel and training needs.

The recommendations for a new soldier-oriented approach to systems acquisition were taken very seriously in the mid-1980's. With the full support of the entire Army leadership, military and civilian, Gen. Maxwell Thurman, as the Vice Chief of Staff, directed that an entirely new approach to systems acquisition be adopted by the Army, one which required that systems fit the soldiers rather than that the soldier—through selection or training—fit the systems.

This new concept also affected industry because, as we all know, defense contractors actually design and develop Army systems. In the mid-eighties, the concept required a radical change in the way contractors did business. To successfully compete in the new Army acquisition process, industry had to focus on the human element and design systems that fit soldier's needs and capabilities. In the MANPRINT process, human parameters are specified in the same manner as any other component of the system. System performance is measured with the humans quantitative performance included as an inherent part of the total system performance. No longer could performance in the laboratory be extrapolated as satisfying the requirements of performance in the field.

The MANPRINT philosophy and examples of the array of concepts inherent in MANPRINT are documented in a book, 'MANPRINT: An Approach to Systems Integration' (Van Nostrand Reinhold, 1990), edited by Dr. Harold R. Booher, who was the first senior Army civilian official appointed to direct the Army's MANPRINT program.

COMANCHE AND MANPRINT

Nowhere has the new soldier-oriented partnership between Government and industry been more visible than on the Army's Light Helicopter Experimental [LHX] program. Better known to us today as the Comanche, the LHX in 1986 was the Army's true experimental program, testing where it was possible to introduce cutting-edge technology into its inventory without running headlong into the problems of unsatisfactory performance and runaway personnel costs. Even opponents of Comanche cannot ignore the great advances achieved in this

program beyond the standard of normal acquisition practices.

Perhaps the first indication that MANPRINT was not only viable but could revolutionize the military's procurement process was the successful development of the Comanche's T-800 engine. The MANPRINT approach fostered hundreds of design improvements affecting both maintenance and reliability. In one striking example, the tool kit for the organization mechanic was reduced from 134 tools to only 6. The trunk-sized caster tool kit used on other helicopters was reduced to a canvass pouch half the size of a rolled-up newspaper. Furthermore, this reduction cost Government and industry nothing and will save taxpayer dollars.

For the Comanche itself, MANPRINT resulted in more than 500 design improvements in system performance and logistics. The cockpit was designed outward, from the pilot seat, using simulations and modeling, lessons learned from previous aircraft programs, and user inputs. In addition, when fielded, the Comanche would allow the aircrew to select what information is needed during missions. The result is an anticipated system with a much improved pilot-crew workload. A typical performance benefit is illustrated in the reduced number of steps it takes for the pilot to acquire a target. The OH-58D Kiowa Warrior required 34; the Comanche, 5.

Incorporation of MANPRINT considerations during Comanche development also introduced entirely new concepts to the acquisition process. The source selection competition included MANPRINT in all evaluation areas. It became impossible for a company to win the contract without a plan to integrate MANPRINT in the design, development, and manufacture of Comanche. In addition, seasoned maintenance personnel and other soldiers with field experience in operational units were assigned to the contractor's plant as representatives of the users in the operating commands. These soldiers were invaluable in fitting the machine to the operator. For example, they completed a rotor design change in 30 days that would otherwise have taken 12 months to achieve contractor-Government approval.

MANPRINT was also responsible for technological advances. To provide for easy maintenance to aircraft components, Comanche was built around a box-like, load-bearing keel. In most helicopters, the load is carried by the external skin. In Comanche, the load-bearing keel made it possible to locate easy-access panels almost anywhere on the aircraft. Consequently, maintenance personnel can easily reach all of the internal components. In this case, a maintenance requirement drove the technological design, which in turn resulted in an aerodynamic improvement.

In another instance MANPRINT and transport considerations suggested the need for an improved rotor blade removal capability. The contractor design team already had a rotor blade design which met Government specifications and was concerned about the added expense. Nevertheless, because of soldier concerns, MANPRINT prevailed. A new blade was designed at a cost of approximately $60,000. Life cycle cost calculations have indicated that the new blade will remain easier to manufacture and should save approximately $150 million in personnel, maintenance, and transport costs from the original design.

From the outset soldier safety has been a major design objective. Safety experts studied more than two decades of helicopters accident reports to determine how the designers could make Comanche a safer aircraft. As a result of their efforts, the Comanche's safety-related design features are projected—when compared to other helicopters such as the OH-58 Kiowa and AH-1F Cobra—to save 91 soldiers lives and avoid at least 116 disabling injuries.

A 1995 report by the Analytic Sciences Corp: Minninger, et al: documents the performance improvements and savings on Comanche attributable to MANPRINT. The report found Comanche cost avoidance in manpower, personnel, training, and safety to be a whopping $3.29 billion. This return resulted from a design investment of approximately 4 percent of the Comanche R&D budget. Calculated as a return on design investment, MANPRINT in the Comanche program yielded over an 8,000-percent return. Moreover, if the costs of the remaining MANPRINT disciplines—health hazards and soldiers survivability—are included in the calculation, the return on investment for the entire program remains well over 4000 percent.

MANPRINT APPLIED TO OTHER ARMY SYSTEMS

MANPRINT is not only limited to new or major acquisition systems. It works with systems already in the inventory as well. In 1994, McDonnell Douglas conducted a study covering

4 years of MANPRINT design improvements on Longbow Apache. More than 80 MANPRINT problems, issues, and concerns were identified and resolved. Each of them yielded an improvement either for the operator or the maintainer of the aircraft. Once again, improved human performance proved cost effective. From a $2.7 million investment, a return in manpower and safety costs reached $268 million, approximately a 2,000-percent return on investment.

The Fox vehicle modification is an illustrative example of MANPRINT's contribution to smaller, less visible acquisition programs. The Army uses the Fox—a mobile sensing module built into an eight-wheeled armored vehicle—as a nuclear, biological, and chemical reconnaissance system for identifying contaminated areas. In a recent system improvement project, the Army wanted to reduce the crew from four soldiers to three. But operational evaluators labeled the vehicle, when operated by three soldiers, 'unsuitable and ineffective.' The program appeared doomed because it was out of money and time. But MANPRINT experts, using two different types of integration models, redesigned the Fox and it was subsequently shown to be fully effective in its projected missions. The MANPRINT effort cost $60,000 and was completed in a short time; additional operational testing was avoided and the Army saved $2 to $4 million from projected program costs while removing on crew member requirement from each vehicle.

MANPRINT VIABILITY TODAY

A recent Army Audit Agency [AAA] report evaluated how the Army, after its radical downsizing, is 'incorporating MANPRINT into weapon systems development.' The good news is that nine Army weapons systems were evaluated and all but one were considered to have incorporated MANPRINT adequately. Based on the AAA's audit assessment, the Army can expect positive MANPRINT results in such current programs as Land Warrior, Javelin, and Extended Range Multiple Launch Rocket System. The Command and Control Vehicle program and several nondevelopmental programs examined by AAA, including the Embedded Global Positioning System/Inertial Navigation System, also include good MANPRINT initiatives. Because of MANPRINT, the Army can have increased confidence in many of the systems it will be fielding in the not-too-distant future.

The Army cannot rest on its laurels, however. Several developments cloud the future of MANPRINT.

First, the AAA report noted that not all systems under development have incorporated MANPRINT. The now-canceled Armored Gun System is an example in the recent past of a program in which MANPRINT considerations were purposely rejected. It is not a coincidence that the Army canceled the program.

Second, the new DOD acquisition system may make it easier to omit MANPRINT from programs. The new system rightly attempts to give program managers more latitude by removing regulations that previously proved too restrictive. But this new-found freedom in itself may make it more difficult in the future to ensure an appropriate incorporation of MANPRINT. It would be very unfortunate if an unintended consequence of streamlining the acquisition process proved to be a reduced emphasis on MANPRINT.

That need not be the case, as the AAA report points out. The new acquisition system, if approached correctly, affords the opportunity for greater integration of people-oriented concerns into the acquisition process. If the 'unbound' program managers appreciate the value of optimizing the man-machine interface, they are free under the new system to tailor their programs to incorporate people-oriented considerations. Consequently, a major effort is needed to adapt MANPRINT to the new acquisition process.

A third concern is the erosion of the MANPRINT program in recent years as the Army has experienced the drawdown. The Army made a commitment to understand and incorporate the features that optimize man-machine performance in the mid-1980's but until recently has been in danger of returning to old ways. MANPRINT personnel have been reduced 55 percent while the active Army has come down approximately 37 percent. The AAA audit report concluded that the Army's training process, which started out so well in 1986, is now inadequate. Career paths no longer identify MANPRINT as important. Nor does MANPRINT always play as prominent a role in source selection as in some programs, such as Comanche. Finally, the technology resources devoted to the research and development needed to advance the state of the art for quantitative

tradeoffs of manpower, personnel skills, and training have shrunk significantly.

Fortunately, thanks to the AAA audit report, Army leadership has been reminded that MANPRINT is a golden nugget and seems determined that it must be revitalized. A panel of senior officers has been working for several months to ensure that the wounds inflicted on the program by the drawdown are not fatal and that MANPRINT recovers its health.

In closing I want to congratulate the Army for developing MANPRINT and for continuing to support the program in a time of very scarce resources.

I also want to suggest that the Army's approach to systems integration is relevant to the other military departments, to the entire Department of Defense, and probably to the remainder of the Government. Acquisition reform seeks to advance technology while holding down procurement costs. Downsizing seeks to ensure essential Government functions are accomplished with a minimum of staff. MANPRINT can be an essential ingredient in both initiatives. With respect to the military, it ensures that the weapons and equipment supporting a reduced force structure will perform as expected on the battlefield.

But the possible applications for MANPRINT go far beyond the military in our constantly evolving technological-based society. Our regulatory agencies like the Federal Aviation Agency, the Nuclear Regulatory Commission, the Food and Drug Administration should push this concept to the forefront with the systems and equipment they regulate. Also it would seem our medical and educational systems could benefit from a technological development and management process which focuses on the end user. One may wonder what a difference it would make it these systems were made to operate primarily for the doctor and the patient or the teacher and the learner rather than fitting these individuals to the system as an afterthought. We have not been in such an enviable position to take advantage of a technological cultural change since Deming's total quality management. Let's not miss our opportunity this time around.