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TURKEY AND THE GULF WAR

A Checklist for the Future

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SUMMER
1993

AIR FORCE JOURNAL ^{of} LOGISTICS

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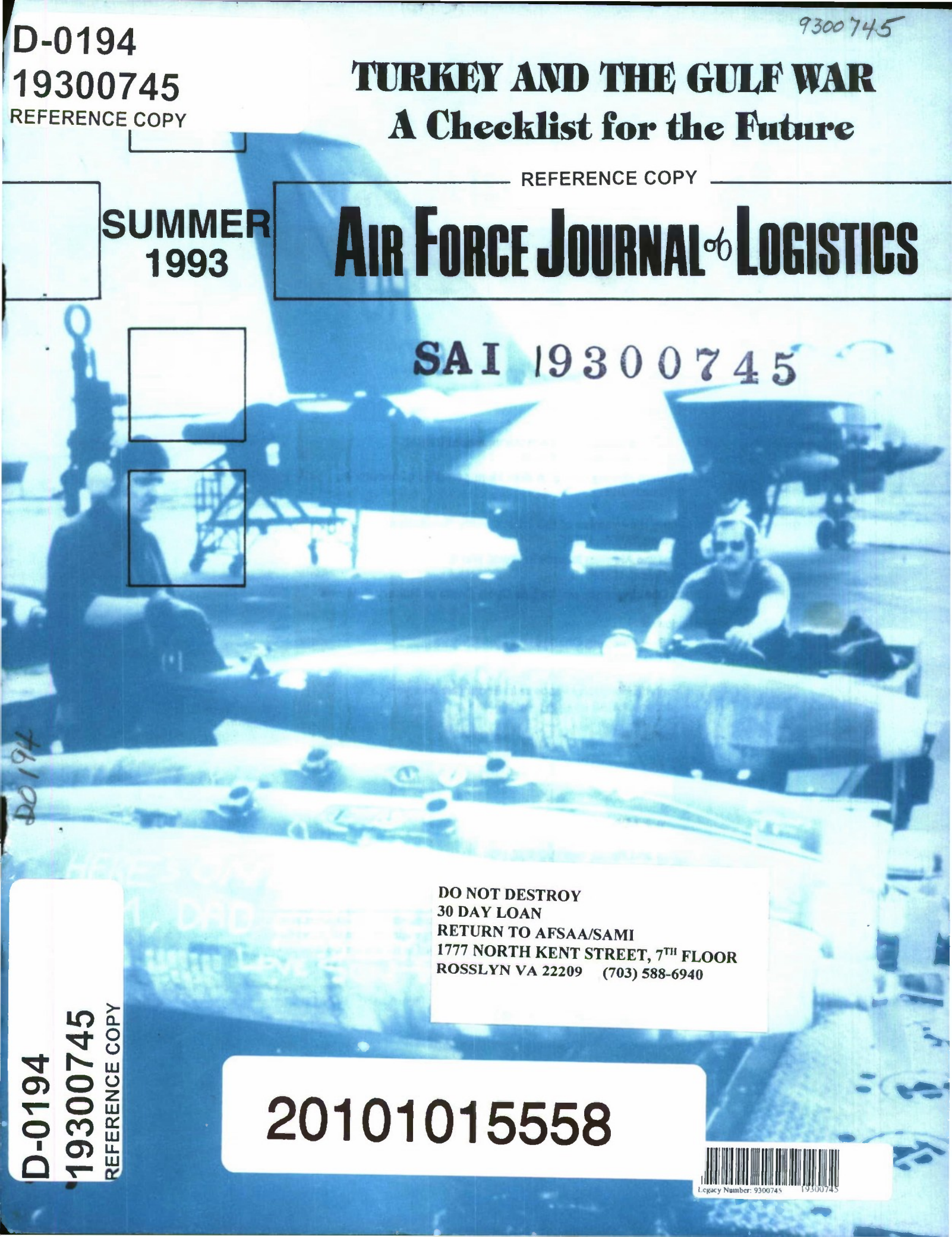
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FRONT COVER: Troops load bombs at Incirlik AB, Turkey, during Operation Desert Storm (photo courtesy of 2CTCS, Norton AFB, California).

BACK COVER: Iraqi POWs (photos courtesy of the U.S. Air Force and Lance Corporal David F. Alexander, USMCR).

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Captain Foote supervised the Logistics Readiness Center at Incirlik AB, Turkey, during the planning, formation, and operation of the 7440th Composite Wing (Provisional) in Operation Desert Storm. This composite wing was composed of more than 100 dissimilar fighter and combat aircraft which conducted a "backdoor" northern air campaign against Iraq. His office received the Air Force Outstanding Logistics Plans and Programs Unit Award, 1991.

Planning Reception, Beddown, and Support of Contingency Operations

SAI 9300745

Captain Wayne C. Foote, USAF

Introduction

Rather than recount an exact succession of events and actions encountered at Incirlik AB during Operations Desert Shield, Desert Storm, and Provide Comfort, my purpose in writing this article is to share some of the planning processes, in the form of checklists, which contributed to the successful operation of the 7440th Composite Wing during Operation Desert Storm. While it would be naive to assume another contingency will occur in which we will see an exact replay of Desert Storm, I believe these planning factors are applicable to a wide variety of contingency operations and will assist the logistics planner in formulating realistic and flexible war plans.

Projected Beddown

The primary planning factors which will affect initial logistics planning are the total number and type of aircraft deploying, the number of people deploying in support of the aircraft, and the required timetable of deployment. All of this information can be obtained from the time-phased force and deployment data (TPFDD) if individuals have access to a worldwide military command and control system (WWMCCS) terminal. An inability to access the TPFDD will hinder planning efforts since the TPFDD is in a constant state of flux during a contingency operation. In October 1990, we received a number of unexpected classified messages and phone calls from individual units, giving us the impression that half the Air Force was planning to bed down at Incirlik. The TPFDD allows one to retain a grasp on reality while the scenario firms up. Following is the peak beddown we encountered (remember that this does not include the airlift aircraft which were continuously arriving and departing):

Aircraft Type	Quantity
F-16	24
F-111	18
EF-111	6
F-15	24
F-4G/F-16	24
RF-4E	4
EC-130	3
MH-53J	5
MC/AC/HC-130	9
KC-135	12
E-3A/B	3
C-130	6
Total	138

Preparing for Desert Storm

At this point, we have a scenario and a projected beddown. However, rather than immediately rush into the mechanics of one-dimensional logistics support planning, it was extremely beneficial to identify contingency variables which might affect logistics planning. Each of the following factors was actually considered in preparation for Operation Desert Storm:

(1) Operational Scenarios

- Compressed scenario
- Noncombatant evacuation operation (NEO) delay
- Covert preparation
- Loss of local national workforce
- Activation of one or more collocated operating bases (COB)
- Terrorism
 - On-base
 - Off-base
- Chemical warfare
- Aircraft/SCUD attack
- Prolonged operations

It is certainly possible to "scenario" oneself to death, but a realistic appraisal of possible contingency variables can help prevent last-minute crisis management reactions which may hinder mission accomplishment. As an example, although the local national workforce ultimately stayed on the job during the war, we had already sent a message to HQ USAFE identifying job specialties which would require augmentation if individuals walked off the job. In the same way, a reserve of vehicles and equipment was retained in case one or more COBs were activated. This turned out to be prudent planning since one COB was activated in the midst of the war. Additionally, although the tempo of modern war has proven increasingly rapid, assuming a quick victory could jeopardize logistics support if the conflict degraded into factional or guerrilla warfare. Since the base logistics planner does not have the luxury of choosing the type of conflict that must be supported, it is prudent to plan on prolonged operations. As an example, Operation Provide Comfort was initially announced as a one-week humanitarian operation, but it took on a life of its own and continued for months.

(2) Augmentation Required

- Identify functional areas requiring special attention
 - Communications
 - Fire protection
 - Maintenance
 - Prime BEEF
 - Security Police
 - Services
 - Supply/fuels
 - Transportation
- Ask key questions
 - Will local nationals stay on the job?
 - If NEO occurs, what slots will be vacated by dependent spouses?
 - What augmentation is required if one or more COBs are activated?
 - When will augmentation arrive?

If a large-scale force beddown is contemplated, many base functions will be overwhelmed by the 24-hour workload, especially if large numbers of local nationals are employed who work limited overtime hours. In this case, augmentation will be mandatory. The sooner augmentation requirements can be determined and entered into the TPFDD, the sooner they will be received. Even then, they may trail the projected force beddown. The good news in this equation is that work-arounds can be found until augmentation arrives. We discovered base personnel were capable of accomplishing more work output than we ever contemplated. Airmen were given cross-discipline tasks by necessity and performed in an outstanding manner. As an example, accounting and finance personnel excelled in building aircraft tanks with a minimum of training.

(3) Billeting

- Estimate number of deploying personnel (add buffer)
- Estimate available billets
 - Visiting Officers' Quarters (VOQ)
 - Visiting Airmen Quarters (VAQ)
 - Temporary Lodging Facilities (TLF)
- Identify opportunities to increase available billets
 - Dorm surge
 - Tent city construction
 - Use of non-US controlled facilities
- Identify emergency billets
 - Gyms
 - Nonessential facilities
 - Buildings near completion
- Identify facilities available if NEO authorized
 - Schools
 - Military housing

Once contingency variables and augmentation requirements have been considered, base preparation activities should begin. A large influx of deploying personnel will soon overwhelm existing transient billeting. The challenge is to identify additional space within the constraints of contingency variables. The easy answer for billeting would have been to use base housing for deployed personnel. However, we faced a situation where the liability incurred by the government for potential damage/loss of personal property without an official declaration of war would have been enormous, so we decided to use other billeting alternatives. The next obvious alternative is off-base housing. In our case, the threat of terrorism made this alternative undesirable. This left the alternative of creating billeting by

either converting other facilities or building a tent city. In the short term, many facilities can be converted for use as billeting; but sustained operations will require gyms and other facilities to support the morale of both the assigned and deployed personnel. We chose to use gyms and schools temporarily until a tent city could be built for deployed personnel. Be advised that deployed personnel will strongly object to being moved from "hard" facilities to a tent city environment.

(4) Messing

- Estimate number of deploying personnel (add buffer)
- Determine deployment status
 - Field conditions vs per diem
- Identify messing facilities/meal capability
 - Augmentation with kitchen tents
- Identify messing concept
- Source Meals-Ready-to-Eat (MRE) shortfalls

We anticipated far more difficulty in feeding deployed personnel than actually encountered. Early assumptions were made that per diem would not be paid for deployed personnel—that was wrong. As a result, only a small percentage of deployed personnel actually used the kitchen tents. Most personnel chose to eat at various base concessions or even have the ubiquitous kebab delivered by enterprising local nationals. Nevertheless, a different set of circumstances would have required all of the feeding facilities.

(5) Civil Engineering

- Site tent city
 - Preferably near sources of potable water and power
- Source housekeeping assets
- Prepare tent city site
- Construct tent structures/latrines/showers
- Identify facilities requiring backup power
- Identify facilities for deploying units
- Construct berms for fuel bladders (if deemed necessary)
- Source/position rapid runway repair (RRR) assets

Unexpected problems were encountered in constructing a tent city. In our case, we had sufficient time to produce a site plan; but we were restricted from "overt" base preparation efforts (including actually building our tent city) prior to Turkish Government approval to use Incirlik AB for hostile action. This approval process lasted for weeks and halted construction efforts. As a work-around, all necessary materials were contracted and wooden tent frames were constructed off-site to minimize construction lead time. Based on this experience, an off-the-shelf tent city site plan would be an advantage in responding to a fast-moving contingency operation. Despite likely time constraints, civil engineering should not skimp on tent city site preparation. Significant rainfall can turn an unprepared site into a morass and render it unfit for occupation.

(6) Maintenance

- Determine aircraft turnaround times by type
- Develop aircraft parking plan
 - "Double-stuffed" hardened aircraft shelters
 - Ramp space for airlift
- Assign squadron operations center (SOC) locations
- Prepare aerospace ground equipment (AGE)
- Exercise mass launch/recovery/quick turn operations
- Preposition aircraft tanks/munitions/AGE

The aircraft parking plan which aircraft maintenance planners devised for the composite wing beddown differed significantly from our off-the-shelf plans. Due to the variance in aircraft turn times, configured ordnance, and operational tactics, it is wise to examine the effectiveness of multiple parking plans. We went through several planning iterations as we discovered more efficient parking configurations. One difficulty we faced in developing the parking plan was simply finding room to park all of the deploying aircraft in conjunction with allowing space for the flow of airlift aircraft since the number of aircraft which deployed exceeded all previous planning factors. Double-stuffing hardened aircraft shelters proved a necessary evil since insufficient parking space was available. The large number of aircraft in operation requires a large amount of AGE which must be prepared and positioned ahead of time. One difficulty that must be resolved prior to reception of forces is that deploying units tend to assume on-hand AGE will automatically be assigned to their unit; consequently, they do not deploy their own equipment. It is essential to apportion available resources and communicate these constraints to deploying units so they can add to the TPFDD as necessary. As soon as forces have arrived, exercise of mass launch operations is essential to hone a cohesive force prior to hostilities. Even if an already integrated composite wing is deployed, the supporting base must still obtain training in working with the newly arrived forces.

(7) Munitions

- Determine required on-hand quantities
 - Bombs, fins, fuses, chaff, flares, etc.
 - Source shortfalls
- Obtain munitions FRAG order
- Calculate projected munitions consumption
- Prepare munitions replenishment plan
 - Necessary country clearances
- Verify adequacy of munitions support equipment
- Prepare munitions delivery procedures
- Initiate munitions buildup

This is an area which was less visible. Based on various conversations, the biggest difficulty encountered in the munitions area was receiving a firm FRAG order. Expect significant FRAG order variability early in a contingency operation.

(8) Security

- Increase base perimeter security
- Restrict base access
- Place concrete revetments/barriers/concertina wire
- Restrict flight-line access
- Perform base tonedown/camouflage
- Prepare for base blackout
- Increase communications security (especially land mobile radio use)
- Perform antiterrorism measures
- Selectively arm personnel

The two most significant threats identified against Incirlik AB were SCUD missiles and terrorism. To counter the SCUD threat, Patriot missile batteries were deployed. However, defending against terrorism required far more comprehensive planning since it presents a diverse threat against both personnel and property within and beyond the base's fenced boundaries. To assist in planning, we considered some examples of terrorist threats: (1) the JP-4 pipeline which supplied the base could be interdicted, (2) several hundred military personnel and civilians

living in downtown Adana could be targeted since they were easily identifiable as Americans, and (3) the base was within one mile of a toll road under construction which overlooked the flight line and could be used to mount a mortar attack. While no direct attacks occurred on the base, terrorism was not an idle threat since two American Nationals were killed and one officer was wounded in the Republic of Turkey during the war. At one point, off-base travel was restricted and military members living in the city of Adana were moved on base to reduce their exposure to danger. In future contingency operations, terrorism may pose an even greater danger to base operations since there will be a high benefit-cost ratio that favors poorly equipped adversaries mounting unconventional warfare operations.

(9) Supply

- Estimate aircraft tank requirements and initiate buildup
- Initiate 100% bench stock fill
- Upgrade fill priorities
- Identify unclassified/classified readiness spares package (RSP)* storage locations
- Order additional quantities of high-use items
- Order special items
- Fill all chemical warfare equipment (CWE) shortages

The supply function will succeed or fail based on its willingness to "get the jump" on projected requirements. During Desert Shield, large quantities of parts were ordered and received based on the projected Desert Storm beddown. Since our participation in the war was contingent upon Turkish Government approval, the Chief of Supply no doubt experienced some sleepless nights contemplating what would happen if the Host Nation disapproved our involvement.

(10) Fuels/Fluids

- Estimate increased fluid consumption rates
- Determine maximum fluid storage capacity
 - JP-4
 - Motor gasoline (MOGAS)
 - Cryogenics
 - Hydrazine
 - Demineralized water
- Identify/source containers for fluid shortfalls
- Top off all storage tanks
- Schedule increased fluid production/deliveries
- Prepare refueling plan based on projected sortie rate
- Practice hot-pit refueling
- Alternate resupply plan if JP-4 pipeline interdicted

Due to the massive projected beddown of aircraft at Incirlik, apocalyptic fuel consumption projections were generated which actually exceeded the known pumping capability of the JP-4 resupply pipeline. Thankfully, our fuels personnel discovered that a significantly higher flow rate could be achieved than was identified in our Operation Plans (OPlans). Nevertheless, consumption exceeded resupply during the first week of the war—which emphasizes the importance of topping off all fluid storage tanks early in the contingency operation. Additionally, an alternative fuel resupply plan was devised in the event enemy forces successfully destroyed our fuel pipeline.

* Formerly war readiness spares kit

Getting Ready



for Combat

(Photos Courtesy of 39 TACG, Incirlik AB, Turkey, and 2CTCS, Norton AFB, California.)



(11) Transportation

- Fill bench stock to 100%
- Identify/source vehicle shortages
- Hire additional local nationals if necessary
- Eliminate vehicle deadlined for parts/maintenance (VDP/VDM) backlog
- Prepare war reserve materiel (WRM) fleet
- Review/practice vehicle decontamination plan
- Allocate vehicles to deploying units
- Implement WRM vehicle dispersal plan
- Prepare munitions shipment reception plan

Our transportation personnel performed an outstanding job distributing massive quantities of materiel from the air terminal during the deployment of forces despite the lack of pallet identification. Unfortunately, the outwardly simple responsibility of vehicle allocation was a continual headache throughout Desert Storm. Deploying unit personnel chose not to use the mass transportation options available, and many personnel spent inordinate effort documenting bizarre rationale which justified their overwhelming need for personal transport. Vehicles were "appropriated" from off the flight line by other units, daily vehicle inspections were not performed, and a large number of minor vehicle accidents occurred which were not reported. The best solution to these problems is to confiscate abused vehicles and enforce one simple vehicle allocation standard. Also, try to minimize movement of forklifts by using flatbed trucks to transport materiel around base. Our failure rate increased in direct proportion to the number of miles the forklifts were driven.

(12) Base Actions

- Emphasize current powers of attorney/wills
- Identify deploying personnel equipment requirements
- Restrict Space "A" travel to base
- Halt concurrent travel
- Cancel leaves
- Practice recalls
- Rigorously exercise base capabilities
- Exercise alarms and broadcasting notification system
- Establish 24-hour operation schedules
- Activate 24-hour work center operations

There are a number of actions the base can initiate to reduce confusion prior to the initiation of the contingency operation. Halting concurrent travel and elimination of space-available travel to a location will reduce the number of people who may require future evacuation and create billeting vacancies. If travel is not restricted, a significant percentage of personnel will ignore news reports and continue to travel to the location based on the assumption that "things will work out." Cancellation of ordinary leave will reduce the number of augmentees required and consequently minimize orientation requirements. Ranking above all of the other base actions, rigorously exercising base capabilities will not only prepare the workforce, but will also mentally prepare the base populace. In part, due to our restriction on overt preparation actions, many base personnel exercised a significant amount of denial and lack of personal planning prior to the war. Most personnel lacked both a will and a current power of attorney and could not be motivated to request them until just before the war began. This overwhelmed the legal office unnecessarily.

Problems—Operation Desert Shield/Storm

Desert Shield

- Uncertainty of operation execution
- Overt preparation actions banned
- Leaks and rumors
- Base populace preparation for evacuation
- Deployment authorization delayed
- Augmentation lagged deployment
- No advanced echelon teams deployed
- Slow time-phased force and deployment listing (TPFDL) generation
- Slow munitions FRAG order generation

Significant uncertainty surrounds every contingency operation; however, despite the anxiety that "leaning forward" causes, it is essential to proceed with planning and preparation—provided that one is depending upon official tasking and not on rumor. Planners may suffer from impediments such as our direction to avoid overt preparatory actions; but for every impediment, one or more creative work-arounds can be devised. Leaks and rumors plagued our planning efforts. The best suggestion I can offer is to limit the planning group to a minimum essential number of people (provided that essential specialties are covered). However, an absolute news blackout is not desirable either. The key is to limit unauthorized sources of information and let the commander release information as the situation develops. When advising the commander, keep in mind that if an evacuation is contemplated, noncombatants need time to prepare. Blanket denials discounting even the possibility of an evacuation will only magnify base cynicism since some leaks about base preparation efforts are guaranteed to occur. Additionally, because overt preparation actions were banned, advanced echelon teams were not deployed prior to the deployment of forces. However, if the logistics planners stay in communication with deploying units, if they already have vehicles and equipment allocated and in place, and if they have a plan to rapidly deliver deployed materiel, they can overcome this handicap.

Desert Storm

- Troops deployed without mobility bags
- Significant numbers of pallets not identified
- OPlan assessment inaccuracies
- Some OPlan assumptions invalid
- Personnel support for contingency operations (PERSCO) tracking inadequate
- Redeployment amnesia
- Base facility/asset abuse

Although planners should prepare for a contingency operation by reviewing applicable OPlans, they must be careful to assess the assumptions inherent in those plans. We found that many OPlan assumptions were invalid when applied to our specific contingency scenario. Also, some of the OPlan assessments, such as facility feeding capability and emergency billeting capacity, were overly optimistic. Planners should also be forewarned that PERSCO struggled to maintain an accurate count of deployed forces throughout the war and tended to err by at least 20%. Continual chaos was experienced at the air terminal, and it will require an aggressive team effort to track all deploying and redeploying personnel. When it came time to redeploy, some redeploying units acted as if they were certifiably brain dead. The redeployment operation requires as much planning as the deployment operation because the units will not

(Continued on page 13)

The following article discusses a logistics subject seldom considered by the Air Force—the logistics of supporting prisoners of war. However, with our changing military environment and the constant danger of new war-fighting conflicts, Air Force logisticians may well be involved in POW support in the future.

A Logistics View of Enemy Prisoners of War

William J. Allen

Introduction

What comes to mind when we hear the term Prisoners of War (POWs)? Most likely, it is the picture of captured enemy soldiers held in some large camp encircled by a high barbed-wire fence, with armed US Army troops patrolling its perimeter. That is probably a pretty accurate picture, but how does all that come about? What does it take to support POW operations? As a student of logistics, I am consciously and unconsciously reorienting my thinking in terms of logistics, the system established to create and sustain military capability. (5:1) A logistician's job is to acquire the right resource, in the right amount, in the right configuration, and then get this resource to the right person when and where it is needed. In addition to supporting combat operations, logisticians must also provide support for our POW operations. So what comes to mind now is, How do we support such operations?

Military logisticians rarely express concern for or about the logistics support of POWs. Yet, when political affairs turn into war, there are always POWs, and they must be supported. Countries with high regard for international law, such as the United States, find a sizable logistics support load is created by the Geneva Conventions which form a part of the body of international law. The Conventions dictate certain support requirements for POWs, and almost all of them are logistics responsibilities. But, most logisticians do not think of POWs nor do they include their support in the logistics planning they accomplish.

This article will bring some of the logistics support requirements for POWs to the fore. These support elements will be recognized for the first time by most logisticians, yet they are responsibilities each of us might have to assume under some military circumstances. Also, we should have thought about them even if we have not planned for them.

POWs are expensive! Their support at times involves manpower and materiel resources of significant magnitude, and that support must be planned for and prepared before the actual need arises. Admittedly, Air Force military logisticians will only rarely be involved in the primary care and feeding of POWs; yet, with the changes in modern warfare, who is to say POWs will not or cannot become major responsibilities of Air Force units?

With that in mind, we might now pursue the logistics of supporting POWs. In this article, we will rely principally on US Army documents because they are the predominant directives concerned with this subject. However, we will not refer to Army organizational structure or units because we want Air Force logisticians to understand the problems without being turned away by strange nomenclature or responsibility terms. This article is aimed at broadening education for the Air Force

logistician who possibly may be involved in POW support at some future date.

This article briefly discusses POW planning and provides an overview of POW operations; defines logistics; includes a short history on the treatment of POWs and the Geneva Conventions; provides information on POW logistical support; and provides information on POW operations during the Gulf War. The point I hope to make is the monumental logistical effort we undertake to provide humane treatment for captured enemy soldiers. The focus of this article is to identify the various logistical concerns and issues involved with our care and handling of POWs.

POW Planning

It is important that commanders plan for POW operations. It is equally important that logistics is actively involved in this planning. Logistical support is crucial in the execution of POW operations, for without proper execution of POW operations, enemy prisoners can and will affect our combat capability. POW operations are apt to require a significant commitment of logistical resources. For this reason, logistics must be brought into the planning for, and coordinating of, POW operations. Failure to plan for the possible magnitude of POW operations will, at a later time, lead to unnecessary competition for badly needed and overly committed logistics resources. (3:1)

When we do war planning and examine limiting factors, we must consider the capture of enemy troops and the impact this will have on our resources. Our responsibility for prisoners begins at the moment of their capture. This also begins a series of actions which place demands on our logistical resources—demands which tend to be very resource intensive.

In every war in which the United States has been involved, POW operations have been an afterthought. Planners tend to underestimate capture rates which later results in an unexpected burden on the entire force structure and an adverse effect on combat operations. Under these circumstances, commanders may not be able to maintain the momentum of an attack because they are legally obligated—and held responsible under international law—for the security and accountability of all enemy soldiers their combat forces capture. The evacuation of enemy prisoners requires manpower for guards and perhaps transportation, valuable resources commanders probably will not be able to spare. (3:5-6)

Guarding and transporting enemy prisoners often drain the fighting strength and supplies of combat units at a critical time. Also, the longer enemy prisoners are left in the hands of emotionally charged soldiers engaged in fighting and seeing their fellow soldiers killed or injured, the greater the risk of war crimes being committed. For this reason, the rapid evacuation of captured enemy soldiers out of the combat area is essential.

Logisticians have the immense task to adequately support large-scale POW operations with supplies, medical care, security, facilities, and transportation. (3:6-7)

POW Operations

POW operations involve the control, care, and movement of enemy prisoners. To do this effectively and efficiently requires significant logistics support. Controlling captured enemy soldiers encompasses guarding the prisoners during their transport from the combat area to a rear prison camp, and also at the prison camp itself. Responsibility for prisoners involves providing shelter, food, medical care, clothing, recreation, personal healthcare, sanitation, and religious needs while en route to a prison camp and while interned in a camp. Movement of POWs involves the necessary transportation to carry the prisoners from the front lines to a prison camp at the rear. In some situations, as in World War II, POWs were transported all the way back to the US.

The general responsibility for conducting POW operations falls on the US Army Military Police. The Army has 47 POW units in its total force structure, with 41 of these units National Guard and Army Reserve. (2:15) It is important that POW operations be fully recognized and implemented; if they are not, combat troops will be depleted by being used in POW activities. Thus, when armed conflict is directed, the reserve POW units should be activated and deployed with the combat forces.

The following is a brief overview of POW operations describing the flow of captured enemy troops from the front lines of combat to the rear area:

The process begins with the capture of enemy soldiers by our combat forces. These captured soldiers are now POWs. The theater commander, adhering to the rules of the Geneva Conventions, must move these POWs out of the combat area. This usually requires the capturing unit to escort the POWs to a forward collection point. The prisoners are then escorted by guards to a POW holding area. This area is intended only to hold the prisoners temporarily until they can be transported to the designated POW camps in-theater. At the POW collecting/holding area, the Army Military Police are normally responsible for the control, security, and movement of the prisoners. The POWs are then moved to an in-theater prison compound located at the rear of our forces. The enemy prisoners are interned in the POW compound where a designated US military agency will:

- Receive prisoners and their documents and equipment.
- Provide medical treatment as required.
- Provide bathing facilities if available.
- Provide clothing, food, and water.
- Provide security of the compound and the POWs.

In the past, US troops have had to deal with enemy prisoners numbering in the thousands. During the Gulf War, for instance, the allied coalition captured 71,204 enemy prisoners of war within just a few days. (1:3) This huge number created an immediate problem for logistics people as well as the combat forces. It was fortunate the Gulf War ended so quickly that the number of enemy prisoners did not become a limiting factor in our war-fighting capability. In World War II, the Allies held more than 1 million German, Italian, and Japanese POWs. The POW situation cannot be considered of little consequence to a military force.

Logistics Defined

Logistics is vitally important to the military's ability to support national objectives when called upon to do so. Military logistics is just about everything necessary to support some type of effort. It is the bullets, the bombs, the fuels, the food, the clothing, the transportation, the spare parts, the support equipment, and on and on. In his book, *Moving Mountains*, Lieutenant General William G. Pagonis, who was in charge of all theater logistical operations for the Gulf War, defines logistics as the integration of transportation, supply, warehousing, maintenance, procurement, contracting, and automation into a single function to allow the overall accomplishment of a particular strategy, objective, or mission. (4:214-215) In other words, logistics is that system established to create and sustain military capability. (5:1)

Logistics is a part of a triad with strategy and tactics. Strategy is the plan. Tactics is the power. Logistics is the source of power. It is the resources which permit tactics to be employed to accomplish the goal of strategy. Together, they provide us with our military capability or potential. (5:4) Leaving logistics out of the process can cause combat operations to be severely handicapped or even fail. A frequently cited example of this is that of General George S. Patton during World War II outrunning his supply lines. As a result, his attack on German troops ground to a halt. Logistics considerations were not adequately addressed in his eagerness to continue combat operations.

This lesson can be applied to operational plans of logistical support for POW operations. If we do not have a clear, supportable plan of POW operations, combat operations could become severely impacted or halted as we deal with the control, care, and movement of captured enemy troops. As Lieutenant Colonel H. Paul Mansky writes in his study of the Army's field manual on Enemy Prisoner of War (EPW) Operations (FM 19-40):

What a shame it would be to have to grind to a halt because we failed to plan for the disposition of EPWs. Is that thought any less worthy of consideration than planning for fuel or ammunition? The end results are the same—momentum is lost. (2:13)

Treatment of Prisoners

A prisoner of war is traditionally defined as a member of an armed force who has been captured by the enemy. International law confers a protected status on POWs. Under this status, a prisoner of war is to be treated humanely and is to be detained for no purpose other than to prevent further participation in combat.

The primary rules most countries follow which regulate POW behavior are set forth in the Geneva Conventions of 1949. These conventions resulted in four international treaties designed to lessen the horrors of warfare. These treaties have been ratified in whole or in part by the vast majority of countries of the world, the United States included. These four treaties were signed on 12 August 1949, in Geneva, Switzerland. These treaties concern the protection of civilians in time of war, the treatment of prisoners of war, and the care of the wounded and sick in the armed forces.

The main principle regarding POW rights under international law is that POWs must be treated humanely. It is forbidden to kill or wound enemies who have laid down their arms or surrendered. This has not always been the case. In ancient warfare, opposing armies did not take prisoners. Captured enemies were either killed, forced to join the conquering army, or sold as slaves to relieve the capturing army of their care and feeding. As civilization developed, the need to protect and

provide humane treatment to those affected by the war, whether a participant or not, was recognized. Eventually, countries began to follow laws or rules of war which basically regulated the way combatants and noncombatants were to behave during war. This behavior has evolved with each war.

The United States fully supports and follows the rules of conduct for war as set forth in the Geneva Conventions, and our military commanders actively enforce their provisions. In any conflict involving US forces, safe and humane treatment of war prisoners is provided.

In adhering to the Geneva Convention Treaty for the Treatment of Prisoners of War, the United States, as a capturing power, is responsible for providing proper and humane treatment and accountability of all persons captured, interned, or otherwise held in our custody from the initial moment of capture until final release or repatriation. Under the Geneva Convention Treaty for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field, the US is responsible for searching for and collecting the enemy wounded and sick; protecting them against pillage and ill-treatment; providing adequate medical and dental care; and burying the dead, if applicable. (1:6) With the US active enforcement of these provisions, it becomes readily apparent that logistics support for POW operations is quite a large and important responsibility.

Logistics Support for POWs

Based on projected capture rates, planners must coordinate their logistics support to assure availability of supplies, equipment, and manpower to operate POW camps. They must assure that the prisoners are provided the minimum essentials for periods of short- and long-term internment. The following are items to consider:

- A basic daily food ration sufficient in quantity, quality, and variety appropriate to their culture.
- Clothing and sleeping equipment suitable to the weather conditions and work requirements.
- Hand tools for camp maintenance activities and work projects.
- Housekeeping supplies such as water bags for drinking water, soap for bathing, and personal comfort items.
- Janitorial and cleaning supplies.
- Mess equipment.
- Religious materials.
- Recreation equipment. (1:21)

Borrowing from US Army directives, we can quickly develop the general logistics support for a compound housing just 250 POWs for 30 days. Larger groups or longer periods of holding quickly change these basic support needs. Table 1 reflects basic support needs and Table 2 shows facility needs.

Basic Logistical Support Requirements for 250 POWs for 30 Days

Food C-Rations (Meals-Ready-to-Eat)	250 people, 3 meals x 30	22,500
Field Range	1 per 250 people	
Clothing	First 30 days retain own w/ minor replacement	
* Drinking Water	2 quarts per day per person	3750 gallons
*** Latrines	1 or 2 provided in each area	
*** Showers	1 shower head per 10 people	25
Shelter (Tents)	17 large/2 medium/4 small	23
Cots/Sleeping Mats	1 per person	250
Toilet Paper	96 rolls per case	3 cases
* Heaters	2 per large tent	34
Light Sets	1 per tent	23
Generators (5kw)	1 per 4 light sets	6
55-Gallon Drums	4 per guard tower, 4 towers	16
* Blankets	2 warm/4 medium/6 cold	500/1000/1500
** Cooks	Field-range operators	5
Soap	4 ounces, 1000 per case	1 case
Towels	200 per case	2 cases
Shovels		50
Picks		50
Hammers		10
Hoes		50
Laundry Detergent	8 ounces per person per week	500 pounds

* Climatic variables

** May be reduced to two with POW performing the task. However, during contingency missions, it is recommended that five cooks be used.

*** Comment: Close coordination between the contingency force, medical personnel, and the engineers must be made to determine the requirements for water (drinking, showers, laundry, and sanitation), medical material (delousing or insect powders, lime, etc.), and fire protection material requirements.

(Extract from Army FC 19-115)

Table 1. (8)

Facility Support Requirements for 250 EPWs

Barbed-Wire Roll	6 x 400 meter	2400 meters
Concertina Wire	4 x 400 meter	1600 meters
Fence Posts	2 x 4, 10-foot long	30
Floodlights		15
Spotlights		19
Emergency Generators		2+
Mess Equipment	1 field range x 250 people	1
Water Cans/Bags		10 5-gallon cans/7 bags (lister)
Water Trucks	2 water trailers	400 gallons each
Public Address Systems		2
55-Gallon Drums		25
Latrine Screens	1 per latrine and search area	7
Locks		20 (200 series)
CONEX	maximum security area	10

(Extract from Army FC 19-115)

Table 2. (8)

Medical support planners for POW operations must coordinate with the medical staff for dental, surgical, and medical treatment for:

- Projected number of enemy prisoners.
- Locations of the hospitals providing treatment.
- Standardized procedures for accounting for enemy prisoners being cared for in military or civilian hospitals.
- Security requirements for each POW hospital.

Additional consideration should be given to coordinating with the Host Nation for joint guard forces for war prisoners hospitalized in Host Nation facilities. (1:21)

When planning the evacuation of prisoners out of a combat zone to POW camps, it is essential the transportation support planners:

- Identify evacuation routes and transportation requirements.
- Get commitments from command logisticians to provide the needed US and Host Nations highway, air, and rail assets to move the captives.

Transportation support planners must know what type of vehicles will be provided and their passenger capacity. Are they open or enclosed? How will they be configured; i.e., with trailers, side panels, canvas tops, etc.? Will drivers be provided and by whom? Planners must be prepared to obtain transportation to handle large numbers of enemy prisoners even though an exact number cannot be forecast. (1:20-21)

POW Operations During the Gulf War

On 2 August 1990, elements from three Iraqi Republican Guard divisions invaded Kuwait. Four days later, the first US Army and allied personnel arrived in Saudi Arabia to begin planning Operation Desert Shield to deter further Iraqi aggression, defend Saudi Arabia, enforce United Nations (UN) sanctions, and develop an offensive capability to liberate Kuwait. On 17 January 1991, Operation Desert Storm, the liberation of Kuwait from Iraqi control, began. Desert Storm was

made up of allied air strikes on major enemy military targets in Iraq and Kuwait. On 24 February, the allied ground offensive began. Over the next four days, allied air, ground, and sea forces pounded Iraqi forces from all directions. On 28 February 1991, only 100 hours from the start of ground operations and just six weeks after the start of Desert Storm, all US and allied coalition forces suspended combat operations, bringing the war with Iraq to an end and all Iraqi forces out of Kuwait. Thus, the mission assigned the coalition by the United Nations was accomplished. (1:2)

The Iraqis surrendered in massive numbers. US and allied combat troops found themselves inundated with surrendering Iraqi soldiers. Large numbers of Iraqi soldiers even surrendered to US helicopters! The allied coalition forces faced an immediate and large-scale problem of handling and caring for all these prisoners. The quick and decisive end of the Gulf War brought POW operations to the forefront. The first step was to move the Iraqi prisoners to collection points. At these points, the prisoners were ordered to sit in rows in the sand, while allied coalition troops searched each one and tied their hands behind their back. The coalition forces holding the prisoners then secured the POWs until they were moved to a holding area farther toward the rear. Every available means was used to transport the Iraqi prisoners from the front to the rear as quickly as possible. Trucks, buses, Humvees, and helicopters were used for POW transport. Vehicles which delivered supplies to the front returned to the rear carrying Iraqi prisoners.

Many of the Iraqi prisoners spent their night of captivity sitting in the open desert without blankets or food. Interpreters were in tremendous demand. Most of the Iraqi prisoners simply needed food and rest, although a number of them needed immediate medical attention and were escorted to combat hospitals. From a number of division collection points, the prisoners were removed farther to the rear, to corps-level POW holding areas, or "cages," where military police conducted a head count. Finally, the Iraqi prisoners were transported farther to the rear to POW prison camps.

The Iraqi prisoners were taken to the "Bronx" or the "Brooklyn," the theater's two prison camps. These tent cities



Iraqi soldiers surrendering. (Photo Courtesy of Patrick Durand/Sygma.)

were divided into compounds operated by the 800th Military Police Brigade (EPW), a composite National Guard and Reserve unit of about 7,200 soldiers. Both prison camps had medical support. The Bronx used the 300th Field Hospital with a 400-bed capacity, and the Brooklyn had a medical detachment. The Geneva Conventions required the coalition forces to assure the Iraqi prisoners received medical care, enough food to sustain them, and lodging on par with that provided coalition soldiers in the same area. The Iraqi prisoners also were provided adequate facilities for worship. In our treatment of the Iraqi prisoners, we made every effort to exceed the Geneva Conventions. The camps procured most of the prisoners' food from the Saudis. The camps also provided prayer rugs and an opportunity to pray five times a day. (6:40-41)

Because of the huge numbers of prisoners in such a short period, front-line Marine troops were performing POW operations on a massive scale. Marine units were transferring Iraqi prisoners from the front-line units to the POW compounds. The Marines anticipated there would be large numbers of Iraqi prisoners and did a lot of preparation to be ready to feed and transport them. There were some instances though in which food, water, or transportation shortages did occur. The shortages were due in large part to the large numbers of Iraqi prisoners that accumulated rapidly. Innovation and initiative by the Marines helped solve these problems. Some Marine units used their own combat food stores (MREs) or used the Iraqi soldiers' field rations. The majority of vehicles used to transport Iraqi prisoners were civilian and comprised of everything from flatbed

trucks to air-conditioned buses. Electricians, engineers, cooks, mechanics, and anyone else available were pressed into service as drivers to move the Iraqi prisoners. (7:36)

As Iraqi prisoners flooded the coalition's POW process, logistical concerns were pushed rapidly to the forefront of coalition operations. Troops noted that the Iraqi prisoners tended to remain quiet and cooperative when adequate food and water were present. A failure of logistical support at this critical time during POW operations could have easily transformed the situation from one of relative calm to mass panic and unrest. (7:37)

The ground war began on 24 February 1991. Shortly before this date, Brigadier General Joseph Conlin, Commander of the 800th Military Police Brigade, stressed the need to start building prison camps to handle the expected POWs. General Conlin estimated there would be about 100,000 Iraqi prisoners to care for. Only days before the start of the war, a stepped-up effort headed by General Conlin and his troops began. They started constructing the two in-theater POW camps, drawing on available stocks of barbed wire, lumber, tents, etc., from the Logistics Operations Center. In just five days, the camps were far enough along to begin receiving and processing POWs. This was a good thing, too, because on 20 February, four days before the start of the ground war, the 101st Division brought in 450 captured Iraqis.

In his book, General Pagonis stated that we had planned to transport Iraqi prisoners to the coalition prison camps at the rear in empty ammunition trucks. These trucks would be regularly traveling to the front lines full of ammunition and, on the return,

they would carry Iraqi prisoners back from the front. But, the demand for ammunition plummeted with the collapse of the Iraqi forces, and empty ammunition trucks were hard to find at the front. So we fell back on our old standby, the rented bus, to move the prisoners to the rear.

The Saudi Arabians were also unprepared to handle large numbers of Iraqi prisoners immediately. As a result, US forces received and processed all of the 70,000 plus Iraqi prisoners taken during the first few weeks of Desert Storm. Once the Red Cross geared up enough to take responsibility for the Iraqi prisoners, the US gladly transferred authority to that organization which, in turn, released the POWs to the Saudis.

General Pagonis also stated that many of the Iraqi prisoners were in a pathetic condition. They were immediately given whatever medical attention they needed. They were fed, cleaned, and clothed. In General Pagonis' view, the POW operations for the Gulf War and the camps were not only a triumph of planning and execution, but also a remarkable demonstration of the humanity of our American troops. (4:151-153)

Our relatively brief POW experience in Desert Storm demonstrated the urgent need to plan logistics support of POW operations. Our national honor, and our humane thoughts, would never permit us to knowingly allow POWs to starve or to suffer from the absence of shelter and medical attention. POW logistics constitutes a major withdrawal of logistics resources which must be planned for before the need exists.

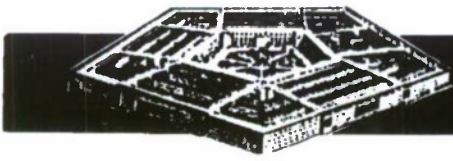
References

1. Bilbo, Lieutenant Colonel Jon F. *Enemy Prisoners of War (EPW) Operations during Operation Desert Storm*, USAWC Military Studies Program Paper, US War College, Carlisle Barracks, Pennsylvania, April 1992 (AD-A251 209).
2. Mansky, Lieutenant Colonel H. Paul. *FM 19-40, Enemy Prisoners of War, Civilian Internees and Detained Persons; Doctrine in Need of Revision - Anyone Listening? Anyone Care?* USAWC Military Studies Program Paper, US War College, Carlisle Barracks, Pennsylvania, April 1990 (AD-A222 368).
3. Mouris, Lieutenant Colonel Paul C. *Rear Area Combat Operations and Prisoner of War Operations: Can we do both?* USAWC Military Studies Program Paper, US War College, Carlisle Barracks, Pennsylvania, March 1986 (AD-A166 812).
4. Pagonis, Lieutenant General William G., with Cruikshank, Jeffrey L. *Moving Mountains: Lessons in Leadership and Logistics from the Gulf War*, Boston, Massachusetts: Harvard Business School Press, 1992.
5. Peppers, Jerome G. *An Overview of Logistics*, School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, October 1988.
6. Roth, Margaret. "Military scrambles to deal with hordes of prisoners," *Air Force Times*, 31 (March 1991), pp. 40-41.
7. Studi, Captain John R. "EPWs: A Lesson to Relearn," *Marine Corps Gazette*, 2 (February 1992), pp. 36-37.
8. US Department of the Army. Field Circular 19-115, *EPW Contingency Operations*, May 1988 (rescinded).

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Marines distribute MREs to Iraqi prisoners. (Photo Courtesy of Derek Hudson/Sygma.)



Quality Reporting of 463L Pallets and Nets

Effective management and accurate accounting of 463L pallets and nets are critical to the airlift system. AFR 76-13, *Management of System 463L Pallets, Nets, and Tie-Down Equipment*, outlines the reporting particulars; however, the last three quarterly reports indicate less-than-adequate information has been furnished to the Vehicle Directorate at Warner Robins Air Logistics Center. For example, some required reports are not provided at all or are not provided in a timely manner. Additional reporting errors include unexplained increases or decreases to asset totals; failure to coordinate or report redistribution; and failure to reconcile discrepancies between the reports made to the Item Manager and those inputted into the Air Force Equipment Management System. Unit and MAJCOM involvement should ensure QUALITY reporting which ensures sufficient assets are located at required locations. (Lt Col Ollie, AF/LGTV, DSN 227-3371)

Ozone Depleting Chemicals/Substances

Ozone depleting chemicals (ODC) or substances (ODS) are quickly being eliminated from use within the Government, DOD, and the Air Force. In accordance with the National Defense Authorization Act of 1993 (Public Law 102-484) and CSAF/SECAF letter, 7 January 1993, Air Force policy is to stop purchasing ODCs to the maximum extent feasible, unless a waiver has been approved by the Assistant Secretary of the Air Force (Acquisition) (SAF/AQ).

ODCs come in many forms including *halons* (primarily used as firefighting agents and vector control in some missile systems), *chlorofluorocarbons (CFC)* (primarily used as refrigerants and cleaning solvents), and other controlled substances (*carbon*

tetrachloride and *methyl chloroform*; cleaning solvents; *methyl bromide*; and pesticide and fumigant).

This policy causes significant changes to many supply, maintenance, and contracting procedures, and weapon systems operations. These changes are expected to add cost, time, and uncertainties to Air Force programs and everyday operational missions. This critical change to the way we do business underscores the continuing evolution of environmental safeguards which all customers, program managers, contracting personnel, environmental managers (actually all Air Force personnel), and our private contractors must be cognizant of to ensure mission and duties are environmentally responsible.

Environmental-soundness is a salient characteristic in all our programs, missions, and duties in today's Air Force. We cannot afford less. (Lt Col Bower or Maj Smith, SAF/AQCO, DSN 224-2289 or 1732)

Airframe and Powerplant License

A recent exchange between the Air Force and Federal Aviation Administration (FAA) promises streamlined procedures for aircraft maintenance personnel seeking an Airframe and Powerplant (A&P) license. Recognizing complementary needs, with the Air Force reducing end strength and civilian airlines in need of qualified mechanics, an effort is underway to develop a matrix which translates Air Force training into FAA requirements. The Community College of the Air Force is spearheading this effort for the Air Force and regularly meets with the FAA's Aviation Training and Education Council. Although Air Force maintainers will not automatically receive an A&P license, this effort promises to considerably reduce the time and expense required to obtain one. (Maj Pauly, AF/LGMM, DSN 227-3523)

(Continued from page 6)

demonstrate nearly as much cooperation. Units will attempt to "dump" improperly palletized equipment on transportation while running for the plane. Additionally, borrowed equipment and vehicles will sometimes not be returned. A specific group of deployed unit personnel must be held responsible to account for borrowed equipment and perform Reports of Survey as required. Another necessary step is to inspect facilities that were used by deployed units since some bizarre behavior can happen—one unit I've entitled "Ali Baba and the 40 Thieves" even ripped off light bulbs and reflectors from the light fixtures of our school!

Conclusion

As a final thought, we should not underestimate the capability and motivation of our base's workforce. Based on my experience during Operation Desert Storm, bases will be able to work harder, more effectively, and more creatively than anticipated if we involve them meaningfully in the operation. Despite the outstanding weapon systems which we possess, our greatest military asset is well-trained and highly motivated personnel.

Captain Foote is presently Small Arms Logistics Manager, WR-ALC Space and Special System Directorate, Robins AFB, Georgia.



Integrated Weapon System Management (IWSM)

INTRODUCTION

A Paradigm for Twenty-First Century Management

Models for management continue to evolve. Today, companies are finding that the old model of a big headquarters staff pushing reams of paper is killing their ability to compete. In place of the centrally controlled and directed operation, we are seeing the evolution of a new management paradigm (model). This new paradigm has been the basis for some remarkable corporate revivals. We, in the Air Force Materiel Command, believe it is the next logical step in management structure evolution.

We see management as an evolutionary process, not as a static condition that can be achieved once and then forgotten. The old polarized ways of Us/Them, Union/The Company, Supervisor/Worker, or Manager/Employee are clearly history. We need every member of the Command as a contributing member adding to our output instead of subtracting from it. This is the challenge we face and that is why AFMC is moving forward with Integrated Weapon System Management (IWSM).

Figure 1 illustrates the paradigm upon which many organizations (including AFMC) are being rebuilt. As the organizations restructured themselves, they restored "Customers" (and satisfying their needs with "Products") to their rightful place as the reason for the organization's existence. This key principle has been incorporated into such diverse areas as the USAF (Air Force Materiel Command (AFMC), Air Combat Command (ACC), and Air Mobility Command (AMC)), automotive (Saturn, Ford, and Chrysler), electronics (Motorola, IBM's Lexmark Printer Division), and aerospace (Boeing 767).

Interestingly, this model can be applied equally to a large organization such as AFMC or Boeing, or to a small machine shop. It works for big projects (Chrysler's latest car and Saturn) and teams working on components. What follows is an explanation of each element of the paradigm.

The first key element of the paradigm is its focus on the customer and satisfaction of that customer's needs by delivering products. In most cases, it is easy to determine who the customer is. Determining the customer's "needs" is a much more difficult job, but absolutely critical to success. The customer is shown next to management and over the products definition stage. Customer input takes many different forms, but success requires that it happen or the customer's needs will not be correctly identified. Failing to correctly define what the customer needs is a major cause of failure in today's business world, but it is avoidable. Once the customer's needs are clearly identified, they are translated into a product description. The agreed upon definition becomes the focus of the organization with trades in the product description (specification) being made as part of a balanced approach to satisfying the customer's needs.

The second key element is the Integrated Product Team (IPT). In the old model, functional organizations (finance, engineering, etc.) controlled their disciplines and tended to optimize their efforts, which was often detrimental to the success of the overall effort. Using IPTs, the emphasis shifts back to the product. The functionals are integrated into a team charged with getting the optimum product out the door. By changing the focus to the product (customer) and empowering the team to make tradeoffs, optimization happens at the product level. Notice how the "Gold Standards" (functional's best practices) influence the functionals as they provide support to the IPTs. Under the new paradigm, the functionals must strive for optimized products; and, to do this, it is necessary to suboptimize their

processes. For example, a financial manager may want more detail than is really required to prudently manage funds. Since the product is the focus, the financial manager would have to settle for less detail.

These key elements apply to everyone and every process involved in the operation. The customer is king and the product takes priority over everything else. Everyone from the CEO to the janitor gets a new job description that includes making the products better, delivering them quicker, and continuously improving everything associated with the operation. Call it what you like, Total Quality Management, Quality Air Force, etc., but the mind-set of every person in the organization shifts into being a partner instead of an employee. Managers relinquish hands-on control over many decisions and empower individuals to take control of their processes and responsibility for their products. In return for giving up a measure of direct control, managers get people actively involved with their processes and interested in their products.

Managers do not forget about control, but the new control takes the form of metrics. Metrics are measurable parameters agreed to by those running a process and the manager as representing good things to track. Metrics may take many forms, but they represent another agreement between management and workers, where control is centralized but execution is decentralized.

This paradigm for management in the twenty-first century is being implemented in AFMC as the heart of the Integrated Weapon System Management philosophy. It affects every aspect of the command and its operation. The following article provides a more detailed look at IWSM and how it affects every aspect of AFMC. To those who are having a "significant emotional experience" about IWSM (because your boss told you to IWSM your program), do not despair. All you ever need to know about IWSM and how to make your program into an IWSM program can be found in AFMCP 800-60, *Integrated Weapon System Management Guide*, dated 29 May 1992. This pamphlet is available through normal PDO (Publication Distribution Office) channels.

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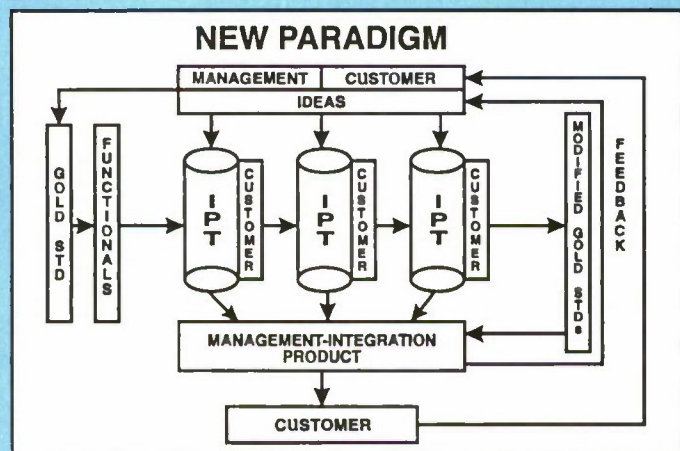


Figure 1.

Integrated Weapon System Management: A New Management Philosophy for the Air Force Materiel Command

Major Al Coutinho, USAFR

Introduction

Over the last four decades, the Air Force Systems Command and Air Force Logistics Command pursued textbook concepts of product management and organizational design. Each optimized its strategies toward its assigned mission. The Air Force Systems Command focused on the front end of the weapon system life cycle and stressed the technology and acquisition elements, while the Air Force Logistics Command focused on wartime readiness and sustainability for the long haul. Bridging organizations were often established to cross the "seams" created along functional boundaries.

Desert Storm was a dramatic test of our progress and prowess. Our logistics system demonstrated its excellence by moving massive amounts of equipment and supplies across the globe and sustaining our forces in battle. Likewise, our weapon systems proved, beyond a doubt, their preeminent technological position in the world. However, all organizations must change to meet today's dramatically altered international environment and the challenges of tomorrow.

About five years ago, the Systems Command and Logistics Command began a quest for total quality leadership. Our customers were demanding it, and our people had many ideas on how to improve our processes. Under the Defense Management Review, these commands continued streamlining and integrating many elements of our business, moving closer to a single, uniform acquisition and support process for the total life cycle. As their organizations transitioned and world events unfolded, it became clear that a smaller, more flexible and responsive Air Force could be better served by a single command charged with supporting all the equipment needs of the war-fighting commands.

On 10 January 1991, Secretary of the Air Force Donald B. Rice announced that the Air Force Logistics Command and Air Force Systems Command would combine to form a single, streamlined organization with an expanded mission:

The time is right. The world is changing rapidly. Budget reductions, the streamlining of the Air Force, and defense management reform demand that we improve the vital acquisition and support required to keep our Air Force number one in the world. This will be another step toward a leaner, meaner Air Force.

Who Are We?

The United States Air Force Materiel Command (AFMC) was formed on 1 July 1992 as an integration of the former Logistics Command and Systems Command. This union is one of the largest in history with tremendous resources and responsibilities, directly controlling over 50% of the Air Force's budget. AFMC supports over 100 varied programs, 10,000 aircraft, and 32,000 engines, with a \$52 billion budget and 128,000 people. At the same time, AFMC operates 13 bases throughout the country.

The command is also recognized as a world leader in critical technologies developed in its own laboratories.

Where Are We?

The cold war is over and, as a nation, we face a different set of threats. The budget deficit continues to grow while technology is developing at an ever-increasing rate and exponential cost. The effects will be smaller forces and more business-oriented and budget-driven operations.

The challenge is to do the right things with less. Reduced funding makes control more important. The USAF must move from the past into the future without compromising the quality of our weapon systems.

In June 1986, David Packard submitted his Blue Ribbon Commission Report, "A Quest for Excellence," to the President. The report reflects a basic management philosophy as well as a standard to which those engaged in the work of our nation's defense must always aspire. The commission studied several cases of the private industry product development to try to determine a common denominator for success. Four of the programs were the IBM 360 computer, the Boeing 767 transport, AT&T's telephone switch, and the Hughes communications satellite. Each of the programs compares in complexity and size to a major weapon system development, yet each took only about half as long to develop and costs significantly less.

Recently, there are many other success stories where organizations realized that, to move forward, they needed a complete culture change. General Motor's Saturn plant shows that the former union-management camps can be effectively bridged to form a new organization. Similar stories are told of Motorola, Chrysler, and IBM's Lexmark Printer Division.

What characteristics were common to success? All of the organizations recognized the need for change. They identified their customers and their individual needs. From this, they developed a new product focus. However, one thread that is evident in every program is that one single manager was given the responsibility and authority for his/her program. This provided stability, along with teams empowered to resolve problems and continuously improve the program through Total Quality Management (TQM). With these insights, the Air Force set out to implement its new plan.

The IWSM philosophy was developed over a period of time with a command-wide staff input and 21 pilot programs. The pilot programs were used to develop and mature the operating concepts and philosophy. The programs represented all product lines (aircraft, space, missile, electronics, and communications) and covered the full spectrum of program maturity. Each organization was charged with analyzing core operating processes and developing management philosophy under a single manager. Process Action Teams were responsible for developing the best business practices based on the experience of the 21 programs.

IWSM and Associated Terms

Now let us look at the definition of IWSM and at some other new definitions created by this program.

Integrated Weapon System Management: IWSM is the AFMC *management philosophy* for acquiring, evolving, and sustaining our products. It empowers a single manager with authority over the widest range of decisions and resources to satisfy customer requirements throughout the life cycle of the product.

Single Manager: In AFMC, the single manager is the generic term we use to describe the individual responsible for a system, product group, or materiel group. The precise definitions are:

Aircraft or Non-Aircraft System: A discrete, stand-alone collection of subsystems and related resources which, in conjunction with user support and operation, provides a capability to accomplish a specific military mission. AFMC will manage approximately 80 aircraft or non-aircraft systems like the F-22 Advanced Tactical Fighter or the Global Positioning System (GPS) Program.

Product Group: A grouping of like products in all life cycle phases that are characterized by an on-going development requirement as well as a much larger sustainment effort. Examples are propulsion and electronic warfare.

Materiel Group: A grouping of like products that normally receive consolidated management for sustainment largely for reasons of economy of scale and specialization of technical expertise. Examples are landing gear or ground vehicles.

If we want to refer to the individual in charge of a specific group, the terms used are:

System Program Director (SPD): The SPD is the single manager who is charged with all cost, schedule, performance, and sustainment aspects of a directed acquisition aircraft or non-aircraft program.

Product Group Manager (PGM) and Materiel Group Manager (MGM): The individual who is ultimately responsible and accountable for decisions and resources in overall product group or materiel group management. The PGM or MGM is the single person who is charged with all cost, schedule, and performance aspects of a product or materiel group.

This is just a partial list of the terms needed to communicate effectively, but it will get us started on understanding the IWSM philosophy.

IWSM Philosophy

As mentioned earlier, AFMC recognized the need to develop a new way of doing business in our rapidly changing world. A new management philosophy was required to meet these new challenges. IWSM provides an expanding framework for doing business at all levels within the command. It is not an organization but a way of looking at management relationships which continuously improve daily operations.

The IWSM philosophy did not spring into being from a single individual or in a single meeting. It is not etched in big letters on stone tablets that will never be revised or changed. It developed and evolved over time with inputs from many sources both inside and outside the Materiel Command. Several key

elements were developed that describe the important aspects of the IWSM philosophy.

These key elements are closely interrelated and cannot be separated. In the case of IWSM, the whole is truly greater than the sum of its parts. Figure 1 depicts the key elements that must play together to make the IWSM philosophy work.

Quality Air Force (QAF): IWSM has the commitment and involvement of the senior leadership of AFMC and the Air Force. It was founded and developed using the basic definition of TQM. We actively seek to create an environment that inspires trust, teamwork, continuous improvement, and customer focus. Our leadership is committed to this approach for developing and implementing IWSM. QAF is the essence of how we do business in AFMC.

This QAF approach to IWSM development is best exemplified by the 21 pilot programs used to chart the course for IWSM. The 21 program managers were given a broad charter to seek out the best way to do business and then try it out to see if IWSM really works. All of their best ideas have been captured so new program managers have a roadmap to follow as they implement IWSM.

Single Face to User: A single manager is empowered with the maximum authority over the widest range of program decisions and resources to satisfy customers' requirements throughout the system/product/materiel life cycle. This gives the user a single individual to call to address any issues that need to be worked to ensure our war fighters are supported. The responsibility never leaves the single manager no matter what part of the life cycle the product is in.

Cradle-to-Grave Management: The single manager is responsible for all product decisions from a life cycle perspective. This involvement in the program starts not later than the Milestone I decision and continues until the product is canceled or retired from the inventory. This new requirement to balance all decisions across the life cycle will ensure that the problems we experienced as a part of Program Management



Figure 1.

Responsibility Transfer (PMRT) are a thing of the past. Now with the single command, AFMC product managers remain responsible for the performance of the program from cradle-to-grave; and the seamless processes they use to do their jobs have been updated to reflect this new focus.

Seamless Processes: The IWSM organization operates with critical processes that are integrated across the life cycle. These processes are designed to take advantage of all the talent available in the command. There are no process seams between organizations, locations, or program phases.

During the IWSM development activities, eight core processes were identified that describe the basic tasks required across the life cycle to manage a program: Product Management, Requirements, System Engineering and Configuration Management, Financial Management, Contracting, Technology Master Process, Test and Evaluation, and Logistics. The best business practices developed by the 21 pilot programs for each process were adapted for all follow-on programs.

A good example of the elimination of a seam was the different contract dollar thresholds in the two former commands. The contracting officer for a program at a Systems Command Product Center could approve a contract at a higher dollar threshold than a contracting officer at a Logistics Command Logistics Center. Now there is only one contracting officer in AFMC with a higher contract approval threshold.

Empowered People: The SPD, PGM, or MGM is responsible for all aspects of their programs. As we explained in the definition of IWSM, single managers are empowered to make the necessary decisions to accomplish their tasking. It is important that the single managers in turn empower their people. Authority and responsibility must flow to the lowest level possible to allow us to most efficiently accomplish our mission. Empowered people are given the ownership and responsibility for the products they build and sustain and the processes that make it happen.

Common Sense Approach: Do what is right; fix it if it does not make sense. This is how we built the IWSM philosophy, and

it is how we must all operate to effectively support our war fighters. As our resources shrink in the future (and shrink they will), we must get smarter and more efficient in what we do. Give people a **goal**, not an answer.

Integrated Product Teams (IPTs): IPTs put the right people in the right place at the right time to make the right decision. IPTs use multidisciplinary functional team members to manage and integrate critical processes. This ensures that the product is developed right the first time, meets the users' needs, and is sustained and evolved for its useful life. The IPT takes ownership of products and breaks down functional barriers.

We asked team managers of 21 pilot programs to try the IWSM experiment and tell us their good ideas. Half of them used integrated product teams to accomplish IWSM development and implementation. IPTs are so successful at focusing the right talent on the right problems that the AFMC Commander has directed that IPTs be implemented AFMC wide by October 1993.

Product Focus: The ultimate test: Is the customer satisfied? One will find that there is a product focus in all of the elements previously listed.

Conclusion

In building AFMC and developing IWSM, we have explored our history through war and peace to find the strengths and areas of excellence that have served us well. In this paper, we have outlined only the basic elements of IWSM in the immediate future. The search for process improvements and better business practices will continue throughout the existence of AFMC. We will continue to seek better ideas and more effective ways of providing our Air Force with the world's most capable weapon systems and sustaining those systems in combat today and tomorrow.

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Most Significant Article Award of 1992

The Editorial Advisory Board has selected "The Logistics Dilemma" by Colonel Joseph B. Corcoran, Jr., USAF, as the most significant article published in the *Air Force Journal of Logistics* during 1992.

Empowerment: Keeping the Promise of the Total Quality Revolution

Major Wayne G. Stone, D.B.A., USAF

Introduction

The term "empowerment" seems to be everywhere. It is what the total quality revolution is supposed to produce; it is what managers are supposed to be doing; and it is what organizational members are supposed to possess. The benefits of empowerment seem to be "intuitively obvious," and leaders are expected to build the concept of empowerment into their organizational cultures. Yet, many feel uncomfortable about doing so because they do not have a firm grasp of exactly what empowerment is.

Misconceptions about empowerment abound and, in many instances, managers and leaders actually fear empowerment. In many organizations, one can hear statements like, "I have worked too long and hard to give up power I rightly deserve"; or "If we allow people to have all the power they want, they will work on personal goals rather than organizational goals"; or "If managers and leaders delegate all their power to the people, what will be left for them to do." All of these statements represent misunderstandings about how empowerment fits into the leadership tool kit. In order to gain a better understanding of empowerment, it might be useful to study its history.

A Short History of Empowerment

Many people consider empowerment to be a fairly new star in the constellation of management. In fact, it is a very old idea which underlies the very definition of an organization. We band together in organizations precisely because we cannot do whatever it is we want to do by ourselves. The underlying assumption is that all individuals have unique skills and abilities which they can bring to bear on organizational goals. Consequently, individuals are most fulfilled when they can freely exercise their skill and ability to the fullest in pursuing those goals. In 1916 Henri Fayol stated:

Thinking out a plan and ensuring its success is one of the keenest satisfactions for an intelligent man to experience. . . . At all levels of the organizational ladder zeal and energy on the part of employees are augmented by initiative. The initiative of all, added to that of the manager, and supplementing it if need be, represents a great source of strength. . . . The manager must be able to sacrifice some personal vanity in order to grant this sort of satisfaction to subordinates. Other things being equal, moreover, a manager able to permit the exercise of initiative on the part of subordinates is infinitely superior to one who cannot do so. (1:35)

Abraham Lincoln was a great believer in people taking action on their own initiative and not waiting to be told what had to be done. He would often tell this story to emphasize his point:

It seems there was this colonel, who when raising his regiment in Missouri, proposed to his men that he should do all the swearing for the regiment. They assented; and for months no

instance was known of violation of the promise. The colonel had a teamster named John Todd, who, as roads are not always the best, had some difficulty in commanding his temper and tongue. John happened to be driving a mule team through a series of mudholes a little worse than usual, when he burst forth in a volley of profanity.

The colonel took notice of the offense and brought John to account. 'John,' said he, 'didn't you promise to let me do all the swearing for the regiment?' 'Yes, I did Colonel,' he replied, 'but the fact was the swearing had to be done then or not at all, and you weren't there to do it.' (2:139)

As far back as 1490 B.C., we find Jethro, Moses' father-in-law and the first management consultant, telling Moses he cannot manage all the problems of the people and must share the burden by empowering able men among the Israelites. In Exodus 18 Jethro tells Moses:

²⁰And thou shalt teach them ordinances and laws, and shalt shew them the way wherein they must walk, and the work they must do.

²⁵And Moses chose able men out of all Israel, and made them heads over the people, rulers of thousands, rulers of hundreds, rulers of fifties, and rulers of tens.

²⁶And they judged the people at all seasons: the hard causes they brought unto Moses, but every small matter they judged themselves.

So, we find that empowerment is not a particularly new concept; but it has been enjoying a resurgence of interest in recent management literature. The growth of a management idea is often reflected in the number of articles which people write about it. Table 1 shows how the idea of empowerment has recently gained prominence, particularly in relation to similar concepts like teamwork, delegation, and decentralization.

	Average Articles Published Per Year			
	1971-1980	1981-1986	1987-1989	1990-1992
Empowerment	3	11	51	218
Teamwork	31	105	233	366
Delegation	30	70	89	90
Decentralization	37	116	161	163
Participative Management	12	40	40	36

Table 1.

The increase in interest in empowerment might be seen by some as simply replacing older terms with more popular ones. However, the increase might actually indicate that empowerment is an idea that significantly improves on the older concepts. If this is true, then we need to try and define what we really mean by empowerment.

Defining Empowerment

To better understand empowerment, we must first understand what it IS NOT:

(1) Empowerment IS NOT giving up power. Management concepts like power-sharing insinuate that, in order to give power to subordinates, managers must give it from some pool of power which they possess. Power is seen as a zero sum game. Actually, empowerment is an organizational power amplifier which aims at capturing all the potential power in an environment. Think of a single wind-driven electricity generator in a field as representing the power of the manager. Empowerment would be the act of building hundreds of similar generators in the field, each one capturing some portion of the potential power which the manager could not possibly capture alone.

(2) Empowerment IS NOT taking away the job of the leader; it is freeing the leader to truly lead. Leaders often find themselves trapped into making all the decisions for organizations. It seems that the more they help people with decisions, the more those people come to them for additional help. By making decisions which are rightfully within the control of the subordinates, leaders do not so much teach leadership as they do dependence. The more leaders build that dependence, the less time they have to attack real leadership issues like envisioning the organization's future, transmitting the vision, and building commitment.

(3) Empowerment IS NOT taking away decision-making power from a manager. If leaders can make people realize what power they already possess to control their environment and goal accomplishment, they can actually make their use of power more effective. Some management theorists would have one believe that all problems and challenges can be solved through team decision-making processes. Unfortunately, practical managers do not exist in a theoretical world. They must deal with people who hold strong beliefs about a problem and are unwilling to compromise. Sometimes the problem is so ill-defined that people cannot even agree on what the possible solutions might be. Not only are teams unable to reach a CONsensus, but they may actually reach a point of irreconcilable DISsensus. This is the point at which leaders absolutely must employ their power. To not do so would mean that the organization might stagnate. Just as Moses reserved for himself the power to decide on the "hard causes," practical managers must reserve their use of power for when that use will best and most effectively serve the organization.

Perhaps the best understanding of empowerment comes to us from the counseling realm. We have all been involved in counseling or have seen it dramatized in the movies or on television. Typically, it is the role of the counselor not to solve an individual's problem but, rather, to help the individual identify the problem and its causes. Once the problem and its causes have been identified, the counselor helps the person realize that he/she had the power to resolve the problem all along. Likewise, leaders do not empower people but rather help them become aware of their potential power. The empowerment process involves giving people an understanding of their work environment so that they:

- (1) Understand what the boundaries of their function are and how their job ties into other jobs to accomplish the mission.
- (2) Understand the processes and goals of their job.
- (3) Have a feeling of competence and control in relation to those processes and goals.
- (4) Have a belief that when they take action to establish or improve on those processes and goals, they will be successful.

(5) Have a further belief that, when they are successful, the organization will benefit from their action and reward them for having been innovative and taking risks.

Empowerment then becomes a feeling of cognizance or understanding, competence, control, contribution, community, commitment, and continuity. The role of organizational leaders is to act as a facilitator, guide, teacher, or mentor in helping people understand the nature and value of their empowerment. Leaders do not empower. They create an environment and culture in which empowerment thrives. In order to do so, organizational leaders need to understand the dimensions of empowerment and how their actions can affect those dimensions.

Making Empowerment Work in Your Organization

In teaching classes at the Air Force Institute of Technology (AFIT) and in consulting, I ask people if they feel more empowered as a result of the total quality revolution. The response is often: "Absolutely not. If anything I feel less empowered." People go on to state that the results of many Process Action Teams include new rules and regulations that actually constrain their behavior rather than free or empower it. Many people feel they are targets of total quality rather than participants in it.

Empowerment of the individual is the foundation upon which the success of total quality is built. If people believe they will have more control over their work processes and goals, they will believe in the ability of total quality to help both themselves and the organization be successful. However, if they view the total quality effort simply as a new group of statistical tools on which they can be graded, they will not long believe the promises of empowerment inherent in the system. To gain empowerment, individuals must plan for it and work at it so they can deliver on the promise.

The Dimensions of Empowerment

Laundry lists of dimensions or parameters of theories tend to cause some managers to think that good leadership can be accomplished with a checklist. In the real world of management and leadership, problems do not tend to fall into neat little categories which can be addressed by employing a particular dimension of a particular theory. Quite often, managers are unable to align a problem with a particular theory, much less a particular part of that theory. Therefore, in evaluating the dimensions of empowerment presented, readers should assume they are a point of departure for experimentation rather than a comprehensive model of reality.

Earlier empowerment was generally described as a feeling of cognizance, competence, control, contribution, community, commitment, and continuity. These "Seven Cs" of empowerment can be better understood by breaking them down into practical elements:

Cognizance

The first step in attaining empowerment is to acquire an understanding and awareness of the organization and one's place in it. If members do not understand the basics of the organizational structure and processes, they cannot learn to operate effectively within the organizational environment. It is equally important for members to understand the "why" of these environmental elements.

The structures and processes of an organization give people the most direct evidence of an organization's logic. By teaching

organizational members—and in particular new members—that there is a reason behind structures and processes, leaders build the belief that the organization is based on logic and not their whims. To the extent that organizational members believe this, they will be more willing to attack illogic in organizational restructuring and process change. Additionally, they may be more willing to initiate such change.

Members must understand not only the formal but the informal structures and processes as well. Organizational effectiveness is based on a combination of the “official” way people do things and the way things really get done. Members who do not understand the informal system may find themselves frustrated by only trying to do things the “official” way. People in organizations need a strong understanding of, and identification with, the mission of the organization. Without that understanding and commitment, the organization becomes a place where individuals do their work and the goal or mission becomes individualized as “completing my shift” or “getting my paycheck.” Failure to build mission understanding, commitment, and internalization negatively affects innovation; creativity; risk-taking; and, consequently, organizational effectiveness.

Finally, we must put individuals within the context of the organization. People naturally want to know “how they fit in.” They need to know what their boundaries are and how they are expected to operate within the formal and informal systems to contribute to mission accomplishment. One of the great fears of managers first approaching empowerment is the idea that, having been empowered, employees will fly off on their own courses of action whether or not those courses contribute to organizational goals. It is the managers’ process of orientation, locating individuals on the organizational “map” in relation to others, which serves to establish boundaries for their operation. If managers set these boundaries in the least constraining way, they allow for experimentation, creativity, and innovation within an acceptable range. Coupling the concept of organizational orientation with an understanding of the mission allows individuals the maximum latitude for creative behavior while still keeping them on course.

Competence

To many people, large organizations and their processes seem daunting. Newcomers, in particular, may feel powerless in the face of incredibly complex procedures and relationships. In order to feel competent within this context, we must address three factors: job/skill alignment, social skill development, and access to processes:

(1) All individuals possess certain skills and abilities in which they have a degree of confidence. They feel more comfortable and confident in their expectation of success when they are allowed to employ prized skills on the job. When organizations are just starting out, members tend to assign people jobs based on their unique skills. Indeed, jobs are often built around the particular skills an individual possesses. As time goes by and jobs become institutionalized, managers tend to give less and less consideration to the individual skill-to-job requirement match. This results in people being assigned to jobs for which they feel they are not particularly well suited. To the degree that there is a skill/job mismatch, people will feel less confident in their ability to successfully achieve goals associated with the job.

(2) Formal orientation programs typically overlook the informal system of getting things done on the job. The “rules and regulations” associated with the informal system are often passed along as part of an informal socialization process which is not necessarily under the control of organizational leaders. To the extent that these social skills are not passed along to

individuals, they will be less powerful. Part of the informal socialization process may actually require that the informal “rules and regulations” be withheld from certain individuals. In management training programs, quite often line or production supervisors withhold social information from trainees because they have not “paid their dues.” Conversely, the more individuals learn about the informal system and its dynamics, the more powerful they may feel in using that system to achieve organizational goals.

(3) It is not enough to simply know about processes and think that one can manipulate them. Members must also have access to those processes. Given an understanding of the formal and informal processes, they will only feel empowered if there is the actual opportunity to manipulate those portions of the process associated with their job. Personnel must be given a degree of control over the dynamics of their operating environment if managers expect them to feel empowered. To know what processes are operating, but to be given no latitude in employing those processes, may be more frustrating than not understanding the processes at all.

Control

Control in relation to empowerment is giving control over selection of goals and processes for achieving those goals. Individuals, within the definition of their function in the organization, are free to use their creativity to develop and improve processes or strategies to achieve goals which they have determined. In terms of empowerment, the giving of control tells individuals that the organization completely trusts them to accomplish a defined portion of the organizational mission.

The fear in giving control to individuals is that they may decide to aim for goals which are in direct conflict with the goals of others. Worse yet, they may decide to aim for a goal which has absolutely nothing to do with the unit’s mission. To say that managers and leaders must allow people to control their own environment is not to say that individuals define the environment. The role of managers or leaders is to define, for organizational members, the vision of the organization and the place individuals have within the accomplishment of that vision. Given commitment to a vision or an overriding set of goals, given the understanding of one’s place within the organization, and given the control to operate within an organizationally defined role, individuals will set appropriate goals and work innovatively toward their accomplishment. If leaders, in observing people operating within their organization, see individuals working toward inappropriate goals, it becomes the responsibility of the leaders to determine why they are doing so. Have the individuals lost sight of organizational goals? Do they not understand what their role is? Do the individuals not understand what the boundaries of their roles are? Should leaders see if whatever the individuals are doing is a reflection of organizational or environmental changes that would lead them to realign goals or roles? In other words, is there a chance that the individuals are right and the organization is wrong?

If managers trust workers with control of their work goals and processes, the managers assume that the members will act with a logic that, from the workers’ perspective, will achieve those goals. It becomes the role of the managers to understand the logic of the individuals before they take corrective action. When managers at first see a divergence from what they expected to see in the behavior of empowered individuals, they should assume that there is a possibility that the divergence represents a better process, or superior understanding of a goal, or is a

reaction to a changing environment which the individuals have perceived before senior management.

Contribution

Organizational members who believe in the mission and feel empowered to accomplish their portion of that mission need to know that what they are doing is contributing to the accomplishment of organizational goals. They need to see a cause-and-effect relationship between what they do and what the organization achieves. They must feel that their contributions are valued by others within the organization. People cannot get this feeling if leaders tell them one thing but reward another.

If leaders say that creativity in job accomplishment is something the organization values, then they must reward such creativity and risk-taking. Often people may try out an idea which fails miserably. In that instance, leaders should reward the willingness to try an idea and not punish the resultant failure. Such failures should be used as learning experiences or as points of departure for developing better ideas. It is much more constructive to say, "What did we learn from this experience?" than it is to say, "Boy, we sure don't want to make any more mistakes like that."

An important way to build a feeling of contribution is to encourage the giving and getting of help to and from others in the organization. By encouraging people to work with one another in helping relationships, leaders are saying that they do not expect workers to know everything. When they have a problem, they should feel free to get together with others who could help. Additionally, if they see someone floundering, they are not making them look stupid or incompetent by offering them help. Developing these types of relationships helps individuals see how different functions can and should tie together to accomplish the mission. It reinforces the perception of the organization as an interdependent system and not just a bunch of people doing their jobs. It helps to build a feeling of community.

Community

Community is a concept which defines a commonality of values and beliefs which encompass not only people working within the organization but customers, suppliers, and families as well. Community breaks down boundaries between insiders and outsiders and allows people to see how their organization fits into the larger world around them. It says: "We don't just accomplish goals for the sake of accomplishing goals. We accomplish goals because we possess a unique capability to contribute to society as a whole."

Organizational leaders must help members see the organization as a family of individuals webbed together by shared values, goals, and beliefs in the importance of the contribution which the organization can make. Further, they must reinforce the idea that the boundary of the organization is not defined by simply those people who receive paychecks from it. Rather, the boundary encompasses all those who contribute to it and depend on it. The power of the organization to make a contribution to society is directly related to the commitment to the core values of the organization held by organizational members, their families, the organization's suppliers, and customers.

Commitment

Empowerment is not part of the organization's culture separable from other parts. Rather, it is a basic framework upon which the culture may be built. Earlier, I stated that empowerment is not a new idea but an old idea that was based on the definition of an organization. People band together in organizations because they are unable to accomplish some task or goal on their own. Empowerment is the idea that nobody should be constrained from making the maximum contribution of which they are capable. This is what Fayol meant when he said, "The initiative of all, added to that of the manager . . . represents a great source of strength." (1:35) To gain the maximum benefit from empowerment, the leader must be committed to building it into every facet of the organization. When making a decision, the manager must always attempt to gauge the impact of the decision on empowerment of organizational members. In addition to evaluating actions in terms of empowerment, leaders must ask themselves what actions they can specifically take to enhance empowerment.

Continuity

We often hear that there is only one constant in organizations and that is change. One of the constants of change is the turnover in leadership. Leaders will not be in charge of their current organizations forever. What happens to empowerment when they leave?

The strength of a culture is often measured in terms of the strength of members' belief in the organization's values. The greatest fear during a turnover of leadership is fear of the uncertain. What is the new leader like? What changes will come about as a result of the change? Will members still be allowed to control their goals and work environment? Leaders have equated empowerment with freedom for workers to be creative in contributing all of which they are capable. Fears about changes in leadership, therefore, become fears about loss of freedom in the work environment.

In order for the organization to gain the greatest benefit from empowerment, leaders must assure the continuity of the process. This means working with the new leader to "enculturate" that person before he or she takes over. Additionally, it means alleviating the fears of the organizational members about the impact of the change on their freedom. Empowerment entails a commitment on the part of management to continue the culture and process beyond the tenure of the current leadership. The leader serves as the embodiment of the culture.

In empowerment workshops we give, we end every session with the suggestion that participants make up a small poster as a reminder of their commitment to building an empowering organization. Once they have made up the poster, we suggest that they put it someplace where they will have to look at it every day. It can be on a wall or simply on the pull-out slab in a desk where they keep their important phone numbers. The important thing is that people ask themselves what they can do "TODAY" to foster empowerment in their organization. You might want to make such a poster for yourself. Your poster might look like the following:

WHAT CAN I DO TODAY...

To help people understand their vision and mission and their place in it?

To help people learn about and feel competent to work within the formal and informal structures and processes of our organization?

To give people control over their own goals and imaginative approaches to achieving those goals?

To let people know that their contributions make a difference to us and are vital to accomplishment of our mission?

To help people understand how the organization fits into a larger community that values what they have to offer?

To demonstrate that I, as an organizational leader, am committed to the empowerment of individuals so they can fulfill their goals and those of the organization?

To demonstrate that I am willing to sacrifice the vanity associated with organizational leadership in order to allow members the freedom and empowerment they deserve as partners in the organization?

Conclusion

In this article I have tried to give readers an understanding of the concept of empowerment through the "Seven Cs" model. Also, building an empowering culture takes time. People often ask, "What is the best way to introduce empowerment into an organization?" This question assumes that the act of creating

empowerment is a program and that the state of empowerment is a condition at which we can arrive at a given point in time. In truth, empowerment is not a program, but rather an ongoing process.

Beginning on the road to empowerment puts leaders/members/organizations on a track to maximize the human side of the total quality equation. Empowerment is the promise total quality has offered to organizational members. As long as we try to implement the quantitative side of total quality in the hope that empowerment will follow naturally, we will be disappointed. To make it a success, we must spend as much time and effort directly addressing the parameters of empowerment as we do devising goals, plans, and metrics. In the total quality empowered organization, empowerment drives performance. Statistics, plans, and metrics may be indirect measures of empowerment, but we cannot depend on them to create empowerment.

References

1. Fayol, Henri. "General Principles of Management," *Classics of Organizational Theory*, ed. J. M. Shafritz and P. H. Whitbeck, Oak Park IL: Moore Publishing Company, 1978, pp. 23-37.
2. Phillips, D. T. *Lincoln and Leadership*, New York NY: Warner Books, 1992.

Further Reading

1. Byham, W. C., and Cox, J. *Zap: The Lightning of Empowerment*, New York NY: Ballantine Books, 1988.
2. Manz, C. C., and Sims, H. P. *Superleadership: Leading Others to Lead Themselves*, New York NY: Berkley Publishing Company, 1990.

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SOLE Logistics Symposium

The 28th Annual Society of Logistics Engineers (SOLE) International Conference and Exposition will be held August 24 - 26, 1993, at the Sheraton Colorado Springs Hotel, Colorado Springs, Colorado. The theme of the conference is "Improving the Bottom Line." The program will address Logistics Engineering, Theory of Constraints, Computer-Aided Acquisition and Logistics Support (CALs), Environmental Logistics, Space Logistics, Total Quality Management (TQM), International Logistics, and many other interesting topics. For more information, call Amy Spiegel at SOLE Headquarters (301) 459-8446.

Announcing the 1993 Air Power History Symposium

The 1993 Air Power Symposium, sponsored jointly by the Royal Air Force and the United States Air Force history programs, will be held on September 9 - 10, 1993, at Bolling Air Force Base, Washington DC. The Symposium will address "Anglo-American Air Power Cooperation during the Cold War Era." Three panels will feature papers by scholars and participants on policy decisions, acquisition, and crisis response. Seating is limited so those interested in attending should register early. For further information, please contact:

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CAREER AND PERSONNEL INFORMATION

Civilian Career Management

Crediting Logistics Experience Under the LCCEP's Whole Person Score

Effective 1 November 1992, this office implemented the Logistics Civilian Career Enhancement Program's (LCCEP) Whole Person Score (WPS). The WPS identifies how competitive registrants are for promotion and career development opportunities in LCCEP. The WPS is computed automatically via the Defense Civilian Personnel Data System (DCPDS), and it is the responsibility of registrants to review their records for accuracy and proper WPS credit. Discrepancies can only be corrected through the local Central Civilian Personnel Flight (CCPF). The LCCEP WPS is divided into five elements: Professional Experience, Education/Training, Performance Appraisal, Interview Score, and Behavior Inventory. This article will focus on the Professional Experience element. The maximum number of points obtainable in the Professional Experience element is 80, and it is subdivided into five areas:

MULTI-OCCUPATIONAL SERIES	24 POINTS
MULTI-COMMAND	16 POINTS
MULTI-ORGANIZATIONAL LEVEL	16 POINTS
SUPERVISORY EXPERIENCE	12 POINTS
MANAGERIAL EXPERIENCE	12 POINTS
	80 POINTS MAX

Points are only given if 12 months have been completed in a given area. For example, if a person only had 11 months' experience in a creditable occupational series, i.e., 346, no points would be given. If another month of experience in the 346 series is completed, then the total would be 12 months, for which credit would be given. When reviewing a Career Brief, employees should pay close attention to the stop/start dates of the position held and ensure that there are no gaps in time or any missing experience.

Multi-Occupational Series - A maximum of 24 points can be earned in this element. Credit is given for performing Logistics work at the GS-11 level or higher in more than one Logistics family for a minimum of 12 months. Experience in 2 separate family groups earns 12 points; experience in 3 separate family groups earns 24 points. There are 13 Logistics families that credit experience:

FAMILY	OCCUPATIONAL SERIES
Administrative	0301*
Management/Program Analyst	0343*
	0345*
	0340*
	0391*

Science/Engineering	08XX*
	15XX*
Equipment Specialist	1670
General Facilities	1601
Industrial Specialist	1101*
	1150
	1152
	1102*
Logistics	0346
Item Management	2010
Quality Assurance	1910
Supply/Warehousing	2001
	2003
	2030
	2050
	6901
	6907
	6912
Transportation	2101
	2102
	2110
	2130
	2131
	2135
	2144
	2150
Packing/Packaging	7001
	7002
	7004
Other	25XX
	26XX
	28XX
	33XX
	34XX
	37XX
	38XX
	53XX
	66XX
	82XX
	86XX
	88XX

*Experience must have been performed in one of the following organizational functional codes: AP, AQ, AW, CE, CJ, CR, CS, CY, DC, DD, DF, DT, DU, MA, MM, MT, OP, PA, PB, PP, SE, SU, or TA.

Multi-Command - A maximum of 16 points can be earned in this element. Credit is given for performing Logistics work at the GS-11 level or higher in more than one command. Logistics work is considered any experience creditable under the Multi-Occupational area. Experience in 2 commands earns 2 points, experience in 3 commands earns 8 points, and experience in 4 commands earns 16 points.

Multi-Organizational Level - A maximum of 16 points can be earned in this element. Credit is given for performing Logistics work at the GS-11 level or higher in more than one level. Logistics work is considered any experience creditable under the Multi-Occupational area. Experience in 2 different levels earns 8 points, experience in Departmental (Code A) or Command level (Code B) and one other level earns 16 points. The creditable levels are:

(Continued on page 41)

Logistical Challenges of the Aleutian Islands in World War II

Captain Britton M. Smeal, USAF

Introduction

Military and academic historians have paid little attention to the Aleutian theater of operations in World War II. The Aleutians was not a glorious campaign, and no Marines stormed ashore in Iwo Jima fashion—which probably explains why little has been published about it. But for 15 months, thousands of courageous soldiers braved some of the worst weather known to man. They seemed to be fighting the elements more than the enemy and the elements often won! To make matters worse, the campaign was hampered by constant bickering between the Army and the Navy, and resources for Alaska were a low priority for the War Department and Congress. (2:56;8:103) The result was a logistical nightmare in the early stages of the war—an embarrassment to the War and Navy Departments—so the Aleutian theater received very little publicity. Still, brilliant tactical maneuvers emerged, great acts of heroism abounded, and the job “got done.”

My purpose in writing this paper is not to present a historical record of battles, tactics, and personalities, but to examine some of the important logistical obstacles faced by the United States in the Aleutians and to identify some “lessons learned” (or not learned) from this obscure but important theater.

Historical Context of the Aleutian Theater

The US purchased the territory of Alaska from the Russians in 1867. The deal was known as “Seward’s Folly” at the time because many Americans thought of the land as barren, desolate, and frozen with no political, economic, or material value. This myopic and ignorant attitude toward Alaska still prevailed at the outbreak of war with Japan in 1941. Consequently, the rest of the US paid little attention to Alaska as it struggled to evolve from wilderness territory to statehood. And, it paid comparatively little attention to Alaska as the war went on.

The political and legal environments were much like the “Old West” for much of Alaska’s early days. Disagreements were often decided by brute force, and justice was sometimes a rare commodity. The economy of Alaska was fragile and growth was slow. The States’ view of this untamed territory was that of a problem child, always needing something but giving little in return. Alaska was left out of much of the mainstream of American politics. One thing would not escape Alaska—the gloom of impending war that began to sweep over the world in the 1930s.

Alaskans became alarmed in 1931 when Japan invaded Manchuria and forged an empire from parts of China and Southeast Asia. Alaskans were convinced that resource-starved Japan would soon extend the Empire of the Rising Sun to include their territory, but their warnings fell on deaf ears in the “lower 48” states. The Alaskan delegate to Congress, who could not vote on issues, pleaded for funds to develop Alaska’s infrastructure, economy, and military defenses, but to no avail.

The fact that the US was unprepared for war was most evident in Alaska where the huge territory was considered militarily

insignificant by both Congress and the War Department. (5:314,315) Because of this misperception, no sizable military base construction funds were appropriated by Congress until Hitler invaded Norway and Denmark. As a result of this lack of preparedness, when Japan bombed Pearl Harbor on 7 December 1941, “. . . not a military installation or naval base was ready for action in Alaska.” (5:315)

Despite desperate US war preparations, when war broke out in December 1941, the Alaskan defenses consisted of little more than 20,000 ground troops, 12 B-18 bombers, and 20 P-36 fighters (3:250-251). Naval forces were limited to 3 Coast Guard cutters, some destroyers of 1917 vintage, 2 squads of submarines, and 10 PBV Catalina flying boats. The minute size of our forces has little significance unless we consider that the Soviet Union lies only 65 miles from Alaska across the Bering Sea, and the nearest Japanese bases on the Kurile Islands were only 650 miles from the western Aleutian Islands.



Bombers line up on frozen runways.

True to the warnings of Alaskans, the Japanese bombed Pearl Harbor and struck out toward other lands to add resources to their empire. In June 1942, a moderately sized Japanese invasion force attacked the US military installation at Dutch Harbor on Unalaska Island and landed an occupation force of 2,500 troops on Kiska, Attu, and Agattu in the western Aleutians.

The Japanese designed the operation not as a stepping stone to invade and conquer Alaska or North America, but as a ploy to draw the American naval force out of hiding in Pearl Harbor. The Japanese planned to destroy the US Navy at Midway and secure Japan’s northern flank. The strategy assumed the US would send the bulk of its fleet north to recapture Alaskan soil while a superior Japanese force waited in ambush at Midway. Fortunately for the US, Japanese radio messages were intercepted and decoded. Thus, the US Navy averted disaster and turned the ambush into a great American victory at Midway.

The diversion in the Aleutians proved of no strategic value to the Japanese. The occupation force, in fact, became a drain on

scarce resources. After the diversion failed, the Japanese held the three islands halfheartedly as they, too, placed the Aleutians low on priority. The two sides fought a holding war in the dense fog which surrounds the Aleutians, while local commanders on both sides of the conflict begged for more men, supplies, ships, planes, and equipment. (6:4)

Only two battles really amounted to anything: the sea battle of Komandorskiye Islands, where an inferior American force defeated the larger, but supply-starved Japanese force, and the Battle of Attu, which resulted in over 5,000 Japanese and American casualties. (2:72) After the Japanese lost Attu, Kiska forces continued to hold out against tremendous pressure from the US Navy's blockade and the Eleventh Air Force's daily bomber raids when weather permitted. Unable to reinforce Kiska by any means except submarine (not a good cargo vessel), the Japanese realized they could not properly resupply their battle-weary troops. Having failed in their last attempt at a major resupply effort (Battle of Komandorskiye Islands), and having lost Attu, the Japanese decided to withdraw the contingent from Kiska under cover of fog and darkness. The Americans did not discover that Kiska was abandoned and invaded the now unmanned island three weeks after the Japanese left.

The Aleutians was the only military campaign actually fought on North American soil in World War II, but its real significance lies in the logistical lessons stemming from the unique geography and climate of the north Pacific, as well as the dangers posed by a rapid buildup in a territory with no infrastructure and poor attention to logistical detail. These lessons were mostly ignored by the US in both the Korean and Vietnam Wars.

Geography

The geography of Alaska is varied with steep mountains, vast forests, and frozen tundra covering much of the coast and interior. Steep mountains send glaciers crashing into the sea and precluded early rail and road development along the Pacific Coast. The vast interior of Alaska is a maze of forested mountains and Arctic tundra. The Alaska Peninsula juts out toward the southwest with the Aleutian Islands extending in a long, narrow line toward the Kamchatka Peninsula in Asia. The Aleutians are a desolate chain of volcanic islands stretching out into the sea for a thousand miles across the International Date Line.

One may appreciate Alaska's gigantic area by considering some interesting facts. The landmass of Alaska is about the same as the next three largest states combined (Texas, California, Montana), and it has more coastline than all the US coasts combined. Anchorage is roughly 1,700 miles by air from Seattle and about 2,000 miles by sea transportation. Sea distance from one end of the Aleutians to the other is about 1,200 miles.

The vast distances involved created a huge logistical challenge. Isolated as it was from the mainland US, Alaska was, in effect, a huge island accessible only by sea and air. The remoteness of the territory, lack of a developed economy, and rugged terrain made ground transportation uneconomical and virtually impossible. Air resupply was limited by the technology and size of aircraft existing in the 1930s and 1940s. Sea transportation was the only practical means of moving supplies, men, equipment, and machines the nearly 2,000 sea-miles from Seattle to the naval headquarters on Kodiak island.



Map of Aleutian Islands.

The supply pipeline stretched 505 sea-miles from Kodiak to Cold Bay on the Alaska Peninsula, 185 more to the major naval base in the Aleutians at Dutch Harbor on Unalaska Island, and 60 more to Fort Glenn on Umnak (the westernmost airstrip in the Aleutians), for a total of 750 miles from Kodiak to Fort Glenn, and about 2,750 miles from Seattle to Fort Glenn. Before makeshift airstrips were constructed farther west in the Aleutians, bombers had to fly 536 miles (air is more direct than sea) from Fort Glenn to attack Kiska. Attu was 200 miles farther west and out of range of US bombers. (6:5)



Troops set up camp on Umnak Island.

Navy ships had to navigate a minimum of 1,500 miles (including return trip) through some of the most treacherous seas known to man to attack Kiska from Dutch Harbor. Making matters worse, inaccurate navigational charts added more danger and chaos to the almost impossible task of blockading the western islands held by the Japanese and protecting Alaska against attack. Still, the mission of the Navy and the Army Air Forces was to patrol the waters around the length of the Aleutians (1,200 sea-miles one way) to choke off the Japanese resupply efforts, regardless of the weather, supply shortages, and the constant threat to the Navy from deadly Japanese submarines. The vast distances stretched supply lines to the limit. However, US shipping was never seriously challenged. As if the sheer vastness of the area was not enough of a challenge, the foul Arctic climate proved devastating.

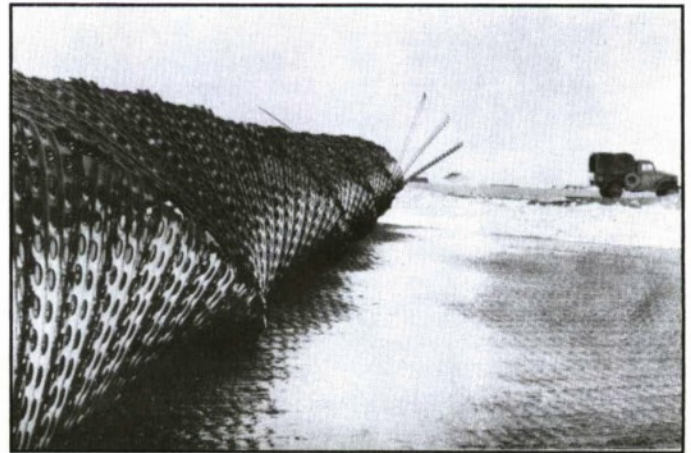
Climate

The Aleutians were (and still are) an unforgiving, desolate chain of mountainous volcanic islands barren of trees due to the cold and constant winds. Most of the year, the islands are hidden by dense fog and cold mists. Near-hurricane force gales, called "williwaws," blast the islands constantly, driving wind-chill factors (the phenomena was well-known but the term not yet coined in 1942) well below freezing most of the year. The water temperature surrounding most of the islands is usually in the 30s (Fahrenheit), dooming downed airmen to quick deaths. In short, the Aleutians are a miserable, wind-swept, barren place generally unfit for man and beast.

The Arctic temperatures posed a constant threat of danger from exposure and frostbite. Trench foot was common because troops lacked proper warmth in their quarters and good, clean socks and footgear for their feet. The wind and cold were so miserable that men would often prefer to suffer in their tents than venture out into severe Aleutian weather (they lacked the

comforts of permanent shelters, mess halls, laundry facilities, and other services now considered necessities). The wind blew down tents and crude buildings. Aircraft and ground vehicles often had to be tied down when not in use.

The cold made aircraft maintenance and all outdoor work very dangerous. The bases in the Aleutians did not have aircraft hangars and permanent facilities so all maintenance was accomplished in the open air. Gloved fingers lacked dexterity for many tasks, but the job had to be done, so men often labored with exposed hands. Exposed skin would freeze in a few short minutes and frostbite was a common ailment among support and combat troops alike. Fingers would stick to the cold metal airframes and were removed with the loss of several layers of skin.



Fierce winds roll over steel runway (weight 8 tons).

The extreme cold took its toll on aircraft as well as men. Hydraulic systems would freeze up, lubricating oils would thicken and become unusable, and any system requiring water would usually be frozen. The only way to keep airplanes flying was to drain the oil from the engine after each flight and store it in a relatively warm place. Before the next flight, mechanics would warm the engine with a blowtorch and then add the "warm" oil when the engine was also "warm." Only then could they start the engine and prepare for takeoff.

Search and Rescue operations were hampered by the williwaws, which would spring up suddenly and crash planes into the sea, landing strip, or a mountain. They claimed many aircraft and lives of crewmen during the war. In fact, more planes were damaged by the weather than the enemy. Rescue attempts were often futile as the icy waters claimed men's lives in a matter of minutes. The islands offered little shelter from the winds and storms, and men soon died of exposure if not properly clothed or if seriously injured.

The thick fog which constantly surrounds the islands was also a danger. Unsuspecting pilots crashed into mountains, and on more than one occasion ships collided. Visibility was often measured in inches. Opposing forces sometimes passed within a few hundred yards of each other undetected. Ships would use the fog as a screen to slip past superior enemy numbers, as the Japanese did to evacuate Kiska in 1943. The fog also could be used for surprise, as when the Japanese invaded the islands in 1942, and when the Americans invaded Attu. Some of these problems were alleviated by the introduction of radar in 1943, but it often did not work well and other essential instruments would fail. Besides, the theater was basically secured by the end of the summer in 1943, and technological innovations and

logistical improvements took place too late in the war to help in the Aleutians.

In general, the cold weather conditions claimed more casualties than enemy gunfire. (6:5) For example, the Battle of Attu resulted in more casualties due to the weather/climate (severe cold injuries, exposure, trench foot, frostbite) than were wounded by enemy fire. (4:266,267)

Infrastructure

Alaska was largely undeveloped with no infrastructure to support the war machine which landed in late 1942 to expel the Japanese invaders. There were neither roads nor rail lines to speak of. As unprepared as the US was for war, funds were not available to build an infrastructure. Not only was money a constraint, but so was time. Besides, Alaska was last priority for both Congress and the War Department. The first airfields were funded by diverting money from other projects, which was illegal, but effective. Funds, men, equipment, and machinery eventually arrived to support the invasion of Attu, but the required infrastructure was actually built by Alaska Defense Command's own group of support personnel and engineers.

The theater commander, Lieutenant General Simon B. Buckner, Jr., Commander, Alaska Defense Command, had to build his own communication, supply, and transportation networks to support his troops. All bases were made from scratch. To prepare for the invasions of Attu and Kiska, Buckner's engineers constructed over 30 airfields and 14 bases, devised ferry and air service commands, and built miles of rail lines and roads. The airfields were hastily constructed with runways consisting of pierced-steel planks which sometimes buckled under the weight of bombers due to a lack of a firm foundation. Also, the edges were dangerous and ruined dozens, perhaps hundreds, of tires.

Shipping was not much better off since most of Alaska's ports were frozen nine months out of the year. This presented another logistical challenge—scheduling ships to deliver a year's supply of equipment, food, and weaponry in three months. Of course, not all ships were frozen out of all of Alaska's ports and some delivered goods year round.

When supplies finally began to arrive in large numbers, ports lacked the capability to move goods from debarkation sites to bases scattered throughout the Aleutians. The fog, enemy submarines, icy storms, lack of good ports, and limited air cargo capability all combined to limit the speed at which the Aleutian bases could be supplied and reinforced. However, as limited as both sea and air transportation were, ground transportation was infinitely worse off.

Roads for moving jeeps, trucks, and artillery were virtually nonexistent. General Buckner had to build any roads he needed for resupply. The few roads in service were often covered in deep mud since water could not drain off through the frozen permafrost. Invading Attu was an extraordinary challenge because heavy artillery had to be dragged from the beach toward the enemy on the mountains through thick mud. The engineers tried to level a road but could make little progress. The elements prevailed and thick mud soon trapped heavy artillery, such as the 105-mm howitzers, making their use limited. Marching through the mud was just as challenging. Many times men would leave their boots stuck in the mud because the only way they could move was to pull their feet out of the boots! This, of course, created major health problems.

The Alaska Highway played no significant role in resupply efforts. (1:34) A pioneer road was completed in 1942 and

improved in 1943, but the outcome in the Aleutians was settled by then. Actually, the highway was never really intended to resupply the Alaska Defense Command. The purpose of the highway was to serve the chain of airfields used to ferry lend-lease aircraft across the northwest to the Soviets, not to supply the troops in Alaska. (1:34) Rail transportation faced the same obstacles in Alaska as roads.

The only railroads were short lines serving some mining operations and two narrow gauge lines, one linking Skagway to Whitehorse and the other connecting Fairbanks to Seward and Anchorage. (3:226) Buckner's engineers built several short lines to help move supplies from ports to military bases on the mainland. One 60-mile stretch of track involved tearing up an old mining track, transporting the materials over the rugged terrain, and then reconstructing the track to link two vital supply points.

Compounding the supply difficulties was a lack of local food stuffs available to supplement the troops' diet. Alaskan agriculture could only support one-tenth the needs of the native population, making Buckner's army dependent on supply by sea and air. (4:48)

There existed no steel, construction, or other industries to support the military buildup. All needs (save some timber available from the interior) were shipped the vast distance from Seattle or ports in California to Alaska. Even when supply ships began to arrive regularly, supplies idly sat by in ports waiting unloading or shipment because of the lack of loading/unloading equipment and infrastructure to move the needed commodities to the dispersed bases. Buckner thus spent large sums of money and valuable hours of engineer and support troops building infrastructure rather than directly engaging the enemy. Unfortunately for the United States (more so for the troops involved), this lesson was not learned and recurred in both the Korean and the Vietnam Wars.

Lessons Learned

Despite the challenges of the geography, climate, and lack of infrastructure, the US forces rid the Aleutians of the Japanese invaders in 15 months. Many lessons were learned along the way to victory; some were applied to other theaters in the Pacific saving thousands of lives and limbs in World War II, Korea, and Vietnam, while others were not learned and the mistakes repeated in Korea and Vietnam.

Many of the problems encountered in Alaska were due to poor planning. The Aleutians could have easily been defended had Congress heeded Billy Mitchell's warnings and provided strong military bases before war broke out. (5:311) The cost for this mistake was 2,500 American casualties, thousands of tons of bombs and other weaponry, and scores of planes and ships sorely needed in other parts of the Pacific. Most of the infrastructure problems could have been averted had ports, bases, railroads, communications, and roads been built prior to the attack on Pearl Harbor.

Some of the lessons were applied to develop better cargo unloading equipment such as an A-Frame cargo hoist developed at Massacre Bay. Amphibious landing craft were first used in the invasion of Attu, and some of the "bugs were worked out" of the Landing Ship Tank (LST) and other craft. Crews learned how to handle their new craft in the choppy waters around the Aleutians and used their experience for other Pacific assaults, such as MacArthur's island-hopping campaign.

The concern for equipment operating in extreme cold led to research to develop multi-viscosity oils and lubricants. The difficulties of operating and maintaining aircraft in subzero

temperatures helped the military focus on the importance of designing aircraft which can be easily maintained in the field.

Pilots learned how to use radar to better advantage and passed on this knowledge as well as practical tips on foul-weather flying (especially fog) to pilot training courses and pilots in other theaters of war. Lessons learned in cold-weather flying proved invaluable to later war efforts as well as civilian uses.

Advances in medical treatment for battlefield medical care were among the most important and best-applied lessons. The Battle of Attu was one of the first uses of the open-air surgical units used in World War II, which later evolved into the better-equipped and better-manned Mobile Army Surgical Hospital (MASH) units made famous by the Korean War. Civilians and soldiers benefited by the knowledge gained and passed on by volumes of studies on the causes and treatment of cold weather ailments, including frostbite and exposure.

Perhaps the greatest lesson learned from the "War in the Williwaws" was the importance of training and clothing the troops properly for the climate. Casualties in the Battle of Attu were high largely because the bulk of the men, the US Army's 7th Division, were fresh out of desert training in San Luis Obispo, California. (3:64) The men were neither physically nor mentally prepared for Arctic warfare—they were planning on going to North Africa. They were hastily equipped with "Arctic gear," including the poorly-conceived Alaska Field Jacket and leather boots. Their jacket consisted of a cloth interior, wool inside, small collar, and no hood. It was forever soaked by the mist and humidity, and the other clothing was not warm enough. The boots, lacking rubber soles, did not keep men's feet dry or warm enough for the foul Arctic conditions. This tragedy occurred despite the fact that Alaskan scouts had special suits designed by a research group in Alaska and the Navy issued hooded parkas and good boots to its men. The result was hundreds of limbs and lives needlessly lost due to frostbite, trench foot, and exposure. The whole affair was so embarrassing to the military that press reports in the States were purposefully low-key and lacking in details—uncharacteristic for such a great Allied victory. This is probably one reason why the Aleutians never have gained much ink or fame.

However, other theaters did benefit from these costly mistakes. The Army changed footgear, clothes, tents, bedrolls, and rations to accommodate the cold and became more sensitive to the specific climatic needs of its troops. The invasion of Kiska was much better planned. The men received special training in Alaska and were issued suitable clothing, and LSTs were ready for assault.

The Alaska Defense Command actually had its own research group for cold weather warfare, but all requisitioned supplies came from the States because Alaska did not have the resources to provide the recommended food, clothing, and equipment. This effort highlighted the need for a systematic approach to the feeding of, and provisioning of, the troops; but the war machine was already too well entrenched to accept much change (the application of these efforts has often been consistently lacking in every conflict the US has engaged in except perhaps Desert Storm).

Summary

The war in the Aleutians has not been well-publicized, and not a lot has been published about the conflict. Most references

to this theater of operations come from historical annals recording the important events of World War II or the development of Alaska (not even much of the latter). Other theaters were more glorious and glamorous, with Marines storming the beaches, war correspondents recording each event, and heroic acts of bravery against overwhelming enemy numbers or firepower. However, a savage, brutal campaign was fought in the Aleutians from which many important logistical lessons were learned (or not learned).

Logisticians faced formidable obstacles, including a very foul climate, rugged geography, and a lack of adequate infrastructure. True of the US, in general, Alaska and the military were not properly prepared for war. (7:6) The major lessons learned improved forward medical care at the battleground, treatment for frostbite and other cold weather ailments, considerations for cold weather equipment and materials for aircraft maintenance, and cold weather gear and rations.

Lessons not learned probably relate to the importance of proper logistical planning, including the infrastructure, aircraft/equipment design for ease of repair, and a truly integrated logistics effort that spans interservice rivalry and political considerations. While it appears that many of these lessons were learned and applied in Desert Storm, the very real threat we face is that the victory may ease the emphasis on continual improvements while the pressure of smaller budgets pushes logistics planning lower on the priority list.

My hope is that this paper will encourage logistics support and operational people to study the historical record and glean important lessons learned by other generations of soldiers, so we will not be doomed to repeat their mistakes.

References

1. Bykofsky, Joseph, and Larson, Harold. *United States Army in World War II, Vol III: Technical Services, The Transportation Corps, Operations Overseas*, Department of the Army: United States Government Printing Office, 1957.
2. Cant, Gilbert. *The Great Pacific Victory*, New York NY: John Day Company, 1945.
3. Conn, Stetson, and others. *United States Army in World War II: Guarding the United States and Its Outposts*, Department of the Army: United States Government Printing Office, 1957.
4. Garfield, Brian. *The Thousand Mile War*, New York NY: Bantam Books, 1969.
5. Gruening, Ernest. *The State of Alaska*, New York NY: Random House, 1954.
6. Morison, Samuel Eliot. *History of United States Naval Operations in World War II, Vol VII: Aleutians, Gilberts, and Marshalls June 1942-April 1944*, Boston MA: Atlantic, Little, and Brown, 1955.
7. Peppers, Jerome G., Jr. *Military Logistics: A History of United States Military Logistics 1935-1985*, Huntsville AL: Logistics Education Foundation Publishing, 1988.
8. Rutenberg, David C., Lieutenant Colonel, USAF, and Allen, Jane S., editors. *The Logistics of Waging War: American Military Logistics 1774-1985*, Gunter Air Force Station AL: Air Force Logistics Management Center, undated, issued December 1986.

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(Photos courtesy of US Air Force Museum, Wright-Patterson AFB, Ohio.)



Impact of Electronics Obsolescence on the Life Cycle Costs of Military Systems

Virginia C. Day
Zachary F. Lansdowne

Introduction

Owing to the rapid evolution in electronic technologies, especially integrated circuits (ICs), many manufacturers have discontinued the manufacture of parts that were designed only a few years ago. A part is said to be *obsolete* when it is out of production or is about to go out of production. As we shall discuss in this article, obsolescence has important implications for the design, modernization, support, and cost of Air Force military systems.

The obsolescence problem for the defense industry is illustrated in Figure 1, which is reproduced from a recent study by the Office of the Assistant Secretary of Defense for Production and Logistics. (1) This diagram shows that the typical life cycle of an electronic part lasts from 4 to 7 years, but the life cycle for a military system could last up to 25 years. (In fact, many military systems remain operational longer than this.) To make matters worse, peak defense use of a given microcircuit technology occurs long after the peak in production and commercial use for the technology. There are several reasons for this lag. First, testing and certification requirements for the military are much more stringent than those for the commercial sector. Second, the requirements for the various design reviews for military projects dictate that the design be frozen long before the start of production. And third, because the defense industry makes up only about 5% of the overall electronics market, it has little ability to influence component manufacturing plans. For all these reasons, a military system with a long service life will almost certainly experience obsolescence in at least some of its electronic parts.

Frontline military systems, such as F-15 and B-1 aircraft, rely on ICs that are now obsolete. Brand-new systems, such as the B-2 stealth bomber, may contain obsolete parts even before they are deployed. Many older Air Force systems in the field, such as the ground HF (high frequency) Communications Systems being modernized under Scope Command, are experiencing

parts obsolescence problems. Obsolescence will continue and probably accelerate in the future due to both the increasing rate of technology development and the fact that, with dwindling military budgets, fewer new systems will be acquired to replace those systems currently operating in the field.

When discontinuing a device or a part, the IC manufacturer has the responsibility of notifying the user community of its plans, which is done by distributing a Diminishing Manufacturing Source (DMS) Notice. To appreciate the magnitude of the obsolescence problem, consider the following statistics. The Defense Electronics Supply Center (DESC) currently manages about 57,000 IC parts and received 4,100 DMS Notices in 1991 for those parts. Thus, about 7% of the IC parts disappeared from the manufacturers' assembly lines in that year. DESC has a DMS master file that contains data on 47,000 obsolete parts that were removed from assembly lines during past years. (2) Figure 2 illustrates the annual increase in the number of obsolete electronic parts during recent years, and this figure shows an increasing trend. It has been estimated that the obsolescence problem has cost the military services \$27 billion over the ten-year period beginning in 1982. (3)

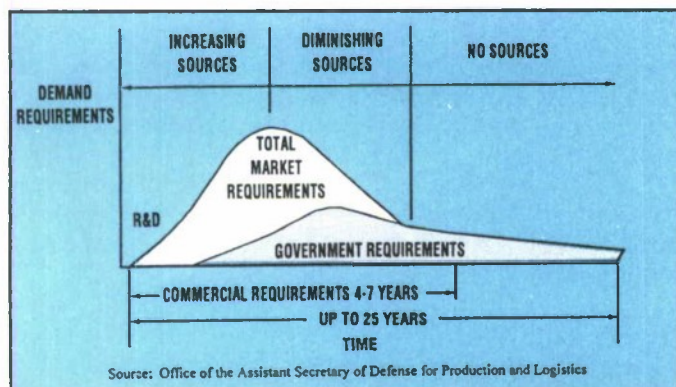


Figure 1. Commercial and Government Requirements Over Time.

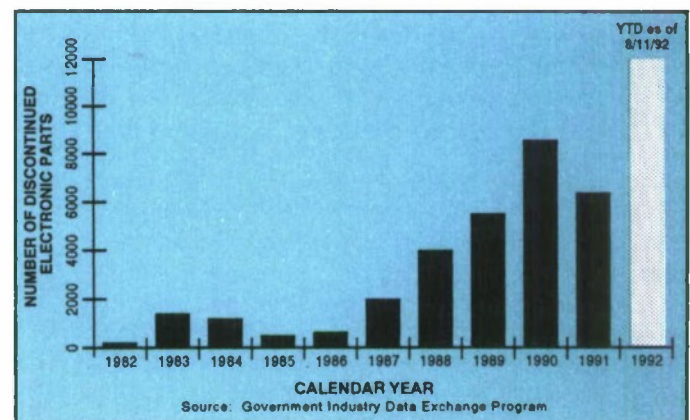


Figure 2. Increase in Number of Obsolete Electronic Parts Over the Past Ten Years.

Methods of Obsolescence Resolution

After receiving a DMS Notice from the last manufacturer for a given part, a user must find some method for obtaining spare parts for the military system. The following methods could be used and are listed in order of increasing complexity:

(1) *Alternative sources.* Even though a manufacturer has stopped producing a microcircuit, inventory may still be available at one of many distributors and suppliers throughout the United States. It may also be possible to obtain a limited number of items through cannibalization.

(2) *Substitution*. Because there may be multiple versions of the same microcircuit that have been tested and qualified with different specifications, it may be possible to find a substitute part that meets all technical requirements. For instance, if the Air Force has more stringent specification requirements than the Army for the same microcircuit, the Air Force version of the item could be used to meet the Army requirement.

(3) *Minor engineering*. If a minor engineering change is made to a commercial part, it may be possible to transform the part into an acceptable substitute. Examples of a minor engineering deviation include: (1) change the lead finish from gold to tin; (2) change the packaging type from a flat pack to a ceramic dip; and (3) add circuitry at the chip's periphery to slow it down to match the original specification.

(4) *Life-of-type (LOT) buy*. A LOT buy refers to purchasing the estimated total quantity of a part needed during the remaining life of its host military system. By law, the original manufacturer must give the government ample time to consider a LOT buy before the part is discontinued. DESC is responsible for making LOT buys for the military services and for storing the components. However, the Center often lacks adequate funding to make LOT buys and may not have sufficient information on chip use, failure rate, etc., to predict accurately the number of ICs of a particular type required by all of its customers.

(5) *Repackaging*. Repackaging is simply attaching leads to a die (silicon chip) and encasing it inside the IC case. Often when the dies for ICs are manufactured, not all of them are packaged right away and some are purchased by aftermarket vendors at the end of a manufacturing run. These dies are then placed in special dry nitrogen storage containers to prevent deterioration until they are needed. Repackaging provides an exact replacement for an IC part as long as dies are available.

(6) *Remanufacturing*. Here, aftermarket vendors maintain a production base for particular items in demand without limit on the quantity of ICs that can be produced. There are three types of remanufacturing approaches: with the original mask, with complete design information, and without complete design information. The last type requires the IC design to be extracted by reverse engineering. Because it is very expensive to open a manufacturing line, several thousand chips need to be produced at a time to make any of these options cost-effective.

(7) *Emulation*. This method uses current technology to make a new electronic part that performs the identical functions of an obsolete part. The new part is guaranteed to have the same "form, fit, and function" of the one that it replaces. Due to unknown peculiarities in the original part, however, an emulated part that works in one military system may not work in another system that uses the same original part. Another problem is the high cost of nonrecurring engineering to design and develop the new part. One advantage of this option is that an emulated chip can always be reproduced in the future if more are needed.

(8) *Redesign*. If a system contains multiple obsolete components, it may be less expensive to redesign the entire system than to emulate each obsolete part. In addition, redesign offers the opportunity to improve the operational performance and/or reliability. For instance, it might be possible to replace a board or even a box with much simpler circuitry, thereby increasing reliability with the use of multi-chip modules, field programmable gate arrays, or simply newer integrated circuits with greater capability.

As shown by the foregoing list, there may be many ways for a project manager to resolve a given obsolescence problem. In choosing a solution, the main questions to consider are:

(1) How many years must the solution last?

(2) How well does the system, board, or box function in terms of both operations and reliability?

(3) How many other ICs in the board, box, or system are also obsolete, or will become obsolete during the remaining service life of the system?

(4) How many of the obsolete ICs are likely to be needed?

(5) What options are available, and what are their relative costs?

(6) What is the impact of the chosen replacement strategy on operations and maintenance costs?

Table 1 gives investment cost ranges for the various solution options, and Table 2 summarizes their pros and cons. This information was obtained from organizations (Table 1) that employ these options. In general, an alternate source is the least costly option, followed by simple substitution and a minor engineering change. However, these first three methods are not always available. If the host military system has many years of service left and suffers from reliability and operational problems, redesign may be a good solution, especially if many of its electronic parts are or will become obsolete in the near future. The main difficulty with redesign is its cost, which ranges from around thirty thousand dollars for a very simple circuit to over a million dollars for a large, highly complex board. If the system is functioning well and only one or two of its ICs are obsolete, emulation either at the part or card level may be a good choice. Individual part replacement with a nonpermanent source, such as a LOT buy or alternate source, may be the best choice if the system will be replaced shortly. A life cycle cost (LCC) calculation that takes into account the increased parts costs will aid in the decision. A model for one option is discussed in the next section.

Life Cycle Cost Model of LOT Buy

Suppose we have identified ICs that are nearing obsolescence or that have the greatest potential for obsolescence. Then there are three steps (two of which we will discuss) in calculating or revising an LCC estimate for an approach to solving the obsolescence problem. First, the onset of obsolescence should be predicted for each selected IC part within the military system. Second, one-time investment costs and a new unit replacement cost should be computed for each IC part and for each year within the remaining service life of the system. And, finally, these new factors should be used when computing the annual replacement costs, which are part of the LCC for the military system.

The first step in the foregoing list requires forecasting the IC commercial life cycle. This life cycle is generally thought to have five stages, and the typical names for these stages are development, design-in, mature, decline, and phaseout. The usage of technology begins and increases during the first two stages. The sources for the technology are limited during the first stage but become widely distributed during the second stage. The usage peaks and levels off during the third stage and then declines during the fourth and fifth stages. The fourth stage begins when the technology is no longer used in the design of new products. The fifth stage begins when there remains only one source for the technology and ends when that last source disappears.

References 4 thru 6 estimated the length of each of the five stages in the IC life cycle, and references 5 thru 10 classified the various IC technologies with respect to these five stages. For instance, Table 3, which is based on data from Westinghouse (6) in 1992, gives estimates of the stage lengths and also classifies the positions of 24 technologies.

Type	Source* (for both solution and cost)	Nonrecurring Engineering (\$K)	Cost Multiplier Per Part (times original cost)
Alternate Source	Aftermarket vendor, e.g., Rochester and Lansdale	None	1 - 4
Substitute	Other military service	None	2 - 8
Life of type (LOT)	DESC or part manager	None	2 - 15
Repackage	Aftermarket	10 - 50	5 - 20
Remanufacture	Aftermarket or AETC, HTT, NAWC, etc.	30 - 100	10 - 30
Minor Engineering	Commercial or after market	10 - 50	10 - 50
Emulation	GEM, AETC, ITD/CRMP	100 - 150	10 - 100
Board Redesign	AETC, HTT, NAWC, ITD/CRMP	100 - 500+	N/A
*DESC	Defense Electronics Supply Center, Dayton OH		
AETC	Advanced Electronics Technology Center, Sacramento CA		
HTT	Hardware Technology Team, Ogden UT		
NAWC	Naval Air Warfare Center, Indianapolis IN		
GEM	Generalized Emulation of Microcircuits, Sarnoff Research Center, Princeton NJ		
ITD/CRMP	Institute for Technology Development/Center for Replacement of Military Parts, Starkville MS		

Table 1. Obsolescence Solutions.

Solution	Pros	Cons
Alternate Source	Lowest cost; no technical risk	If there are only a few suppliers, the part may be unavailable soon; quality of parts may be poor due to improper storage.
Substitution	Low cost; low technical risk.	Quantity may be limited; if the substitute part was specially screened or qualified, its cost may be higher than that of its standard counterpart.
Minor Engineering	May improve reliability and be a permanent solution.	Design changes require retesting qualification, and documentation, which are costly.
LOT buy	Low cost; no technical risk.	Difficulty in forecasting the required demand; budget constraint may prevent the entire purchase; quality of parts may be poor due to improper storage.
Repackaging stored dies	Little effort is involved; low technical risk.	Quantity may be insufficient; quality may be poor; may need requalification.
Remanufacturing	Ensures more or less permanent supply; should be exact replacement; may involve little effort and risk.	May not be possible; considerable effort is involved when documentation is unavailable and must be extracted with reverse engineering.
Emulation	May be a permanent solution.	High nonrecurring costs make small production sizes expensive; high technical and schedule risk.
Redesign	May improve the system functionality, reliability, and maintainability; may provide the greatest lifetime extension.	Usually the most expensive option at least initially; high schedule risk.

Table 2. Pros and Cons for Obsolescence Solutions.

Suppose that we wish to predict when a given IC part might become obsolete. If we are able to estimate the current stage for its technology, then we can use the stage lengths in Table 3 to forecast the onset of obsolescence. If the part is in an early stage, then the ranges in Table 3 imply a large amount of uncertainty about when obsolescence would occur. In such a case, we may wish to represent the uncertainty with a probability distribution and compute expected costs (discussed further).

If we have predicted that a given part will be obsolete at some point within the remaining service life of its host system, the next step is to determine a new unit replacement cost for it. Eight different methods for dealing with obsolescence were described earlier. To illustrate the application of one of these methods, we shall derive formulas giving the unit replacement cost of a LOT buy.

(There are several justifications for this choice. First, the government always has the legal right to make LOT buys and often does make such buys. For instance, Edmund Westcott, former US Air Force technical director of product assurance and acquisition logistics, was quoted as saying: "Historically, we have approached the (obsolescence) problem with a life-of-type buy." (11) Because the government would prefer an alternative method only if it were cheaper than the LOT buy, the cost for the LOT buy is often an upper bound on the cost that actually occurs. And, finally, the analysis for the LOT buys is relatively simple and does not require any cost estimates for engineering or design changes. The other methods may be analyzed similarly, once the engineering and design work has been defined and costed.)

Let p be the unit replacement price for the given IC part prior to obsolescence. If we assume that this price remains constant as long as the part remains in production, then p is also the cost per unit for a LOT buy. Suppose that the part becomes obsolete in year r and the government makes a LOT buy at the end of that

year. According to instructions from the DESC Directorate of Engineering Standardization (12), the annual recurring costs should be expressed in terms of present value within a cost-benefit methodology used for controlling spare parts; the implication is that the LOT unit price must be translated to a unit replacement cost for each year the part is used. The relevant factors are i , the annual discount rate (assumed to be positive), and h , the annual holding cost per dollar of inventory, which includes the expenses for storage, deterioration, and excessive purchases. If the part is actually used at the end of year t , where $t > r$, the total discounted (or present-value) purchasing and holding costs for the part are

$$p + hp(1+i)^{-1} + \dots + hp(1+i)^{-t} \quad (1)$$

Let c_t be the effective unit replacement cost for the part in year t , which is after the part has become obsolete. In other words, if we could buy the part in year t , then c_t is the unit price that would make the discounted costs the same as formula (1). According to this definition,

$$c_t(1+i)^{-t} = p + hp(1+i)^{-1} + \dots + hp(1+i)^{-t}$$

By multiplying each side by $(1+i)^{t-r}$, we obtain

$$c_t = p(1+i)^{t-r} + hp(1+i)^{t-r-1} + \dots + hp$$

which is equivalent to

$$c_t = p(1+i)^{t-r} + hp[(1+i)^{t-r} - 1]/i \quad (2)$$

Phase	1	2	3	4	5
Period	Development 1 - 3 Yrs	Design-In 1 - 5 Yrs	Mature 4 - 10 Yrs	Decline 1 - 3 Yrs	Phaseout 1 Yr or Less
Projected					
Time to DMS	7 - 22 Yrs	6 - 19 Yrs	5 - 14 Yrs	1 - 4 Yrs	Within 1 Yr
Occurrence					
Technology Groups*	VHSIC GAAS RISC BICMOS	CMOS FAST EEPROM 512K	ECL-100K PLD ALS BIFET HCMOS	ECL-10K NMOS BP-PROM CMOS MG PROM 256 LS	BIPOL DTL TTL STT LTTL HTTL
<p>* VHSIC = Very High Speed Integrated Circuit, GAAS = Gallium Arsenide, RISC = Reduced Instruction Set Computer, BICMOS = Bipolar CMOS, CMOS = Complimentary Metal Oxide Semiconductor, FAST = Fairchild Advanced Schottky TTL, EEPROM = Electrically Erasable PROM, ECL = Emitter Coupled Logic, PLD = Programmable Logic Device, ALS = Advanced Low-Power Schottky, BIFET = Bipolar Field Effect Transistor, HCMOS = High-Speed CMOS, NMOS = Negatively Doped Metal Oxide Semiconductor, BP-PROM = Bipolar-PROM, MG = Metal Gate, PROM = Programmable Read-Only Memory, LS = Low-Power Schottky, BIPOL = Bipolar Technology, DTL = Diode Transistor Logic, TTL = Transistor Transistor Logic, STT = Schottky TTL, LTTL = Low-Power TTL, HTTL = High-Speed TTL</p> <p style="text-align: right;">(Source: Westinghouse Electric Corporation (1992))</p>					

Table 3. Integrated Circuit Commercial Life Cycle (1992).

What parameter values are appropriate? According to the latest version of the Office of Management and Budget Circular A-94 (13), $i = 0.07$ should be used as the annual discount rate. According to the General Accounting Office (14), DESC uses the factor $h = 0.09$ to cover the inventory costs of storage, excessive purchases, and deterioration. The price prior to obsolescence is assumed to be $p = \$1.00$. Given these values, Figure 3 shows the effective unit replacement cost as a function of the number of years ($t - r$) that the LOT buy must supply. The curve crosses the vertical axis at \$1.00 and then rapidly increases as the number of years increases. For instance, if the part is obsolete for 10 years, then the effective unit replacement cost is \$3.21. If the part is obsolete for 20 years, the cost is \$7.56.

Because formula (2) is directly proportional to the original price, p , we can use Figure 3 to evaluate the effective unit replacement cost for any arbitrary value of p simply by multiplying the scale of the vertical axis by p . For instance, suppose that $p = \$10.00$, which means that we should multiply the vertical scale by a factor of 10. Thus, if the part has been obsolete for 20 years, the effective unit replacement cost is \$75.60.

When estimating the onset of obsolescence, suppose that we represented the uncertainty in the forecast with the distribution $f(r)$, which is the probability that the part will become obsolete in year r . In this case, the effective unit replacement cost for the part in year t is

$$c_t = \sum_{r=y}^t (p(1+i)^{t-r} + hp[(1+i)^{t-r} - 1]/i) f(r) + p \sum_{r=t+1}^{\infty} f(r), \quad (3)$$

where y is the current year.

For instance, suppose that $f(r)$ is the uniform mass function over the years from L to U . In other words, $f(r) = 1/(U-L+1)$ for r between L and U , and it is zero outside this range. If $L \geq t$, then $c_t = p$. But if $y \leq L < t$, then (3) becomes

$$c_t = [p/(U-L+1)] \left\{ \sum_{r=L}^{\min(t,U)} [(1+i)^{t-r} + h[(1+i)^{t-r} - 1]/i] + |U-t| \right\},$$

where $|U-t|$ refers to the absolute value of $U-t$.

An LCC analysis is a necessary part of selecting a solution method for a particular obsolescence problem. If the military system will remain in service for a long period, IC replacement methods with low initial cost may have higher LCC than a

solution that is more comprehensive and initially costly. On the other hand, if the system is scheduled to be phased out within a few years, individual part replacement will probably be the best choice even if many parts must be replaced and some of the replacements are very costly.

References

- Office of the Assistant Secretary of Defense for Production and Logistics, *Report on Diminishing Manufacturing Sources and Material Sources*, Supply Management Policy Directorate, Deputy Assistant Secretary of Defense for Logistics, Washington DC, 1991.
- Adams, C. "DOD's Troubles with Obsolete ICs Keep Growing," *Military & Aerospace Electronics*, March/April 1991, pp. 23-26.
- Joint Technical Coordinating Group on the Microelectronic/Electronic Component Production Base, *Background Document For the Final-Presentation Report*, Joint Secretariat, US Army Materiel Command, February 1988.
- Macaruso, E. "DOD Vexes IC Makers," *Electronics Week*, 4 February 1985, pp. 63-67.
- Stolinski, R., and Leonard, J. "Parts Obsolescence: A New Concern for EEs," *IEEE Potentials*, October 1987, pp. 39-41.
- Westinghouse Electric Corporation, briefing presentation, "A Systems Approach to Solve Diminishing Manufacturing Sources Material Shortages (DMS) Problems," Baltimore MD, 1992.
- Lineback, J. R. "Civilian Chips Don Uniforms," *Electronics Week*, 4 February 1985, pp. 42-74.
- Leopold, L. "Shortage of Obsolete Chips Makes it Tough on Military," *Electronics*, 14 October 1985, pp. 42-43.
- Baca, M. "Technology Advancement and the Obsolescence Impact on Military Electronics," *Proceedings: 1990 Government/Industry Parts Non-availability (DMS) Symposium*, Office of the Assistant Secretary of Defense Production and Logistics, 1990, pp. 277-285.
- Greer, W. T. "Motorola's View of the Obsolescence Problem and Alternatives," presented at the DMS Conference sponsored by Rochester Electronics, Inc., 15 October 1991.
- Elliot, M. "Stay Ahead of Obsolete Parts," *Electronics Purchasing*, June 1988, pp. 66-71.
- Directorate of Engineering Standardization, *DOD Parts Control Program: Cost-Benefit Reporting Technique for Military Parts Control Advisory Groups*, CRPCP-88-01, Defense Electronics Supply Center, Defense Logistics Agency, 15 April 1988.
- Office of Management and Budget, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, Circular No. A-94, Washington DC, 29 October 1992.
- General Accounting Office, *Defense Inventory: Cost Factors Used to Manage Secondary Items*, Report to the Ranking Minority Member, Committee on Government Affairs, US Senate, GAO/NSID-92-112, Washington DC, May 1992.

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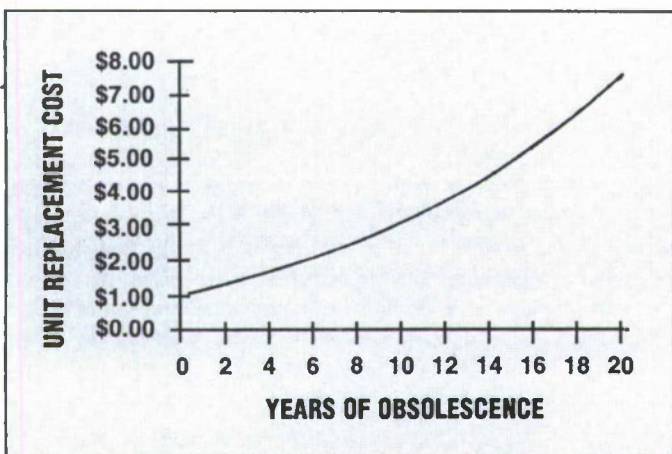
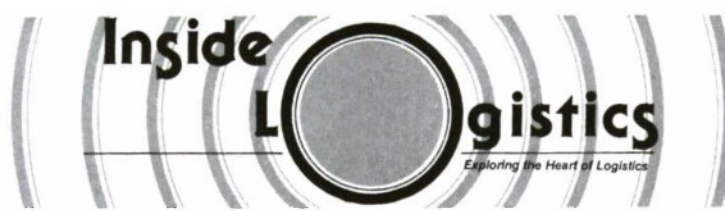


Figure 3. Effective Unit Replacement Cost as a Function of the Years of Obsolescence.



Logistics Status and Readiness (LOGSTAR)

First Lieutenant Matthew D. Cox, USAF

In May 1992, Colonel James Moore (now retired), 19th Maintenance Group, coined a term that has changed the way the 19th Air Refueling Wing looks at logistics and readiness. LOGSTAR, short for Logistics Status and Readiness, was conceived as a way to begin the quality benchmarking process for the Maintenance Group and to provide a clear method of tracking and reporting key logistics and readiness indicators.

Prior to LOGSTAR, the Monthly Maintenance Summary met a specific need—higher headquarters. The past system tracked and reported more than 300 statistics in maintenance and logistics. However, thousands of statistics still remained in the database ready to be used as needed. LOGSTAR tracks about 50 of these statistics monthly, with emphasis on “as needed.”

LOGSTAR began with a development plan and survey to see what measures people in the Refueling Wing thought were important with regard to logistics, aircraft maintenance, and readiness. Two products resulted from the initial survey: a weekly report (called the “Toolbox”) of frequently used logistics data and the LOGSTAR Handbook, an “owner’s manual” for the LOGSTAR Monthly Report. Both were welcomed by users and managers as providing timely and useful information for day-to-day operations and continuous improvement efforts.

“Toolbox” provides a snapshot of the status of mission capable (MICAP) and tail number bin parts for aircraft, due-in-from-maintenance parts, programmed depot maintenance schedule, the weekly flying schedule, aircraft on and off station, and time compliance technical order status.

The LOGSTAR Handbook gives users information on how logistics and readiness data is gathered and reported, and explains the tools and techniques used in quality improvement and process control. The handbook explains the mission, goals, data elements, and the application and management of the system. It offers practical guidance to the Wing’s Analysis Section when it produces reports, assisting Process Action Teams (PATs) or Quality Teams in data collection and reporting. The handbook is also the basic reference for logistics and readiness metrics within the Wing.

With chapter titles, such as “How Does LOGSTAR Fit In?” “So What Do I Do With All of This?” and “When and How to Act on the Data,” the handbook explains the tools and processes of continuous improvement in everyday language. The “So What Do I Do With All of This” chapter is a down-to-earth introduction to commonly used charts and techniques. The handbook also explains the details of contemporary statistical process control techniques and applications for those who wish to dig deeper into the various statistical techniques available. For example, a chapter on “Statistical Process Control Systems and Techniques” introduces subjects such as Defining the Need and System Requirements, Planning and Building the System, Troubleshooting, and Tips for Streamlining the Control System. Technical portions of the chapter include discussions on Process Capability, Confidence Intervals and Control Limits, Control and Attribute Charts, Analysis of Variance, and Regression and Correlation.

Two computer help programs, the LOGSTAR Help Program and the Statistical Process Control (SPC) Help Program, were

written to complement the LOGSTAR Handbook and provide instant reference to any subjects contained in the handbook. Additionally, a compilation of more than 200 quality decision-making forms and worksheets was developed to assist PATs in process management and improvement of the logistics systems reported in LOGSTAR. These files are available to all computer users for downloading from the 19th Air Refueling Wing Bulletin Board Quality Files Section.

The development of LOGSTAR has prompted a close review of several programs and processes in the logistics and readiness support of the Refueling Wing. Some of these include the management and training of the core automated maintenance system (CAMS) database, the CAMS standard base supply system interface, and Wing supply self-sufficiency reporting. Other areas highlighted for their improvement potential are upgrade, qualification, and mobility training; chemical warfare equipment management; mobility plans and processing; and MICAP parts time from order to receipt.

LOGSTAR will play a role in monitoring some of the significant changes in the operation of the Refueling Wing. The objective wing structure has offered areas of LOGSTAR application in the certified mechanic program and production team maintenance. LOGSTAR will further assist in the operation and improvement efforts in the Wing’s conventional mobility commitment and provide the means to monitor and streamline supply operations under the Defense Logistics Agency (DLA) and defense level repairables (DLR) office.

In concept, LOGSTAR begins with the unit mission statement. It then defines the major categories of supporting elements that enable mission accomplishment. It further defines data elements (or indicators) of each category. Finally, it outlines who, what, when, where, why, and how that data is used to support the mission.

LOGSTAR is the link between the detailed information created and collected on a daily basis, and the broad mission and vision objectives of the Wing, Air Mobility Command, and the Air Force. There has to be a strong foundation behind the scenes to see this through. This foundation is people. Now more than ever officers and senior NCOs must assume the roles of leaders, teachers, and supply technicians—leaders, to provide vision and goals; teachers, to impart the experience and knowledge they have been exposed to; and supply technicians, to give their people the tools they need to get the job done. As for the airman on the line, it will take a strong commitment to learning the job, focusing on what is important and why, finding the persistence to continue to strive for the best, and having the faith that one can attain it.

LOGSTAR is more than a response to the evolving quality culture in the Wing. It is a common-sense approach to a complicated system: logistics. It applies the contemporary tools of quality and follows the examples put forth by the Air Mobility Command and the Air Force. LOGSTAR, in itself, is not metrics. It does, however, have flexible characteristics which enable it to be adapted easily to metrics. Instead, LOGSTAR attempts to link the conceptual with the practical and the present with the future.

First Lieutenant Cox wrote this article while OIC, Maintenance Operations, Maintenance Group, Robins AFB, Georgia. If you have any questions on LOGSTAR, please call TSgt Davidson, 19th Maintenance Support Squadron/MALMP, Analysis Section, Robins AFB, DSN 468-3813.

STRATEGIC PLANNING - Managing Change

Major Diane J. McFain, USAF
Rick Forster

Business literature is discussing a new concept, "permanent white water." This concept states that the world is always changing, always turbulent; and organizations must learn how to manage in such an environment. Can we be sure what will change? No. New missions, leadership, technology, and organizational structures all require change. Can we be sure that change will occur? Absolutely. Recent events throughout the world and at home clearly illustrate that change is a fact of organizational life. It is critically important to understand how to manage in this type of environment, as change consumes more management and leadership attention than any other single issue. Its impacts can be devastating if we are not prepared.

How do we deal with change? Some organizations respond with denial or negativity toward the need to change. Others rush to do something, anything. Even the more positive approaches are all too often reactive. In other words, a change happens and then we decide how to deal with it. While our responses always produce results, we do not always pick the right responses because time, money, or pressure does not permit a thorough analysis of our options. To survive, organizations must become flexible in the allocation of resources and development of responses to change. Fortunately, there are better ways to manage change.

Since the late 1940s or early 1950s, long-range or "strategic" planning has been taught in the world's leading colleges and universities. In the mid-1970s, strategic planning experienced a revival and emerged as a proactive way for organizations to deal with change. Strategic planning is proactive because organizations can anticipate what changes will impact them and then develop appropriate strategies. By looking ahead, organizations have the opportunity to carefully craft their responses and ensure that change works for their betterment. The key is to make change work for the organization, not catch it unprepared.

Strategic planning has also changed the planning paradigm. No longer is it the province of "planners" brainstorming responses to future scenarios. The problem with this approach is that life rarely, if ever, emulates these scenarios. This leaves planners trying to drain the swamp while simultaneously fending off the alligators of change. Strategic planning puts the emphasis on dealing with issues that affect an organization's flexibility and its readiness to respond to new conditions. Planners have the ability to look beyond the day-to-day crises and identify the "strategic" issues which form the basis for managing change.

Strategic issues involve identifying the organization's mandates—determining what it must do in the future, not necessarily what it does now; understanding whom it must satisfy to be successful; and identifying the external and internal influences which can help or impede progress. The organization must know who judges its success or failure and who has a stake in that success or failure. It must understand its mission along with the strategic goals of that mission. The planners can then use this data to identify strategic issues that face the organization

and work with senior leadership to develop strategies of response. An orderly study and implementation of the strategies help the organization evolve into the future while continuing to accomplish its mission and satisfy its customers.

Many organizations, not just those in the private sector, are coming to this realization and are adopting this "strategic" line of thinking. *Planning Review* reports that over 75% of all companies now use strategic-management techniques, compared with less than 25% in 1979. (2:16) This includes businesses such as Westinghouse, Royal Dutch/Shell, Hewlett Packard, and Hershey Foods, as well as different public sectors such as the California Prison Authority, Federal Aviation Administration, Department of Transportation, Port Authorities of New York and New Jersey, and the Government of New Mexico. (1,2) They, and many others, now have various forms of staff support dedicated to strategic planning. Each may define the "future" differently, and the exact process may vary; but the end results are basically the same.

Royal Dutch/Shell credited strategic planning as the tool which enabled them to survive the oil crises of 1973. (1:4-1) Their prior planning positioned the company effectively within the volatile oil industry and prepared them for a future where oil prices might drop by 50%. When prices went down, they were ready. Another success story is PepsiCo's sales increase of 18.5% in 1989. (2:10) As a result of some business purchases suggested through their strategic planning efforts, PepsiCo expanded their overseas distribution and production network and are ready to capitalize throughout Europe.

Likewise, strategic planning concepts and principles can be employed in the Air Force, as we, too, are experiencing change. Our logistics mission of supporting the operational forces constantly challenges us, and operational mission changes directly impact our support posture. Budgetary and technology changes require that we be more innovative in finding ways to support our customers. Strategic planning provides needed information to make choices about the future as well as the environment in which organizational innovation will need to be developed and sustained.

The Air Force logistics community adopted strategic planning as a way of trying to understand and influence the future and dealing with rapid change. The first USAF Logistics Strategic Plan was produced in 1988, taking into consideration the expected environment at the time of its writing. The plan was built on a Logistics Concept of Operations consisting of ten concept elements and associated goal statements (Figure 1). The goals, broad-based statements of a desired mission capability, are supported by time-phased objectives. Each of the objectives provides a general direction to fulfill the goal. Each objective has a series of specific strategies which define actions to achieve the objective. Collectively, the concept of operations, goals, objectives, and strategies form the basis for the USAF Logistics Strategic Plan. A revision to the plan came out in October 1990, and another revision is soon to be published. Selected

Ten Elements of Logistics Concept of Operations

1. Mutual Support
2. Depot Support
3. Forward Support
4. Joint/Allied Support
5. Inter-Theater Transportation
6. Intra-Theater Transportation
7. Logistics Command and Control
8. Mobility
9. Air Base Operability
10. Space Systems Support

Figure 1.

MAJCOMs have been tasked to write their own Logistics Strategic Plans (see the new Air Force Policy Directive 20-1 which replaces AFR 400-13).

We realized strategic planning requires two things to be effective. First, we need an iterative process—not a one-time plan that is written and put on a shelf. It must be a process which continually prepares the organization for the impact of change. Second, something must happen as a result of this planning process—the strategic plan has to be implemented. That means we must manage change in accordance with the goals and objectives in the plan, not simply update the plan to reflect the changes.

Usually, achievement of the goals, objectives, and strategies stated in the plan requires resources (funding, staffing, etc.) be allocated. Consequently, the logistics community is working to create a bridge between the strategic planning process and the budget planning process both at HQ USAF and the MAJCOMs, where appropriate, to help identify the resources needed for strategic plan implementation. The Air Force requests, justifies, and allocates resources through the Program Objective Memorandum (POM) process, part of the Biennial Planning, Programming and Budgeting System (BPPBS). To help ensure that strategic plans can be tied to required resources, the logistics community developed a methodology to “link” planning strategies to POM program elements (PEs). This link shows Air Force leadership how the resources will be used and how they will improve logistics support to the Air Force mission. The methodology is called the Global Evaluation Process (GEP) and has been implemented in a small computer software decision

support tool and training package. This software has been distributed to all MAJCOMs and is available from HQ USAF/LGXX (Logistics Plans and Concepts Division). The GEP helps both logistics planners and budgetary programmers see possible impacts which budgetary decisions might have on their specific logistics strategic plan implementations. The methodology involves some initial effort to implement, but provides a very useful capability. It should be added that not all strategic planning strategies require a tie to the BPPBS—many needed changes for the future may involve policies or procedures.

In summary, strategic planning is a tool that can help us do our jobs better. It will help us prepare for the future and ensure that we are prepared to manage change. The old phrase “. . . the only thing constant is change . . .” is truer nowhere else. Despite the challenges it offers, strategic planning in the Air Force can bring many of the same benefits experienced by the civilian business community. Strategic planning is crucially needed if we ever want to escape the “dark ages” of reactive planning and is only as effective as the people using it. Additionally, strategic planning requires the strong endorsement of leadership or the process will flounder. In the world of permanent white water, strategic planning is a life preserver.

References

1. Booz, Allen & Hamilton Report, *Strategic Planning Scan*, 1990.
2. David, Fred R. *Concepts of Strategic Management*, New York NY: Macmillan, 1991.

Additional Sources

1. Below, Patrick J., Morrisey, George L., and Acomb, Betty L. *The Executive Guide to Strategic Planning*, San Francisco CA: Jossey-Bass Inc., 1987.
2. Hines, Gary. “Strategic Planning Made Easy,” *Training & Development Journal*, April 1991, pp. 39-43.
3. Kaufman, Roger. “6 Steps to Strategic Success,” *Training & Development Journal*, May 1992, pp. 107-112.
4. Moskow, Michael H. *Strategic Planning in Business and Government*, New York NY: Committee for Economic Development, 1978.
5. Reid, David M. “Operationalizing Strategic Planning,” *Strategic Management Journal*, Vol 10, pp. 553-567.
6. Sample, V. Alaric. “Resource Planning and Budgeting for National Forest Management,” *Public Administration Review*, Vol 52, July/August 1992, pp. 339-346.
7. Smith, Perry M., Allen, Jerrold P., Stewart, John H. II, and Whitehouse, F. Douglas. *Creating Strategic Vision*, Washington DC: National Defense University Press, 1987.

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Most Significant Article Award

The Editorial Advisory Board has selected “Traditions of Excellence: A Final Salute to the Air Force Logistics Command” by John C. Brownlee as the most significant article in the Winter-Spring 1993 issue of the *Air Force Journal of Logistics*.

The Use of Saaty's Analytic Hierarchy Process in Economic Analysis

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Background

A discounted cash flow comparison of acquisition alternatives, termed "economic analysis" by the Department of Defense (DOD), necessarily focuses on quantifiable benefits and costs. Nonquantifiable factors are much more difficult to include, but should not be ignored. Saaty's Analytic Hierarchy Process (AHP) is one way to capture both quantifiable and nonquantifiable costs and benefits by establishing relative weights for the selection criteria and relative ratings for the alternatives. This paper briefly reports the theory behind AHP and its potential application to economic analysis using an Air Force project to renovate an aircraft taxiway as an example. Despite several potential implementation problems, this decision support tool should foster a more complete, systematic, and objective evaluation of acquisition alternatives.

Introduction

When selecting a project or set of projects, both quantitative and qualitative factors are important. In "cost-benefit" analysis, the benefits as well as the costs of alternative investments should be considered. Traditional capital investment models that employ purely economic selection criteria, such as net present value or internal rate of return, have been criticized for failure to adequately include intangibles. (14,15)

This problem is particularly important to DOD, where qualitative noneconomic factors can dominate. Despite this, there is little guidance on how to include noneconomic factors in what the DOD narrowly terms an "economic analysis." Department of Defense Instruction 7041.3, *Economic Analysis and Program Evaluation for Resource Management*, for example, recognizes the need to assess nonmonetary costs and benefits across alternatives, but provides little procedural guidance. (7) Air Force Regulation 173-15 (same title as above instruction) similarly requires that a comparison of benefits between alternatives be formally documented for the decision maker, but devotes only one paragraph to the issue. (8:9)

A multi-criteria decision model is needed that can combine quantitative and qualitative factors into the capital investment decision. The model should not replace the decision maker but improve the capital investment decision by a systematic consideration of all relevant factors. One such model that has received significant attention and broad application is Saaty's "Analytic Hierarchy Process." (24,28)

This paper describes the Analytic Hierarchy Process and provides an example using data from an Air Force project to renovate an aircraft taxiway. Limitations and potential implementation problems are described. The purpose of the paper is to inform the reader of a viable tool for systematically including nonquantifiable factors in an economic analysis.

The Analytic Hierarchy Process

The Analytic Hierarchy Process is a rational and systematic approach for finding a solution to a problem. The method allows decision makers to partition large unmanageable problems into smaller parts that are easier to handle. It provides decision makers with the ability to include qualitative and quantitative criteria to form a rating for each of the alternatives. These ratings may then be used as a basis for project selection.

Four steps are used to solve a problem with AHP:

- (1) Build a decision "hierarchy" by breaking the general problem into individual criteria.
- (2) Gather relational data for the decision criteria and alternatives.
- (3) Estimate the relative weights of the decision criteria and alternatives using the "proportional method" or the "eigenvalue method."
- (4) Aggregate the weights of the criteria and alternatives into a vector of ratings for the alternatives, which can be used to rank the alternatives.

These steps are perhaps best understood with an example. Here, data from an Air Force economic analysis are used. More elaborate examples of using AHP in capital acquisition problems are available elsewhere. (10,22)

The decision problem was the repair or replacement of an aircraft taxiway. (2) There are three alternatives: Alternative A, repair the old taxiway; Alternative B, construct a new taxiway with material recycled from the old taxiway; and Alternative C, construct a new taxiway and dispose of the materials from the old taxiway.

The selection criteria were (1) the cost of each alternative, termed "Cost"; (2) the ability of each alternative to sustain aircraft weight, termed "Weight"; and (3) the minimization of taxiway congestion, termed "Congestion." The first criterion was quantitative and based on estimates of a cost analyst; the other two were qualitative and based on the judgment of the decision maker.

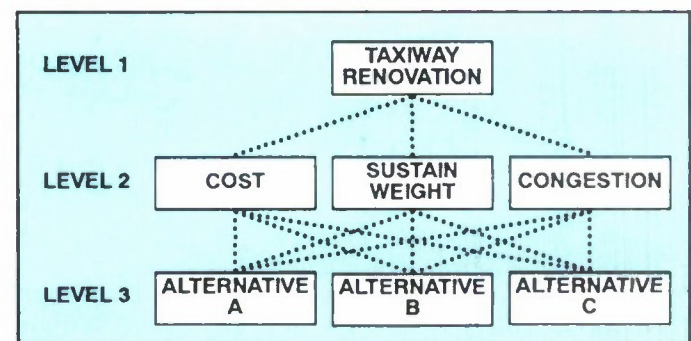


Figure 1. The Taxiway Hierarchy.

Step 1. As illustrated in Figure 1, the “hierarchy” is simply a tiered framework of decision elements related to the problem, with a statement of the overall objective at the top and the alternatives at the bottom. Between the top and bottom levels are relevant attributes of the decision problem, such as the selection criteria. The number of tiers depends on the complexity of the problem and the capacity of the decision makers to make pairwise comparisons between the elements at each level.

Step 2. In this step, relational data for comparing the alternatives are generated. Generating quantitative data, such as the cost of each alternative, is straightforward. In an economic analysis, costs are in constant dollars and discounted using a real 10% rate. Generating qualitative data typically requires the decision maker to make pairwise comparisons of elements at each level in the hierarchy regarding the contribution made to the objective in the next higher level. In the taxiway example, the importance of each criterion to the taxiway and the relative ratings between alternatives for each criterion needed to be established.

In AHP a *ratio scale* of real numbers from 1 to 9 is used to systematically assign the preferences. To facilitate the pairwise comparisons, verbal descriptions of the numerical ratings may be used. In either case, AHP software will systematically prompt the decision maker to perform all the pairwise comparisons. (9,16) For each pairwise comparison, the decision maker is asked which element is most important, preferred, or likely, and by how much or how many times. Tables 1 and 2 detail the results of the pairwise comparisons in the taxiing example.

As shown in Table 1, the cost criterion was judged to be three times more important to selecting the taxiway than was the weight criterion. Similarly, the cost criterion was judged to be five times more important to the taxiway decision than was the congestion criterion. The weight criterion was judged to be twice as important as the congestion criterion.

In Table 2, relational data derived from comparing the alternatives are shown for each criterion. For the cost criterion, the present value cost of each alternative is listed. For the other criteria, pairwise comparisons between alternatives were necessary. The relational data in the table reflect the decision maker’s preferences between the alternatives with respect to each criterion and are interpreted the same way as in Table 1. With respect to the congestion criterion, for example, Alternative A was judged to be the most desirable.

Tables 1 and 2 also show “inconsistency ratios.” In the process of making the pairwise comparisons, inconsistent judgments are possible. In the taxiway example, Cost was judged to be more important than Weight, and Weight was judged to be more important than Congestion. Accordingly, Cost should be judged more important than Congestion. Otherwise, the comparison would be inconsistent.

The inconsistency ratio quantifies an inconsistent comparison. An inconsistency ratio of zero reflects perfect

consistency, which is difficult to achieve when there are many comparisons. For n alternatives, $n(n - 1)/2$ comparisons are required for each criterion. With eight alternatives, for example, 28 pairwise comparisons would be necessary for each qualitative criterion. The inconsistency ratio is thus rather useful feedback to improve the accuracy of the pairwise comparisons.

According to Saaty, small inconsistency ratios do not drastically affect the ratings by AHP. Based on experiments reported by Saaty (20) and Vargas (23), a “rule of thumb” is recommended: when the inconsistency ratio is less than .1, the inconsistent comparison is acceptable. When the ratio is larger than .1, AHP software will prompt the decision maker to redo the comparisons. Each time the pairwise evaluations are reaccomplished, a new inconsistency ratio is computed. The process of revising the pairwise judgments can help the user discover illogical thinking and generate insight into the decision problem.

Step 3. Based on relational data developed in Step 2, two methods are used to assign relative weights to the criteria and relative ratings to the alternatives. According to Saaty, a “proportional method” is used for quantitative data, such as for the cost criterion, and an *eigenvalue* method is appropriate for qualitative data generated by the pairwise comparisons.

In the proportional method, relative weights are assigned according to the amount that each alternative contributes to the sum of the values of all of the alternatives for a particular criterion. Because less cost is preferred to more cost, Alternative C received the highest rating under the cost criterion. In the *eigenvalue* method, an eigenvector is estimated from a matrix of the pairwise comparisons to calculate the relative ratings for each alternative. A detailed description of this method is available elsewhere. (17,18,19,20). For either method, the relative weights or ratings are normalized to add to unity.

Table 3 shows the resulting vector of relative weights assigned to the three criteria and matrix of relative ratings assigned to the alternatives based on these methods. The cost criterion was judged to be the most important to the taxiway decision, with a weighting of .648. The weight and congestion criteria have relative weights of .230 and .122, respectively. For the congestion criterion, Alternative A had the highest rating of .706; for the weight and cost criteria, Alternative C had the highest ratings.

Step 4. In the final step, the relative weights and ratings are combined into a single vector, reflecting the overall ratings of the alternatives. The vector of ratings for the alternatives is determined by a series of matrix multiplications beginning at the second level and ending at the lowest level of the hierarchy. In the taxiway example, the ratings of the alternatives were calculated by multiplying the vector of criteria weights against the matrix of relative ratings to yield an overall rating of .276 for Alternative A, .291 for Alternative B, and .433 for Alternative C. Accordingly, Alternative C is the preferred alternative.

RELATIONAL DATA FROM PAIRWISE COMPARISONS OF TAXIWAY CRITERIA			
Criteria	Cost	Weight	Congestion
Cost	1	3	5
Weight	1/3	1	2
Congestion	1/5	1/2	1
Inconsistency ratio = 0.003			

Table 1.

RELATIONAL DATA FROM PAIRWISE COMPARISONS OF ALTERNATIVES

Criterion	Alternative A	Alternative B	Alternative C
Cost	\$5M	\$4M	\$3M

Inconsistency ratio = 0.000

Weight	Alternative A	Alternative B	Alternative C
Alternative A	1	1/3	1/5
Alternative B	3	1	1/2
Alternative C	5	2	1

Inconsistency ratio = 0.003

Congestion	Alternative A	Alternative B	Alternative C
Alternative A	1	6	4
Alternative B	1/6	1	2/3
Alternative C	1/4	3/2	1

Inconsistency ratio = 0.000

Table 2.

NORMALIZED WEIGHTS AND RATINGS

Criteria (Weight)	Alternative Rating		
	Alternative A	Alternative B	Alternative C
Cost (.648)	.255	.319	.426
Weight (.230)	.109	.309	.582
Congestion (.122)	.706	.118	.177
Overall Rating	.276	.291	.433

Inconsistency ratio = 0.000

Table 3.

Implementation Issues

Having reviewed the basics of AHP, a brief consideration of issues involving the use of AHP in an economic analysis is appropriate. The following listing is not comprehensive, but is intended to highlight issues and direct the reader to the relevant literature.

(1) The *eigenvalue* method for establishing relative weights is computationally difficult. Without a familiarity with matrix algebra, the method is incomprehensible. Fortunately, the computations are made transparent by AHP software such as *Expert Choice* (9), or *Automan* (16). Once the hierarchy is established, the software will systematically lead the decision maker through the necessary pairwise comparisons to establish the weights and ratings. After each set of comparisons is completed, the software will also provide information regarding the consistency of the judgments by reporting the inconsistency ratio and prompt the user to redo the judgments as appropriate. Once accomplished, the software will compute the ratings.

(2) The ratio scale used in AHP has been criticized as inappropriate. Saaty (20) argues that the intensity of preferences between alternatives can be expressed using a ratio scale; others

disagree, claiming that an interval scale is appropriate. Harker and Vargas (11) review this issue and rebut the criticism.

(3) Saaty (20) has warned against combining costs with benefits in one hierarchy and recommended separate hierarchies for each. The resulting ratings are then combined as benefit-cost ratios to establish a ranking suitable for selecting projects. Even if this is done, there are problems with the use of benefit-cost ratios derived from AHP to select capital investment projects. (5,6) Generally, the problem is using benefit-cost ratios for selecting projects, and not the method of establishing the ratios. The capital budgeting literature thoroughly addresses this more general problem. (4)

(4) A problem of "rank reversal" has been reported. (3,27) Rank reversal occurs when new alternatives are added to the hierarchy and the resulting new ranking differs from the former ranking. If the new alternatives provide no additional information on the relative rating of existing alternatives, then reversal should not happen. Harker and Vargas (11) rebut these criticisms as an inappropriate use of AHP and suggest a method to avoid rank reversals. Schoner and Wedley also explored the issue and concluded: "Those who were troubled by rank reversals when no real new information is added should be reassured that AHP can be made to work correctly." (21:474)

(5) It is unclear how multiple decision makers or evaluators can use AHP. Vargas and Saaty (25) have reported a few cases. Graham (10) has reported the use of AHP in an Air Force setting, where analysts perform the initial analysis and provide it to a supervisor for consideration and possible revision.

(6) In a typical economic analysis conducted in DOD, there are often significant pressures to force the analysis to favor a particular alternative. Thus, a third-party review is required to identify potential bias. It is clear that AHP can also be manipulated to favor a project. AHP software can facilitate the review by thoroughly documenting the decision problem and the judgments made to establish the ratings. In addition, AHP software can record these details for later sensitivity analysis.

Conclusion

Despite these technical issues, AHP has been applied to capital acquisition problems (1,10,12,13,16,25,26) and is consistent with the goals of economic analysis:

Economic analysis is an aid to rational choice among competing alternatives. It is not intended to replace the judgment of the decision maker but rather to aid that judgment. . . . A good economic analysis systematically examines and relates cost, benefits, and risks of various alternatives. (8:3)

AHP facilitates a comprehensive and rational analysis of the capital acquisition problem. Although the pairwise comparisons required in AHP may seem tedious, the method is systematic and comprehensive. All relevant comparisons are made. When the comparisons are illogical, the method warns the decision maker with the inconsistency ratio.

User-friendly AHP software will lead the evaluator through all the pairwise comparisons and compute the relative ratings and inconsistency ratios. The software will not, however, force the user into revising the judgments. AHP is a decision support tool; it does not replace the decision maker.

Other important requirements of economic analysis are sensitivity analysis and thorough documentation to support subsequent third-party review. AHP software allows the decision maker to evaluate the sensitivity of the ranked alternatives to the weights assigned to the criteria and alternatives. Of course, weights can be easily changed and the impact of the change on the ratings is immediately apparent. In addition, the framework of the hierarchy and the weights are recorded for subsequent review. It is a relatively easy matter for a third party to use AHP software to evaluate the reasonableness of another's judgments.

In short, AHP is a promising tool for facilitating an economic analysis. Despite implementation issues and occasional technical objections, AHP has received wide application in multi-criteria problems. Given the increasing availability of personal computers and excellent AHP software, such as *Expert Choice* (9), the use of AHP in the capital acquisition problem is appropriate and highly recommended.

References

1. Arbel, Ami, and Seidmann, Abraham. "Performance Evaluation of Flexible Manufacturing Systems, *IEEE Transactions on Systems, Man, and Cybernetics* 14 (July-August 1984), pp. 606-617.
2. Battin, Jeffrey L., and Bender, Thomas J. *A Methodology For Project Selection Using Economic Analysis And The Analytic Hierarchy Process*, Master's Thesis, Air Force Institute of Technology (September 1992).
3. Belton, V., and Gear, T. "On a Short-coming of Saaty's Method of Analytic Hierarchies, *Omega* 11 (1984), pp. 228-230.
4. Bernhard, Richard G. "A Comprehensive Comparison and Critique of Discounting Indices Proposed In Capital Investment Evaluation, *The Engineering Economist* 16 (Spring 1971), pp. 157-186.

5. Bernhard and Canada, John R. "Some Problems in Using Benefit/Cost Ratios with the Analytic Hierarchy Process," *The Engineering Economist* 36 (Fall 1990), pp. 56-65.
6. Boucher, Thomas O., and MacStravic, Elin L. "Multiattribute Evaluation within a Present Value Framework and its Relation to the Analytic Hierarchy Process, *The Engineering Economist* 37 (Fall 1991), pp. 1-32.
7. Department of Defense. Department of Defense Instruction 7041.3, *Economic Analysis and Program Evaluation for Resource Management*, 18 October 1972.
8. Department of the Air Force Cost Analysis, Air Force Regulation 173-15, *Economic Analysis and Program Evaluation for Resource Management*, Washington: Headquarters United States Air Force, 4 March 1988.
9. Forman, Ernest H., Saaty, Thomas L., Selly, Mary Ann, and Waldron, Rozann. *Expert Choice*, Mclean VA: Decision Support Software Inc., 1983.
10. Graham, David R., and Forman, Ernest. "Cost Project Funding Choices Using the AHP & Linear Programming," Unpublished Report, Air Force Materiel Command Space and Missile Systems Center, Los Angeles AFB CA, 1992.
11. Harker, Patrick T., and Vargas, Luis G. "The Theory of Ratio Scale Estimation: Saaty's Analytic Hierarchy Process," *Management Science* 33 (November 1987), pp. 1383-1403.
12. Jensen, R. E. "A Dynamic Analytic Hierarchy Process Analysis of Capital Budgeting Under Stochastic Inflation Rates, Risk Premiums, and Liquidity Preferences: Theory," *Advances in Financial Planning and Forecasting* 2 (1987), pp. 269-302.
13. Jensen, "International Investment Risk Analysis: Extensions for Multinational Corporation Capital Budgeting Models," *Mathematical Modelling* 9 (1987), pp. 265-284.
14. Kaplan, Robert S. "Must CIM Be Justified By Faith Alone?" *Harvard Business Review* 64 (March-April 1986), pp. 87-95.
15. Pinches, George E. "Myopia, Capital Budgeting and Decision Making," *Financial Management* 11 (Autumn 1982), pp. 6-19.
16. Romano, Patrick L. "Automan-Decision Support Software," *Management Accounting* (November 1989), pp. 58-60.
17. Saaty, Thomas L. *The Analytic Hierarchy Process*, New York NY: McGraw-Hill Book Company, 1980.
18. Saaty, "Decision Making For Leaders, Belmont CA: Lifetime Learning Publications, 1982.
19. Saaty, "Decision Making, Scaling, and Number Crunching," *Decision Sciences* 20 (1989), pp. 404-409.
20. Saaty, "How to Make a Decision: The Analytic Hierarchy Process," *European Journal of Operational Research* 48 (1990), pp. 9-26.
21. Schoner, Bertram, and Wedley, William C. "Ambiguous Criteria Weights in AHP: Consequences and Solutions," *Decision Sciences* 20 (Summer 1989), pp. 462-475.
22. Stout, David E., and others. "Decision Support Software for Capital Budgeting: It Can Help Quantify Intangible Benefits of Capital Investments," *Newsletter of the Society of Cost Estimating & Analysis* (October 1991), pp. 4-8.
23. Vargas, Louis G. "Reciprocal Matrices With Random Coefficients," *Mathematical Modelling* 3 (1982), pp. 69-81.
24. Vargas, "An Overview of the Analytic Hierarchy Process and its Applications," *European Journal of Operational Research* 48 (1990), pp. 2-8.
25. Vargas and Saaty, "Financial and Intangible Factors in Fleet Lease or Buy Decisions," *Industrial Marketing Management* 10 (1981), pp. 1-10.
26. Varney, Mark S., Sullivan, William G., and Cochran, Jeffrey K. "Justification of Flexible Manufacturing Systems With The Analytic Hierarchy Process," *Proceedings of the 1985 International Industrial Engineering Conference*, Norcross GA, Institute of Industrial Engineers, 1985.
27. Watson, S. R., and Freeling, A.. "Assessing Attribute Weights By Ratios," *Omega* 10 (1982), pp. 582-583.
28. Zahedi, Fatemeh. "The Analytic Hierarchy Process—A Survey of the Method and its Applications," *Interfaces* 16 (February 1986), pp. 96-108.

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READER EXCHANGE



Dear Editor

At last someone has taken off the gloves. Colonel Joe Corcoran's article in the Spring 1992 issue of the Journal is totally refreshing. His frontal attack on the status quo sets a new standard for openness regarding the *real* issues confronting our logistics community.

Without doubt, some embedded bureaucrats, and others with special interests, being insecure or uninformed (or both), will ride forth to defend the way they do business and shield their sacred lambs. The fact is, however, Joe is at least 80% right on the issues he raised—we can debate the real number later.

Hopefully, those unpretentious but knowing few who understand the logistics business end-to-end (as Joe does), and their counterpart subject area experts, will see this as an opportunity to come forth and help take on the real issues in-the-clear. For those who do not understand what Joe is talking about, this is a wake-up call. I, for one, am ready to engage on the issues—the best ideas win.

We, as a logistics community, need to get back to basics. The economy and the Defense budget will no longer support

extravagance and waste. It is only through belt-tightening efficiencies and a practical approach to doing business that we can prevent the recurrence of the hollow force.

Let's get the issues on Joe's list, including the sacred lambs, out on the table. Is anyone willing to debate the gut issues of direct support objectives (DSOs), economic order quantity (EOQ) items in readiness spares packages (RSPs), asset based computations, capability assessments, the proper use of marginal analysis techniques in requirements computations, deployed supply support concepts, the real impact of "dirty data," etc? And do it in writing in this public forum? Perhaps we could all benefit from a little wire brushing.

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(Continued from page 23)

CODE	LEVEL
A	Positions at Departmental
B	Positions at Command
C	Positions at Region/Area
D	Positions at Subcommand/Numbered AF
E	Positions at Depot/Air Logistics Center
F	Positions at Center/Test Center Range
H	Positions at Laboratory
J	Positions at Joint Activity (Multi-Service)
K	Positions at Division (Contract Management Division, Aeronautical Systems Division, Field Training Division, etc.)
L	Positions at Product Division (Program Office)
M	Positions at Center (Program Office)
Q	Positions at Base/Site/Wing
R	Positions at Plant/Air Force Programs Residence Office
T	Positions at Complex (Air Force Commissary Service)
U	Positions at Contract Management Division w/limited policy-setting authority

Supervisory Experience - A maximum of 12 points can be earned in this element. Credit is given for performing supervisory duties at the GS-05/WS-1 level or higher. A Supervisor under the Civil Service Reform Act (CSRA) who supervises less than 2 people earns 6 points. A First-Level Supervisor earns 9 points. A Second-Level Supervisor earns 12 points. The supervisory codes are:

CODE	SUPERVISORY EXPERIENCE
4	Supervisor - CSRA
1	First-Level Supervisor
2	Second-Level Supervisor

Managerial Experience - A maximum of 12 points can be earned in this element. Credit is given for performing managerial duties at the GS-05/WS-1 level or higher. An individual with Program Responsibility earns 6 points. A Management Official earns 9 points. A Manager earns 12 points. The managerial codes are:

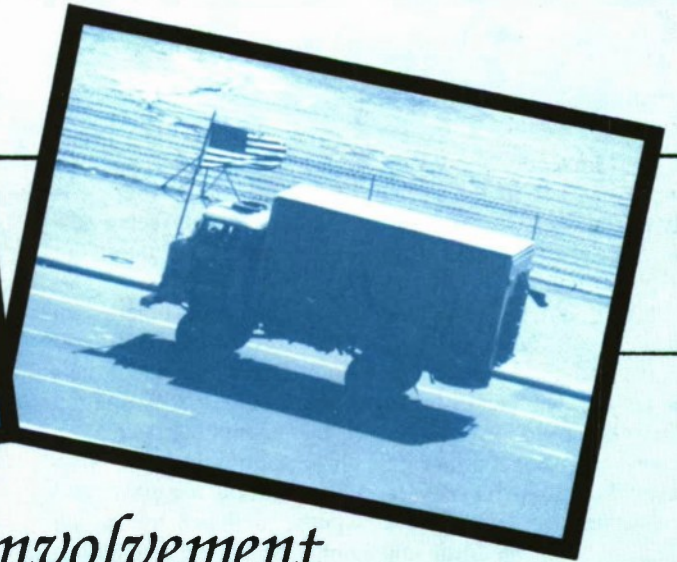
CODE	MANAGERIAL EXPERIENCE
7	Program Responsibility
5	Management Official
3	Manager

It is very important that employees periodically review their records. A typographical error can cost individuals valuable points and perhaps consideration for promotion or training opportunities. (Gary M. Grandstaff, AFPCPMC/DPCMLLO, DSN 487-4087)

Please



Re



*American Involvement
with Iraqi POWs
During Desert Storm*

