

General Motors Corporation

Research & Development

Study of the Product Development Work Systems of
the Military/Defense Industry

Final Report

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Introduction:

This project is a research analysis and report on the Military/Defense Industry for the R&D Work Systems Innovation Project – “21st Century Product Development Work Systems” at General Motors Corporation.

This research report includes a literature review and interview reference sources, which concisely summarize the most important findings of the research and analysis of the Military/Defense Industry Product Development. The report provides a description of the characteristics of the Military/Defense Industry product development work systems and practices, how these practices developed, the evolution of these practices over time and how these practices diffused within the industry, as industry norms. It addresses the organization, development and execution of a “war” or “operation other than war” engagement. It also describes the military product development process using the F-22 as an example.

The overall system of the U.S. Department of Defense and its supply base and stakeholder base constitute the Military/Defense Industry. The way in which the system develops its products for war, as well as prepares and fights a war is described in the study organized around the framework below.

Topic areas addressed are the framework of Process, People and Economics, and include the GM model specifics:

Process: Organizing Model
Coordination Model
Phasing Model
Enabling Model

People: Reward Model
Recognition Model
Learning Model
Staffing Model

Economics: Feasibility Model
Financing Model
Budgeting Model

Accounting Model

Each one of the twelve elements is explored in terms of how the defense establishment accomplishes the specific function. It must be noted, however, that the defense system differs greatly from any corporate model in the economic areas. The defense economic system is described in detail even in the areas that it does not correspond to the model. The other elements do correspond directly to functions in the military establishment. In addition, there are functions of the military that go beyond the model, especially the systemic processes that are also described.

There are thousands of pages of Doctrine written to regulate and provide the rules for every aspect of the Department. This report is written as the "Voice of the Doctrine." The report quotes extensively from the Doctrine, itself. This approach enables the Doctrine to tell its own story of the twelve pieces of its system that correspond to the twelve GM elements. It is important to recognize that the twelve elements are only a small piece of the larger Military/Industry system, just as they only represent the product development system that GM is studying.

Methodology:

This study uses several methodologies. Some primary research was required to interview appropriate individuals at the Pentagon. Much research was conducted in the private, unclassified libraries at the Pentagon, and some research was conducted on the web where possible to keep costs down. The University Group used several subject matter experts to locate the appropriate unclassified documents and individuals with process knowledge.

Dr. Sheila Ronis, President of the think tank, The University Group, and a Pentagon consultant was the Project Manager of the research and author of the deliverables. The Honorable James R. Locher, III, former Assistant Secretary of Defense for Special Operations and Low Intensity Conflict, the chief "staffer" of the Senate Armed Services Committee that wrote the Goldwater Nichols Act of 1986, and is considered the Pentagon's chief "organizational" expert assisted Dr. Ronis. Resumes of Dr. Ronis and Mr. Locher are attached. In addition, the author wishes to thank Major General Harold Mashburn, Jr., USMC, Commandant of the Industrial College of the Armed Forces at the National Defense University and Colonel Genaro

Dellarocco, Program Manager, Force Projection, U.S. Army, for their assistance on a variety of subjects including the F-22 and logistics operations. In addition, several others who require anonymity were also consulted. The University Group was also able to utilize some 34 federal publications and presentations, 40 books on relevant topics and 17 articles to support the work. Please see the bibliography for a complete listing of references.

All information collected and used are open-sourced and unclassified.
***Although there are some processes that make the Pentagon work that are classified, they could not and were not available for this study.
Fortunately, most of the processes and doctrine are not classified.***

Overview – The Context

The National Security – Department of Defense “System”:

Today’s United States Department of Defense (DoD) was created in the National Security Act of 1947. In *C³I, Issues of Command and Control*, edited by Thomas P. Coakley, Rodney B. McDaniel writes on the history of the National Security Act,

“The National Security Act ...was the final Congressional output of . . . the lessons of World War II. It was thought that the services didn’t cooperate with each other very well, so the way to fix that was to put the . . . services under a common thread. . .and establish the National Security Council, as a mechanism to integrate domestic, military, and foreign policy, to effectuate the overall national good. . .National Security policy, then, is the integration or the fusion of diplomacy and military operations.”

The Goldwater-Nichols DoD Reorganization Act of 1986 improved the integration or “jointness” of the Army, Air Force, Navy and Marine Corp services as well as the other Defense Agencies to more effectively and seamlessly “organize, train and equip” to prepare for any action along the entire war-peace spectrum of contingencies and operations other than war.

The Department of Defense extended system is enormous and has many stakeholders. In fact, it is difficult to separate the Department from the entire national security community. Sun Tzu, the ancient Chinese philosopher wrote more than 2500 years ago, in his book, *The Art of War*, “The art of war is of vital importance to the state. It is a matter of life and death, a road either to safety or to ruin. Hence under no circumstances can it be neglected.” Sun Tzu and his rules of engagement are studied, and guide today’s military establishment. The U.S. Department of Defense (DoD) is organized “to provide for a common defense,” the current Congressional mandate of DoD and the “product” within the GM Model. ***But, this product increasingly is defined by the President and the National Security Strategy, not just as a capability for war, but preserving a state of national security.***

In every administration, the Constitutional meaning of “common defense” is debated, since to provide for it requires organizing for a new set of requirements, depending on the meaning and the environmental conditions. Since World War II, that meaning was equated with the Cold War and containing communism around the world.

With the fall of the Berlin Wall, the crumbling infrastructure of the former Soviet Union, the increasing pace of change and technology which has led the planet well beyond Alvin Toffler’s “third wave,” and the globalization of the world economy, the stable bi-polar world of the Cold War changed forever. Those changes included an American will to limit the resources available for defense in spite of the need to increase its capabilities. Instead of a global “peace dividend,” the people of the world inherited an increasingly complex, unstable, and violent place to live, with less predictability than ever before. That violence emerged most clearly on September 11, 2001 with the terrorist attacks against the United States.

Preparing for an volatile, uncertain, complex and ambiguous environment, what the Department refers to as VUCA, with many different kinds of contingencies, all of which belong on the war-peace spectrum of contingencies, is what today’s Department is all about. “How does the Department of Defense help to improve peace prospects and deter war around the world, while being prepared to fight a war, if necessary?”

DoD’s military forces are expected to function well along the entire war-peace spectrum of contingencies and operations other than war. Many of today’s and tomorrow’s challenges and opportunities are precisely because of the amount of continuous change and uncertainty in the world. There are many different venues for conflict from deep space to cyber space, from urban areas to deep underground, and within the U.S. homeland as well as around the world.

There are also challenges with transnational concerns that involve terrorism, intertwined economies, mass migration, failed states, drug trade, organized crime and the environment. The information age reduces the timelines to react or recover, with instant global communications, information access and advanced technologies. U.S. fanatical adversaries from rogue states and terrorist groups and non-state actors attack in asymmetric ways using their strengths against U.S. weaknesses using whatever is at their disposal from

high technology information warfare, to weapons of mass destruction. They utilize U.S. free society to the full extent and catch the nation off-guard as they did on September 11. Today, DoD is in the process of developing better global processes with their allies abroad, and better interagency processes at home.

“Traditional” warlike conflicts have been reduced and replaced with far more difficult to defend conflicts. And, no matter what kind of conflicts the United States is engaged in, they rarely are acting alone. Most of the time, they are working in concert with additional partners:

- other government agencies, in an inter-agency mode
- allies
- coalitions
- adhoc partners
- non-government organizations, such as global corporations, and
- international organizations, such as the Red Cross.

The Department is most effective when it is shaping the future. But, how does it shape knowing that only through preparedness and shaping can a stable world emerge? This ultimately relies upon cooperative security arrangements around the world based on mutual trust and collective planning. But, when this fails, the United States and its Department of Defense must be ready, capable, and agile enough to fight and win the nations wars, whatever they may look like.

These issues are not only the purview of the military. They are the responsibility of the entire National Security community -- and that broad community develops a vision of the future, called the *National Security Strategy of the United States*. The most recent one was published in September, 2002. Once that vision is published, a *National Military Strategy* is published to show *how* to shape the future of the world. ***It is critical to remember that the U.S. Department of Defense is used as the nation’s infrastructure for almost all contingencies anywhere in the world, from humanitarian assistance and disaster relief to peace-keeping and nation-building to all out war.***

After World War II, General George C. Marshall said,

“We are now concerned with the peace of the entire world.
And the peace can only be maintained by the strong.”

These words were never more true. But, what does it mean for the United States to be strong in the 21st century? The Department of Defense and National Security community must be thought of in a “systems” perspective in order to enable the United States to be strong. It is important to remember that systems have interdependent and interconnected elements. Systems, like National Security, require integrative mechanisms of many of the departments and agencies of the government. In the end, DoD shoulders the responsibility of making them work.

The Department makes assumptions about its environment and its Congressional responsibilities to the nation such as:

- The world is a system. In a system, every element is interdependent with every other element and the system is only as strong as its weakest link.
- The United States has global interests. Its National Security community includes the military, economic, diplomatic, political and other communities inside the government and outside of the government, such as NGOs, businesses and so on.
- Conflict anywhere on the planet can negatively affect the world anywhere, including the U.S., because the world is a system. Therefore, the promotion of peace may require U.S. involvement anywhere to deter, reduce or eliminate conflict.
- The process of deterrence, management and reduction of conflicts throughout the world is something of value to the United States. Promotion of peace requires active shaping; prevention, reduction and management of conflict, including post conflict maintenance processes. These processes are all systemic.
- The “rule of law” and principles of good governance are values of the United States and need to be promoted around the world. And,

- Peace can only be maintained by the strong.

There is an understanding that peace prospects and root causes of conflicts are complex and systemic. They require a thorough understanding of the system relationships between elements of a society that can lead to conflict, if not in balance. This leads to activities to promote peaceful futures through *prevention* on a global basis. That is the essence of shaping since prevention is far less costly in dollars and lives than any conflict.

The sovereignty and security of the United States, and the protection of its citizens and property around the world remains the bedrock of U.S. National Security and is the *raison d'être* of the Department of Defense. The execution of U.S. National Security Strategy is conducted in a highly volatile global environment characterized by quantum changes in technology, unprecedented economic and political interdependencies, broadened opportunities to foster democratic principles, and allegiances, and alliances frequently founded on interests other than traditional nationalism. Osama Bin Laden and Al Qaeda fight for no nation-state. The National Security community needs to be agile enough to respond effectively to a broad range of deterrent challenges, while maintaining the ability to wage and win wars when necessary. But, much of the infrastructure for National Security at home and abroad still mainly resides at the Pentagon.

The mission of DoD increasingly more clearly reflects 21st century realities and challenges and better support of the National Security of the United States. This is accomplished by:

- preventing conflict and deterring potential adversaries,
- supporting world-wide stability, and U.S. foreign policy
- maintaining ready forces for deployment worldwide,
- responding to threats and protecting U.S. citizens, property and interests anywhere on the planet, and, increasingly in space
- responding to emergencies and humanitarian assistance at home or abroad, and
- contributing to other National priorities,

through cooperation with allies, friends, and other federal and state agencies, where appropriate.

The mission describes what the Department of Defense is in a National Security context. The mission of the U.S. Department and Defense is to support the National Security of the United States and its military, political, diplomatic, economic, social, technological, foreign and domestic policy efforts in the 21st century by being able to:

- remain premier in its capacity to prevent, deter, and win the nation's wars, worldwide, quickly and decisively in concert with its allies and friends or unilaterally, with minimum casualties,
- leverage national assets wherever they are to support national interests, competitiveness, sustainability and capabilities,
- employ superior human resources in both the military and civilian workforce,
- be proactive and work closely and effectively with other Federal and State agencies and others to meet dynamic National Security priorities in support of domestic needs and global contingencies,
- be foremost in innovative practices in all areas; leveraging of U.S. core competencies; and efficient stewardship of all resources and capabilities through partnerships with industry and academia, to renew the nation's infrastructure while enhancing the overall National Security posture, and
- be the world leader in information dominance and technological superiority.

The Department supports the values that include a culture that empowers people, rewards innovation, encourages teamwork, enhances individual skills, leverages core competencies, provides a safe and healthy workplace, employs contemporary management practices, and instills commitment to excellence.

Ultimately, the Department provides for the common defense while working toward a world of freedom, stability, prosperity and peace in a 21st century world.

Today's Department has approximately a trillion dollar annual budget and represents about two and a half million employees, both uniformed and civilian, and millions more in the industrial base.

In addition, the Department remains in a continuous state of Transformation and development. Transformation is seen as a process, and a continuously changing and evolving activity. It is actively sought and worked toward. With each passing year, the Department and its units, from the services to the Departmental agencies become more cohesive, interdependent and operating like the system that it is.

The United States Armed Forces are deployed around the world in more than a hundred places at any one time on various missions of war and peace.

Within this context, today's DoD processes have emerged. And, the GM Model Components are described with regard to DoD's current processes, people, organization and Congressional oversight and intervention.

The Framework Components:

The Process Framework:

Organizing Model

“The Organizing Model describes how the product development team is to be organized for the purpose of getting the work done. It includes not just the organization structure but also the set up of job titles and responsibilities of the team.”

The GM Model

Goldwater-Nichols, more than any other piece of legislation gives today’s Department its basic character and genius to “fight and win the nation’s wars,” its Constitutional mandate. In this landmark legislation, *despite incredible opposition by the services to change*, today’s DoD structure and functions emerged. They include:

- A strong Chairman of the Joint Chiefs of Staff (CJCS) who is the designated principal military advisor to the President, National Security Council and Secretary of Defense
- The Chiefs of Staff of the Army, Air Force, Navy and Marine Corps report to the Chairman
- The Chairman of the Joint Chiefs of Staff (CJCS) is responsible for strategic planning, logistics, net assessments, joint doctrine, programs and budgets
- The Vice Chairman, who acts as Chairman in the absence of the Chairman outranks all other military officers except the Chairman
- The Joint Staff reports to the Chairman, not to the service chiefs
- The Combatant Commanders, the regional four-star generals who have to fight the wars, have the power, influence and authority over subordinate commands in their respective areas of responsibility,

especially regarding joint training, force organization and force employment

- The Joint Specialty Officer program that consists of definitive military personnel requirements designed to ensure the services assign some of their highest quality officers to joint duty.

Dennis J. Quinn, in *The Goldwater-Nichols DoD Reorganization Act: A Ten-Year Retrospective*, says,

“Congress intended that these changes should have two major impacts: improve the ability of the President and the Secretary of Defense to make correct security decisions based on clear, direct, and sound military advice, and create a joint, unified military fighting force, unhindered by service rivalry and self-interests.”

Fundamentally, the Department of Defense has all major functions and operations reporting to the Secretary of Defense. ***Since the dawn of the Republic, the United States, in its earliest forms had civilian control of the military, and that reporting relationship has been fundamental regarding who we are as a nation.*** The Secretary has the Office of the Secretary of Defense (OSD) reporting to him, as well as the Chairman of the Joint Chiefs of Staff. In addition, the Defense Agencies also report directly to the Secretary and, of course all the Military Departments and Combatant Commanders. This is because there always has to be civilian control of the military. It ensures that military force is never used except as a mechanism for state business or to further the purposes of the state, according to the President of the United States and the Secretary of Defense. As Sun Tzu states, “A government should not mobilize an army out of anger, military leaders should not provoke war out of wrath. Act when it is beneficial, desist if it is not. Anger can revert to joy, wrath can revert to delight, but a nation destroyed cannot be restored to existence, and the dead cannot be restored to life. Therefore, an enlightened government is careful about this, a good military leadership is alert to this. This is the way to secure a nation and keep the armed forces whole
.”

Reporting to the Secretary of Defense:

Chairman, Joint Chiefs of Staff

Office of the Secretary of Defense (OSD)

Deputy Secretary of Defense
Under Secretary of Defense for Policy
Under Secretary of Defense Comptroller and Chief Financial Officer
Under Secretary of Defense for Personnel & Readiness
Under Secretary of Defense for Acquisition, Technology and Logistics
Assistant Secretary of Defense for Command, Control, Communications and Intelligence
Inspector General
Assistant Secretary of Defense for Public Affairs
Assistant Secretary of Defense for Legislative Affairs
Director, Operational Test and Evaluation
General Counsel
Director of Administration and Management
Director, Net Assessment
Assistant to the Secretary of Defense for Intelligence Oversight
Assistant to the Secretary of Defense for Civil Support

Defense Agencies:

Director, Defense Advanced Research Projects Agency
Director, Missile Defense Agency
Director Defense Commissary Agency
Director, Defense Contract Audit Agency
Director, Defense Finance and Accounting Service
Director, Defense Information Systems Agency
Director, Defense Intelligence Agency
Director, Defense Legal Services Agency
Director, Defense Logistics Agency
Director, Defense Threat Reduction Agency
Director, Defense Security Cooperation Agency
Director, Security Service
Director, National Imagery and Mapping Agency

Director, National Security Agency

The Military Departments:

U.S. Army
U.S. Air Force
U.S. Navy
U.S. Marine Corps
U.S. Coast Guard

Within this structure, the Chairman of the Joint Chiefs of Staff reports directly to the Secretary of Defense. Each Chief is responsible for the core competencies of their service to “organize, train and equip their troops.” Each Chief of Staff reports to his Service Secretary, that is the Chief of Staff of the Army, reports to the Secretary of the Army, who reports to the Secretary of Defense.

Unified Combatant Commanders

According to the Department of Defense, “Operational control of the U.S. combat forces is assigned to the nation’s Unified Combatant Commands. The chain of command runs from the President of the United States to the Secretary of Defense to the Unified Commanders. Orders and other communications from the President or Secretary are transmitted through the Chairman of the Joint Chiefs of Staff. A Unified Combatant Command is composed of forces from two or more services, has a broad and continuing mission and is normally organized on a geographical basis. The number of unified combatant commands is not fixed by law or regulation and may vary from time to time.” At the present time, there are nine commands:

U.S. Joint Forces Command
U.S. Central Command
U.S. European Command
U.S. Pacific Command
U.S. Southern Command
U.S. Space Command
U.S. Special Operations Command
U.S. Strategic Command
U.S. Transportation Command

The relationship between the Chiefs of Staff of the Military Departments and the Combatant Commanders is a matrix organization.

The more than fifty individuals at the senior levels of the Department of Defense run the defense organization and its stakeholder environment.

According to Doctrine, “The NCA exercise authority and control of the Armed Forces through **two distinct branches of the chain of command**. One branch runs from the President, through the Secretary of Defense, directly to the commanders of combatant commands for missions and forces assigned to their commands. The other branch, used for purposes other than operational direction of forces assigned to combatant commands, runs from the President, through the Secretary of Defense, to the Secretaries of the Military Departments. The Military Departments, organized separately, operate under the authority, direction, and control of the Secretary of Defense. The Secretaries of the Military Departments exercise authority through their respective Service Chiefs over their forces not assigned to the combatant commanders.” See Figure 1.

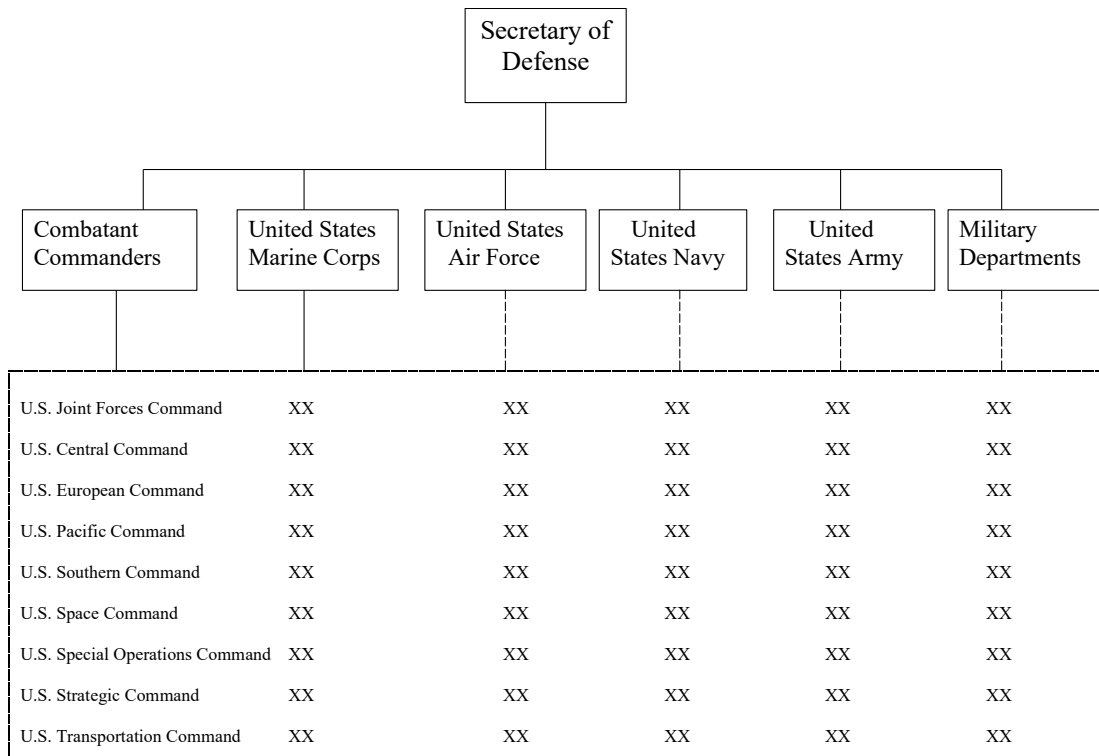


Figure 1. The Matrix Organization of the Services and the Combatant Commanders.

With a smaller span of control, reporting to the Chairman are the following:

Vice Chairman, Joint Chiefs of Staff
Chief of Staff, U.S. Army, dotted line
Chief of Naval Operations, dotted line
Commandant, U.S. Marine Corps, dotted line
Chief of Staff, U.S. Air Force, dotted line
Joint Staff



- Directorate of Management
- J1-Manpower
- J2-Intelligence
- J3-Operations
- J4-Logistics
- J5-Strategic Plans
- J6-C⁴ Systems
- J7-Operational Plans
- J8-Force Structure

Unified Combatant Commanders, dotted line

The Chairman and the Joint Chiefs of Staff, as well as the Combatant Commanders are all 4-star generals.

It should be noted that in addition to the Office of the Secretary of Defense and the Joint Staff, there is an additional element of the “system” that comprises the defense establishment.

Congressional Committees:

The United States Congress is responsible for oversight of the Department of Defense. All programs within the Department are reviewed and/or approved by various committees in both the House and Senate.

Additionally, there are specific sub-committees within the Appropriations Committees with oversight responsibilities for the Department of Defense. The four major Committees are as follows:

The House Armed Services Committee
The Senate Armed Services Committee
The House Appropriations Committee
 Subcommittee on Defense
 Subcommittee on Foreign Operations, Export Financing and
 Related Programs
 Subcommittee on Military Construction
 Subcommittee on VA, HUD and Independent Agencies
The Senate Appropriations Committee
 Subcommittee on Defense

The National Command Authority:

It is critical to understand the hierarchical nature of the National Command Authority. At the very top of the hierarchy is the President of the United States who chairs the National Security Council. As Joint Doctrine dictates, “National security is among the fundamental national purposes that the American people embedded in the Constitution. The United States relies on the complementary application of the basic instruments of national power, diplomatic, economic, informational and military, for its security...”

“Developing national security policy and strategy involves the interaction of the highest level of U.S. civilian and military authorities, principally the President and the members of the National Security Council (NSC)...The National Command Authority (NCA), which consist of the President and the Secretary of Defense...are the highest levels in the military chain of command.”

The President gives the order to go to war to the Secretary of Defense who gives the order to the Chairman of the Joint Chiefs of Staff who gives the order to the Combatant Commanders and the Chiefs of Staff. There is never any doubt about who gives orders. They start at the President’s level and go down through the chain of command to the combatants.

According to Doctrine, “ Unified action in carrying out the military component of National Security Strategy is accomplished through an organized defense framework. Command is central to all military action, and unity of command is central to unity of effort. As prescribed by higher authority, the Department of Defense will maintain and employ Armed

Forces to **support and defend** the Constitution of the United States against all enemies, foreign and domestic; **ensure**, by timely and effective military action, **the security of the United States**, its possessions, and areas vital to its interest; and **uphold and advance the national policies and interests of the United States. Command.** Although commanders may delegate authority to accomplish missions, they may not absolve themselves of the responsibility for the attainment of these missions.”

The Process Framework

Coordination Model

“The Coordination Model describes the means for the team to work together to accomplish the task to work together to accomplish the task of developing a product. It includes formal and informal processes, workflow tools, development stage design, and coordination devices such as a movie script, a blueprint, a database, etc.”

The GM Model

Joint Publication 1 is the capstone joint doctrine publication. It guides the Armed Forces of the United States in “joint, multinational, and interagency activities at all levels across the range of military operations.” It is the primary unifying force of the Department guiding all behavior and decisions.

Its purpose is to explain the Armed Forces unique and crucial roles, “defending the United States against all adversaries and serving the Republic as a bulwark and the guarantors of its independence. When called to action, they support and defend national interests worldwide. The Armed Forces... fulfill their roles, missions, and functions within the American system of civil-military relations. They serve under the civilian control of the President who is the Commander in Chief.”

According to the Joint Publication 1, “The nature of the challenges to the United States and its interests in the contemporary security environment demand that the Armed Forces operate as a fully integrated joint team in combat and non-combat operations. These operations often take place with forces of allies and coalition partners, and with US and foreign governmental and nongovernmental nonmilitary agencies. The challenges

are best met when the unified action of the Armed Forces elicits the maximum effect from the unique but complementary capabilities of each Service and command, and from the synergy that results from their synchronized and integrated action.”

So, the Pentagon is organized for Jointness. Its services represent its functional expertise in Army, Air Force, Navy and Marine Corps core competencies. The Combatant Commanders are responsible for taking their various service troops and bringing them together for whatever operations need to take place. Services “organize, train and equip.” Combatant Commanders take command to fight. Joint Pub 1 is the pre-eminent publication that outlines everyone’s responsibilities. All report to the Chairman, Joint Chiefs of Staff as equals, in a matrix reporting relationship.

According to the doctrine, “Joint warfare is team warfare. Effectively integrated joint forces expose no weak points or seams to an adversary, while they rapidly and efficiently find and engage those adversary weak points and vulnerabilities that assure mission accomplishment. This does not mean that all forces will be equally represented in each operation. Joint force commanders may choose the capabilities they need from the air, land, sea, space, and special operations forces at their disposal.”

It should be noted that doctrine is not a policy or a strategy, that means that it is a guideline for behavior, that should be followed “except when, in the judgment of the commander, exceptional circumstances dictate otherwise.” A great deal of joint education and training permits this.

The joint team is comprised of the members of each Service, active and reserve, as well as associated civilians in the supporting governmental and private sector workforces.

The Joint Pub 1 clearly states, “The Services have the principal responsibility to organize, train, equip, and sustain forces. These forces are employed under joint force commanders. Therefore, to assure that the Armed Forces achieve their fullest potential, all American military leaders must integrate the content of this publication into their efforts to develop leaders and train forces for joint, multinational, and interagency operations.

Service skills form the very core of US military capability. Joint warfare relies upon Service traditions, cohesion, and expertise. Successful joint operations are made possible by the capabilities developed and embodied in each Service, including Service ‘cultures,’ heroes, and professional standards.”

The matrix, developed in 1986 in the Goldwater-Nichols Act, has worked fairly well for such a complex organization conducting very complex operations. According to Joint Pub 1, “Today, joint action is practiced and routine. The key to maintaining and enhancing joint force effectiveness is the military leader’s diligence in studying, applying, teaching, and ultimately improving joint doctrine, which provides the foundation for joint warfare.”

Doctrine states that, “**Command** (the lawful authority of a commander) **and control**, C² (the regulation of forces and functions to accomplish the mission in accordance with the commander’s intent) is the most important function undertaken by a JFC. C² is the means by which a JFC synchronizes and/or integrates joint force activities in order to achieve unity of command and unity of effort. C² **ties together** all the operational functions and tasks and applies to all levels of war and echelons of command across the range of military operations.”

“Unity of effort is strengthened through adherence to the following C² tenets. C² of joint operations begins by establishing **unity of command** through the designation of a JFC with the requisite authority to accomplish assigned tasks using an uncomplicated chain of command. It is essential for the JFC to ensure that subordinate commanders, staff principals, and leaders of C² nodes understand their authorities, their role in decision making and controlling, and their relationships with others.”

“Command and control is the exercise of authority and direction by a properly designated commander over assigned and attached forces. Command (the lawful authority of a commander) **and control** (the regulation of forces and functions to accomplish the mission in accordance with the commander’s intent) is the most important function undertaken by a JFC. C² is the means by which a JFC synchronizes and/or integrates joint force activities in order to achieve unity of command and unity of effort. C² **ties together** all the operational functions and tasks and applies to all levels of war and echelons of command across the range of military operations.”

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War and Operations Other Than War

According to Doctrine, “The Armed Forces of the United States hold in trust for the American people the military power of the Nation and are the ultimate guarantors of its territorial integrity and independence. Challenges and threats may arise from adversaries who are opposed to US values and interests. **The fundamental purpose of the Armed Forces is to win the Nation’s wars.** The employment of American military power adheres to constitutional and other legal imperatives, the highest societal values, and the concepts of proportionality, decisiveness, and accountability to the American people. Military commanders at all levels are responsible for infusing in the fighting forces an attitude of willing joint integration of effort that recognizes that all forms of combat power present advantages for exploitation.”

“The United States relies for its security on the complementary application of the basic instruments of national power: diplomatic, economic, informational, and military. Guided by national security policy and strategy, the Armed Forces of the United States shape and employ the military instrument to advance and defend national security interests and objectives. The fundamental purpose of the Armed Forces is to win the Nation’s wars. National security depends on the complementary application of the instruments of national power.”

“American military power has vital roles in peace, crisis, and conflict. In peace, the political imperative is to maintain visible, credible military capability and readiness for response across the range of military operations. **Demonstrated military capability is the cornerstone of deterrence**, which remains a principal means for dissuading would-be aggressors and adversaries from action harmful to the United States. During crisis, US military authorities focus on activities that bolster deterrence in conjunction with the other instruments of national power and prepare for rapid and effective transitions to conflict should deterrence fail. During conflict, the principal responsibility of the Armed Forces of the United States is to employ rapid and decisive military power to achieve US objectives, and do so in a manner that sustains the fruits of success in the postconflict environment. In unilateral or multinational operations, the United States adheres to domestic and international law governing warfare. It also conforms to domestic and international legal conventions and prescriptions supporting human rights. Military doctrine presents fundamental principles that guide the employment of forces. Joint doctrine provides authoritative guidance, based upon extant capabilities of the Armed Forces of the United States. It incorporates time-tested principles for successful military action as well as contemporary lessons which together guide aggressive exploitation of US advantages against adversary vulnerabilities. Doctrine shapes the way the Armed Forces think about the use of the military instrument of national power.”

“Effective deterrence depends on visible, credible, military capability that can be demonstrated. Its use in conflict must be decisive and overwhelming. Military doctrine shapes the way the Armed Forces think about the use of the military instrument of national power.”

“The campaign is the central organizing instrument for joint warfare.”

“Military plans and operations serve to support the attainment of the overarching political objectives that give rise to military involvement. Therefore, military plans and operations must focus both on achieving the political objectives and on establishing the military conditions necessary to sustain the objectives following cessation of military operations. This calls for planning based on the desired end state, ensuring that the longer-term

postconflict environment called for by US political objectives is preserved following conclusion of military involvement. Military plans at all levels should therefore include consideration of conditions under which conflict termination and termination of military involvement can be executed.”

“Joint Force Commanders (JFCs) issue prioritized mission-type orders to subordinate commanders and define command relationships to facilitate mission accomplishment consistent with their concept of operations.

Planning for employment of joint teams begins with **articulating and understanding the mission, objective, purpose of the operations, and commander’s intent**. The Joint Strategic Planning System provides strategic direction; assigns missions, tasks, forces, and resources; and designates objectives and rules of engagement. It also establishes constraints and restraints and defines policies and concepts to be integrated into combatant command strategies and plans. **The ultimate goal of US military forces is to accomplish the objectives directed by the NCA.** For joint operations, this will be achieved **through full spectrum dominance** — the ability of US forces, operating unilaterally or in combination with multinational and interagency partners, to defeat any adversary or dominate any situation across the full range of military operations.”

Planning Joint Operations

“Combatant command strategic planning in peacetime provides the framework for employing forces in peacetime and in response to crises.”

“Combatant command planners develop **peacetime assessments** that ease transition to crisis or war as well as to postconflict. Peacetime intelligence and logistic assessments, for example, are essential for force projection and rapid transition to combat operations. When directed by the NCA to conduct military operations, the **combatant commanders refine peacetime strategies and modify existing plans or develop campaign plans as appropriate**. The result, expressed in terms of military objectives, military concepts, and resources (ends, ways, and means), provides guidance for a broad range of activities.”

“A campaign is a series of related major operations that arrange tactical, operational, and strategic actions to accomplish strategic and operational

objectives.”

“A campaign plan describes how these operations are connected in time, space, and purpose. Campaigns are joint in nature and serve as the focus for the conduct of war and MOOTW (Military Operations Other Than War). Campaigns must be kept simple and focused on clearly defined objectives.”

“A wartime campaign is the **synchronization and integration** of any necessary air, land, sea, space, and special operations — as well as interagency and multinational operations — in harmony with diplomatic, economic, and informational efforts to attain national and multinational objectives.”

“Operational art is the use of military forces to achieve strategic goals through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles.”

“Operational art **determines when, where, and for what purpose major forces will be employed** and should influence the adversary disposition before combat. It governs the deployment of those forces, their commitment to or withdrawal from battle, and the arrangement of battles and major operations to achieve operational and strategic objectives. Operational art **helps commanders use resources efficiently and effectively to achieve strategic objectives**. It provides a framework to assist commanders in ordering their thoughts when designing campaigns and major operations. Operational art helps commanders understand the conditions for victory before seeking battle, thus avoiding unnecessary battles. Without operational art, war would be a set of disconnected engagements, with relative attrition the only measure of success or failure.”

“The initial plan establishes the commander’s intent, the concept of operations, and the initial tasks for subordinate units.”

“Key planning considerations include: mission, commander’s intent, commander’s critical items of information, concept of operations, targeting, support, air apportionment, countering air and missile threats, space support operations, concept of logistics, force protection, environmental

considerations, and command, control, communications, and computer systems.”

“Actions JFCs are able to take before the initiation of hostilities can assist in determining the shape and character of future operations.”

“JFCs should **prepare the operational area**, which involves implementing intelligence and counterintelligence operations in order to understand clearly the capabilities, intentions, and possible actions of potential opponents as well as the geography, weather, demographics, and culture(s) of the operational area. JFCs should also consider **isolation of the adversary, movement to attain operational reach, special operations protection, space operations, and assessment of the physical environment.**”

“As combat operations commence, JFCs need to exploit full dimensional leverage to shock, demoralize, and disrupt opponents immediately.”

“JFCs seek decisive advantage through the use of all available elements of combat power to seize and maintain the initiative, deny the enemy the opportunity to achieve his objectives, and generate in the enemy a sense of inevitable failure and defeat. Actions that JFCs take include **conducting force projection, seeking dimensional superiority, attacking adversary centers of gravity, conducting special operations, and ensuring force protection.**”

“JFCs conduct sustained operations when a quick military resolution is not possible.”

“JFCs seek to extend operations throughout the breadth and depth of the operational area. During sustained operations, **JFCs simultaneously employ air, land, sea, space, and special operations forces.** During a major operation, one component or major category of operations might be the main effort, with others in support. When conditions change, the main effort might shift to another component or function. **Some functions** (e.g., strategic attack, interdiction, and psychological operations) **continue throughout** the conflict, to deny the adversary sanctuary, freedom of action, or informational advantage. When prevented from concentrating, opponents can be attacked, isolated at tactical and operational levels, and defeated in

detail. At other times, JFCs may cause their opponents to concentrate their forces, facilitating their attack by friendly forces.”

“Military operations other than war encompass a wide range of activities where the military instrument of national power is used for purposes other than the large-scale combat operations usually associated with war.”

“MOOTW usually involve a **combination of air, land, sea, space, and special operations forces** as well as the efforts of governmental agencies and nongovernmental organizations, in a complementary fashion. Although these operations are often conducted outside the United States, they also include military support to US civil authorities.”

“Combatant commanders support national objectives through combatant command strategies and military operations, which translate strategic intent into operational and tactical actions.”

“Thus, **joint MOOTW involve strategic, operational, and tactical considerations**. Because the Department of State is frequently the lead Federal agency and nearly always a principal player in joint MOOTW outside the continental United States, JFCs should maintain a working relationship with the chiefs of the US diplomatic missions in their area. **Planning considerations for MOOTW** include interagency coordination, command and control, intelligence and information collection, constraints and restraints, training and education, postconflict operations, and redeployment to other contingencies.”

The Process Framework:

Phasing Model

“The Phasing Model describes the product development stages that are used by the product development team to enable efficient and effective product development. It describes how work is arranged, the sequencing of tasks and the cadence.”

The GM Model

The phases of war depend on the mission of the military campaign. What is the political objective that the action is attempting to address? The mission drives everything else. When the President, through the Command Authority, that is through the Secretary of Defense and the Chairman, Joint Chiefs of Staff gives an order to send the troops on a mission, the “operational tempo” begins based on the mission.

According to the Military Acronym Dictionary, published by the Pentagon, “**operational tempo (OPTEMPO)** is the pace of an operation or operations. The OPTEMPO includes all of the activities the unit is conducting. OPTEMPO can be a single activity or a series of operations. Logistics is the major focus of operational tempo.”

To be prepared to fight a war at any time and any place on the planet, the Department of Defense has evolved four major interacting, interrelated and interdependent systems. They constitute the overall National Security Planning Processes. They are:

- The National Security Council System
- The Planning, Programming, and Budgeting System (PPBS described in the Economic Framework)
- The Joint Strategic Planning System
- The Joint Operation Planning and Execution System.

The National Security Council System (NSC)

The NSC is chaired by the President of the United States. It is the major mechanism for developing issues of national security, foreign policy and issues of war and peace. By law, its members include:

The President
The Vice President
The Secretary of Defense
The Secretary of State
The Chairman of the Joint Chiefs of Staff
The Director of the Central Intelligence Agency
Others, as required

The NSC System is the major process by which the national security community comes together to develop the National Security Strategy. It is the integration of all the elements of national power, and it is meant to be an integrated approach to the world; the role the United States plays on the world stage. Doctrine dictates, “The NSC prepares, disseminates and oversees execution of Presidential national security decisions and directives, the U.S. National Security Strategy (NSS), and other directives that provide the basis for military action.” The NSC System also integrates the U.S. Government agencies that must work together to accomplish the National Security Strategy.

The Planning, Programming, and Budgeting System (PPBS)

PPBS is fundamentally a system that is used by the Department of Defense to allocate resources needed by the military establishment to carry out the National Security Strategy (NSS). It is important to understand that every time the NSS is published, the Department of Defense then puts together a National Military Strategy (NMS) to accomplish its portion of the NSS.

Doctrine dictates, “The PPBS enables the Services and selected commands and agencies to develop and sustain necessary military capabilities. Under this system, the Department translates requirements for forces, personnel, materiel, and facilities into budgetary requirements to be presented to the President for approval and to the Congress for authorization.”

Joint Strategic Planning System (JSPS)

The JSPS is the system used to provide the senior leadership of the Department of Defense and the NCA the military advice they need for the PPBS. The products of the JSPS include the National Military Strategy (NMS) and the Joint Strategic Capabilities Plan. These provide “guidance and instructions on military policy, strategy, plans, forces, and resource requirements and allocations essential to successful execution of the NSS and other Presidential directives.”

Doctrine stipulates of the JSPS that it “also provide a means to evaluate extant U.S. military capabilities, to assess the adequacy and risk associated with current programs and budgets, and to propose changes for NCA and Congressional approval.”

Joint Operation Planning and Execution System (JOPES)

The JOPES is a system that translates the policy decisions coming out of the other systems into operational plans and orders. It is meant to ensure that military capabilities are used wisely to meet the needs of the national agenda. According to Doctrine, “The JOPES includes deliberate and crisis action planning processes. It guides U.S. military action during crises and transition to operations through rapid, coordinated planning and implementation of plans. Campaign planning encompasses both the deliberate and crisis action planning processes. If the scope of contemplated operations requires it, campaign planning begins with or during deliberate planning. It continues through crisis action planning, thus unifying both planning processes.”

It is especially important to understand the operational definition of peace, crisis and conflict. According to Doctrine,

Peace:

“In peace, the political imperative for the Armed Forces of the United States is to maintain visible, credible military capability and readiness for employment across the range of military operations. Demonstrated military capability is the cornerstone of deterrence, which remains a principal means for dissuading would-be aggressors and adversaries from action harmful to the United States.”

Crisis:

“During crisis, U.S. military authorities focus on military activities that bolster deterrence in conjunction with coordinated actions by civil authorities in charge of the other instruments of national power. The NSC has a lead role in managing crises that may involve military action.”

Conflict:

“During conflict, the principal responsibility of the Armed Forces of the United States is to employ rapid and decisive military power to achieve U.S. objectives in a manner that sustains the fruits of success in the post-conflict

environment. Conflict encompasses combat (including formally declared war) or situations in which there is a risk of combat, such as those that result in multinational peace operations. The rapidity and visible capability of U.S. force deployments alone may be sufficient to deter conflict expansion and achieve U.S. objectives. In conflict situations, U.S. military commanders adhere to U.S. joint doctrine and ratified multinational doctrine, and integrate their efforts with multinational and interagency partners.”

Logistical support is a major phasing issue for all campaigns. The Logistics Directorate, J-4 is charged with “the formulation of logistic plans and with the coordination and supervision of supply, maintenance, repair, evacuation, transportation, engineering, salvage, procurement, health services, mortuary affairs, security assistance, host-nation support, and related logistic activities. Because many of the problems confronting this Directorate are necessarily of a single Service nature, the established policies of the Military Departments should be considered.”

Logistics efforts for any major campaign operation require knowledge of the logistics doctrine for each Service. Fortunately, the J-4 coordinates logistics between the Services to for a smooth logistical effort that is seamless to the war-fighter.

According to Doctrine: “Logistics is the process of planning and executing the projection, movement and sustainment, reconstitution, and redeployment of operating forces in the execution of national security policy. Logistic functions include:

- Supply
- Maintenance
- Transportation
- Civil engineering
- Health services
- Other services”

“The **science of logistics** concerns the integration of strategic, operational, and tactical sustainment efforts within the theater, while scheduling the mobilization and deployment of units, personnel, equipment, and supplies in support of the employment concept of a geographic combatant commander.

The relative combat power that military forces can bring to bear against an enemy is constrained by a nation's capability to plan for, gain access to, and deliver forces and materiel to the required points of application across the range of military operations."

"Supply is the function of acquiring, managing, receiving, storing, and issuing the materiel required by forces. **Maintenance** includes actions taken to keep materiel in a serviceable condition or to upgrade its capability."

"Transportation is the movement of units, personnel, equipment, and supplies from the point of origin to the final destination. **Civil engineering** provides the construction, operation, maintenance, damage repair, and reconstitution of facilities, roads, and utilities and logistic infrastructure. **Health services** includes medical evacuation, hospitalization, medical logistics, medical laboratory services, blood management, vector control, preventive medicine services, veterinary services, and dental services. **Other services** are nonmaterial support activities provided by Service personnel and the logistic community that are essential to force support. For each of the above functional areas, the combatant commander should consider these four elements of the joint theater logistic process: **procurement and contracting, distribution, sustainment, and disposition and disposal.**"

The Process Framework:

Enabling Model

"The Enabling Model describes the subsidiary processes and approaches that complement the major processes allowing them to be fast, focused and high quality but with managed risks and costs."

The GM Model

Doctrine:

The most important enabler is doctrine, and the role it plays as the major change agent of the military establishment. It is helpful to remember that the military is always in a state of transformation... always striving for perfection and therefore in a state of continuous improvement – by quantum leaps, if possible. The military refers to doctrine as its "engine of change." Doctrine is a set of guidelines for behavior. It uses history's lessons to guide

“aggressive exploitation of U.S. advantages against its adversary vulnerabilities.” This is done by inculcating common values and perspectives through joint planning, education and training; the conduct of joint military operations in combat and noncombat situations.

Doctrine is a description of what the organization is; what the organization is trying to do and how. Doctrine can be described as the rules by which everything must work; the guidelines for behavior, the governing principles. Doctrine is also the mechanism to communicate, educate, train, and instill values to the people of the organization. It is an *enabler* to help the people of the organization accomplish its vision, mission and objectives. It is written by the leaders of the organization and taught by them to the rest of the organization. It is “lived” every day. It is reinforced continuously. Doctrine provides individuals with a sense of the role they play in the organization. Doctrine provides alignment in the organization.

In the military, the development of doctrine is the “Generals” Work. That is, the leadership is responsible for the system, its aim, and the writing of its rules.

Doctrine says: **“Command is central to all military action, and unity of command is central to unity of effort.** Inherent in command is the **authority that a military commander lawfully exercises over subordinates** and confers authority to assign missions and to demand accountability for their attainment. Although commanders may **delegate authority** to accomplish missions, they may not absolve themselves of the **responsibility for the attainment of these missions.** Authority is never absolute; the extent of authority is specified by the establishing authority, directives, and law. Higher headquarters staff officers exercise no independent authority over subordinate headquarters staffs, although staff officers normally honor requests for information.”

“Levels of Authority. The authority vested in a commander must be commensurate with the responsibility assigned.”

According to Doctrine:

“Joint doctrine and its supporting tactics, techniques, and procedures focus on how best to employ the Armed Forces in order to achieve U.S. objectives at strategic, operational and tactical levels.”

Doctrine enables change because it is always evolving to meet new environmental conditions, new situations in the world and new and emerging technology. Doctrine is always in the process of improving, and because the military is always in the process of education and training, the new doctrine is able to diffuse through the organization quickly. Every time there is an operation, or a training exercise, the doctrine process takes the lessons learned and changes the doctrine itself, if need be. The process is never permitted to stagnate. In fact, rehearsals of political and military plans are ongoing along with the concomitant process of creating and training the new revised versions of doctrine.

The Military remains most effective at learning as an organization through doctrine.

Enduring Concepts and Their Enablers:

There are seven “Enduring Concepts” that have eleven “enablers” that make them possible. These will be described in detail.

The seven Enduring Concepts are:

1. Strategic Agility
2. Overseas Presence
3. Power Projection
4. Decisive Force
5. Forcible Entry
6. Timeliness
7. Survivability

The eleven enablers are:

1. People
2. Technology
3. Information Superiority
4. Global Command and Control

5. Air, Land, Sea, and Space Control
6. Strategic Mobility
7. Sustainment
8. Intelligence, Surveillance and Reconnaissance
9. Assured Access to the Battlespace
10. National Will
11. Force Protection

The enduring concepts permit the U.S. Armed Forces to be ready to conduct their military operations anywhere, at any time. They are a part of the joint doctrine that provides guidelines for behavior in accomplishing missions. The following represent their operational definitions according to Doctrine.

Strategic Agility

According to Doctrine, “Strategic agility is the ability to adapt, conceptually and physically, to changes in the international security environment in order to prevent an adversary from successfully exploiting surprise and to ensure the protection of U.S. interests at risk.”

Overseas Presence

Overseas presence includes “permanently stationed and rotationally or temporarily deployed forces forward in regions of particular importance for advancing and defending U.S. interests.” It is critical that U.S. forces are deployed around the world for deterrence, intelligence purposes and generally understanding the state of the world outside of the United States homeland. It is also important for the United States to “shape” the outcome of many world situations. No other mechanism is as effective as “being there.”

Power Projection

“Power projection is the ability of a nation to use all or some of its instruments of national power – diplomatic, economic, informational, or military – to rapidly and effectively deploy and sustain forces in and from multiple dispersed locations to respond to crises, to contribute to deterrence, and to enhance regional stability.” It also means you have the capability to

move your forces from anywhere, to anywhere, to conduct any military operation or operation other than war.

Decisive Force

Decisive force means that you have enough power to defeat the enemy anytime, every time, quickly, to achieve the military objective.

Forcible Entry

Under many circumstances, armed forces need to force their way into an area and be prepared to fight the moment they enter that area. Doctrine states that, “Forcible entry entails seizing and holding a military lodgment in the face of armed opposition.” There is great risk to the soldier in a forcible entry operation even when successful. Joint training and doctrine reduce that risk considerably, but the risk is always there for loss of life.

Timeliness

Being in the right place at the right time with the right force is the main objective of a military operation or operation other than war. Although the U.S. may be the most capable at rapid response, it nevertheless may take a great deal of time to build coalitions, assemble the troops and arrive ready to take action. Doctrine states, “The art of planning military operations is to sequence the concentration in conjunction with application of other instruments of national power.”

A major enduring value needs to be explained. As Doctrine dictates, “While not unique to American culture, preserving human life is among its highest imperatives. However, casualties are inevitable in most violent applications of military power. The guiding principle for U.S. military operations is to assure mission accomplishment while making every effort to ensure the combat capability and survival of the force.”

Enduring Enablers:

There are eleven enduring enablers, each one a process in and of itself. What follows are descriptions of each one.

1. People

Although the people portion of this research effort will be covered later, it is important to understand that Doctrine states that, “People are the most important enabler of U.S. military forces and are the key to their success in peace and war. While technology may assist Service men and women, it is their innate courage, intellect, motivation, skill, tenacity, and self-sacrifice that makes the difference and assures victory. In developing and fielding forces, the Armed Forces of the United States keep foremost the responsibility to provide the best leadership, training, and equipment; to attend to the welfare of Service members and families; and to treat all individuals with dignity and respect.”

2. Technology

The United States is committed to providing the most sophisticated and capable technology for its warfighting efforts. It is a major driver of technological innovation in the world, and it is integrated into the training, leadership and doctrine of the entire military establishment.

3. Information Superiority

With the technological advantage of the United States, the country has a clear advantage over any adversary. The need to use knowledge while denying the enemy their ability to use knowledge is a key element of victory. Doctrine states that the objective of information superiority is to “make the most effective use of friendly forces by assuming a timely, reliable, and secure continuous flow of accurate key information about the ongoing situation, and interfering with the opponent’s information to the extent that opposition becomes ineffective or nonexistent. Of particular importance is the timely availability, integrity, and confidentiality of intelligence, and the integration of intelligence functions with all other functions across the range of military operations.”

4. Global Command and Control

The United States, because of its technological capability is able to maintain global command and control systems and processes without difficulty and with great security. It is a robust system that is continuously improving and evolving.

5. Air, Land, Sea, and Space Control

Currently, within the limits allowed by law, the United States military has air, land, sea and space access to operate freely with superiority and dominance to work in an unfettered way wherever and whenever needed.

6. Strategic Mobility

Strategic Mobility is the ability to “deploy, sustain, and redeploy U.S. military forces with their associated equipment worldwide” in the effective execution of their operations. In addition, “The Armed Forces must maintain the mix of military and immediately available civilian contract capabilities to meet the most challenging scenarios across the range of military operations.”

7. Sustainment

Logistical support is critical to the global deployment of U.S. forces and their ability to conduct operations anywhere at any time. This requires that “logistic support and the underlying civilian industrial base be immediately available to initiate, prosecute, and terminate operations without a prolonged period of mobilization and buildup. Logistic considerations are integral elements of military planning for all types of operations from the development of requirements, options, and concepts through the conclusion of operations.”

8. Intelligence, Surveillance and Reconnaissance

It is impossible to conduct war without intelligence, surveillance and reconnaissance. These three need to be integrated to see the complete picture. Doctrine says that a robust system must “combine all sources – U.S. military, nonmilitary intelligence agencies, commercial systems, and systems of allies and other friendly countries.” All these must operate as a

single system along with the supporting network to be effective. Without this systemic view, the U.S. cannot have information superiority.

9. Assured Access to Battlespace

To deploy around the world at any time and anywhere, it is imperative to be able to get there and gain access to the area where you need to be. This can be very difficult if the countries close to action have political or economic reasons to deny the U.S. access. Access is sometimes a problem, but whether through unilateral agreements or other agreements, or through force, if necessary, access is essential for victory.

10. National Will

No military action can ultimately be successful in a Democracy without the overall will of the nation to provide support for the action. In a representative Democracy, the national leaders are expected to inform the public why it is in their interest to use U.S. national assets. This is the responsibility of the President, appointed leaders and Congress.

11. Force Protection

Because Force Protection is one of the most important enablers, and a major focus of the Department of Defense Constitutional mandate, it may be best to describe it deliberately by quoting Doctrine:

“It is essential for the Armed Forces to provide the best feasible protection for U.S. forces, people, families, and facilities worldwide from a variety of predictable and inherently unforeseeable threats. Protection should include military capabilities and functions such as information, intelligence, logistics and others that are essential for mission accomplishment. These threats include the extension of a conflict beyond its original region to U.S. citizens, bases, facilities, and interests, even into U.S. territory. Of particular concern is the capability of clandestine military operations and terrorist organizations to attack vulnerable, populated areas and critical infrastructures with a variety of lethal means.”

“The threat includes employment of nuclear, biological, and chemical and radiological weapons and other highly destructive conventional explosives

and highly toxic chemicals and materials against unprotected people and facilities. Military considerations for force protection therefore include not only military elements in a region of conflict, but also military and civilian potential targets of high value to the United States wherever they may be, including U.S. territory. While not a stand-alone military mission, force protection is an essential consideration for peacetime readiness and military activities across the range of military operations.”

The eleven enablers, together, constitute a set of concepts, processes and systems that seen together permit the military establishment to operate successfully around the world.

The People Framework:

Remember that Doctrine states that, “People are the most important enabler of U.S. military forces and are the key to their success in peace and war. While technology may assist Service men and women, it is their innate courage, intellect, motivation, skill, tenacity, and self-sacrifice that makes the difference and assures victory. In developing and fielding forces, the Armed Forces of the United States keep foremost the responsibility to provide the best leadership, training, and equipment; to attend to the welfare of Service members and families; and to treat all individuals with dignity and respect.”

It is important to understand that there are no hard and fast rules of war, though there are many guidelines for behavior. War is not linear, and so there is no one way that “describes how work is arranged, the sequencing of tasks and the cadence” other than logistical support. In fact, Joint doctrine clearly states, “War is a human undertaking that does not respond to deterministic rules. Of primary importance, therefore, are the values that U.S. military experience has proven to be the bedrock of combat success.”

The four primary military values are:

- Integrity
- Competence
- Physical and Moral Courage
- Teamwork.

Integrity is the “cornerstone for building trust.” As the Joint doctrine describes it, “Military men and women must know that they can count on each other to say what they mean and do what they say, relying with confidence on others to carry out assigned tasks.”

Competence “is at the core of the profession of arms and includes both the technical competence to perform the relevant task to standard as well as the ability to integrate that skill with others according to joint doctrine.”

Physical courage is captured in the individual “fighting spirit” that inspires teamwork and camaraderie. *Moral courage* is the “competent risk taking and tenacity that includes the willingness to stand up for what one believes to be right.

Teamwork results from cooperative efforts based on demonstrated competence and a willing attitude to achieve common goals.”

The People Framework:

Reward Model

“The Reward Model describes the system of compensation that recognizes not only the time and effort spent on product development, but also the reward (and the lack of it) when the job is done particularly well or poorly. Rewards are both monetary and non-monetary, e.g., promotions, awards, commendations, publicity, etc.”

The GM Model

Basic pay is received by all people and is the main component of an individual’s salary. There are also, from time to time, “special pays” for special qualifications or events. “For example, there are special pays for aviators and parachutists; special pays are also paid for dangerous or hardship duties.” This is sometimes called combat pay that gives extra monetary incentives for people who are put in harms way.

There are also monetary cash rewards to stay in the services and not leave that frequently entice people with specific skill sets that are needed to remain in the services.

There are also “living allowances” for people both at home and who are sent abroad that make moving to such assignments very attractive. Allowances are the second most important element of military pay. According to the Under Secretary of Defense for Personnel and Readiness, “Allowances are moneys provided for specific needs, such as food or housing. Monetary allowances are provided when the government does not provide for that specific need. For example, the quantity of government housing is not sufficient to house all military members and their families. Those who live in government housing do not receive full housing allowances. Those who do not live in government housing receive allowances to assist them in obtaining commercial housing.”

What is critical to understand about military compensation is that other than an individual’s base pay, *most other benefits, such as basic subsistence and housing allowances, which can comprise a significant portion of the individual’s total pay, are not taxable.* This is a significant additional benefit of military pay.

It is very important to understand that an individual’s basic pay is based on a person’s grade or rank and the number of years of service. With special training and skill sets, additional pays are added on. It is not unheard of for some members of the military with special training and skill sets to have pay very competitive with industry, especially at the upper levels, and with their tax advantages. Individuals who are motivated to learn and take courses that qualify them with special skills are compensated accordingly.

According to Doctrine: “To **develop, sustain and retain the force**, it isn’t enough to make recruiting quantitative and qualitative goals each year. The Military Services must turn those volunteers into soldiers, sailors, airmen and marines, and must ensure that the requisite number of these young people choose to stay in and participate in the career force. Key actions to accomplish this objective include:

- (1) Determining if current incentives motivate performance and retain or transition members at the right time;
- (2) Maintaining an environment conducive to retention;
- (3) Balancing PERSTEMPO (personnel tempo) and mission accomplishment;

- (4) Reviewing language and cultural training curricula and making adjustments as appropriate;
- (5) Studying the interrelationship of variable officer career lengths, promotion-timing, and in-career compensation and benefits to ensure optimal career patterns and also determining the optimal active duty service obligation;
- (6) Completing a study already initiated on Service programs designed to prepare officers to serve as General/Flag Officers;
- (7) Validating retention metrics;
- (8) Conducting a study on an indefinite (re) enlistment option for enlisted members;
- (9) Given a commitment to systems that are more productive, and less manpower intensive, reviewing grade structure and qualitative requirements;
- (10) Reviewing opportunities to improve the alignment of manpower (spaces) and personnel (faces), and their supporting management systems;
- (11) Achieving cost-effective human resource programs.”

The Under Secretary states, “Annual pay raises are linked to the increase in private sector wages. Beginning with the January 1, 2000, pay raise, annual pay raises through 2006 were to be on-half percent above private-sector average increases. This is an important change. Since passage of a 1990 law, the military annual pay raise has been capped at on-half percent below private sector growth unless specifically granted a larger increase by Congress. The FY2000 National Defense Authorization Act directed that pay raises for 2000 through 2006 will automatically be above the private-sector wage increases. Pay raises may exceed these automatic levels if authorized and funded by Congress. The pay raise for January, 2001 was 3.7%. In January, 2002, officers received a minimum 5% and enlisted members a minimum of 6% pay raise. Some grades with certain years of service received a higher increase – up to 10%. The average increase was 6.9%.”

Among the most important incentives available is the ability, if you qualify (and most people do) to obtain a college education and other vocational skill sets that are very marketable. For career military, this also can include graduate degrees, such as a Masters and/or Ph.D. and even professional degrees, such as becoming a lawyer or a physician.

For many cash strapped individuals, the road to upward mobility through education comes through the military establishment.

For those individuals who choose a twenty-year career, the retirement benefits are considered outstanding by many not only for the financial pay, but in addition, health care for life and a knowledge that the benefits accrue to the individual and their family for life. After an individual retires, they usually have outstanding marketable skills and have enough time to have a complete second career along with a second retirement to live on when they really retire. According to the Under Secretary, “Retirees also retain the privilege to use base facilities, such as the Commissary and gym.”

Those individuals who remain on active duty for 20 years or more, become eligible for retirement.

“The Military has a wide variety of benefits ranging from complete health care to commissary and exchange shopping. A recent GAO review of active duty military benefits noted that when comparing the types of benefits offered by the military with those offered in the private sector, all the core benefits offered by most private sector firms – retirement pay, health care, life insurance, and paid time off – are offered by the military. In fact, the GAO review found that military benefits in some cases exceed those offered by the private sector.”

Generally speaking, the pay and benefits packages for active members include:

- Retirement and Savings Programs
- Complete Health Care for Member And Family including Dental and Eye Care
- Housing Allowances
- Paid Time Off
- Discount Shopping
- Family Support Services
- Child and Youth Programs
- Educational Assistance and Tuition Assistance
- Life Insurance
- Home Loan Guarantees

- Legal Assistance
- Travel Assistance
- Disability
- Death and Burial Benefits

The People Framework:

Recognition Model

“The Recognition Model describes the methods and systems used to provide recognition for accomplishing the product development tasks. It encompasses the traditional awards programs but goes beyond to cover all aspects of giving and receiving positive or negative credit for the work and similarly for the person who did the work.”

The GM Model

It is critical to understand that today’s Military is comprised of an “all volunteer” force. When the military draft was eliminated, and the military services began to recruit, a variety of incentives, including monetary, were put in place.

What is most important to understand about the self selected population that chooses the military as a career is that it is more than a career. It is a way of life. The military way of life is community oriented. The military shares the same set of values and, in many ways, the belief of most in the military that they are contributing to something greater than themselves is its own reward. Many military members express the need to serve their community and their country. *Many believe they are serving the world by making it a better place...removing bad people who hurt others, helping to feed the hungry, providing humanitarian assistance, being peace makers and peace keepers and so on.*

Although there are many decorations, honors and medals for specific acts of bravery or service, most members of the military serve because they want to serve. The military has evolved a very ritualized environment to celebrate important events, promotions, graduations, and so on. All of these are family driven, and looked forward to. The culture of belonging and positive

reinforcement from the community is an enormous motivation to its members.

For the small number of problem individuals in the community, there are also disincentives to continue. But, these represent a tiny fraction of the whole. Doctrine stipulates a Uniform Code of Military Justice that “provides the basic law for discipline of the Armed Forces.” This is the legal framework that the military uses when necessary for a court-martial. The “Manual for Courts-Martial prescribes the rules and procedures governing military justice.” It is not only Doctrine. It is law. Military justice systems mirror civilian justice systems, and are very similar in terms of punishment for crimes.

To illustrate the way in which the military culture emerges, it might be best to understand the way in which its leadership is taught. Colonel Larry R. Donnithorne (Ret), in his book, *The West Point Way of Leadership*, describes the values of a “leader of character” that is the objective of West Point cadet’s development over four years. He says, “A leader of character has all of the qualities we normally associate with leaders – ambition, confidence, courage, intelligence, eloquence, responsibility, creativity, compassion – and one thing more which we unfortunately overlook too frequently among civilian leaders: A leader of character is absolutely trustworthy, even in times of great stress, and can be depended upon to put the needs of others – the organization, the community – above personal considerations – not now and then, or when the spirit moves him, or when it will look good on his résumé – but in every instance.”

The trust is based on competence and a strong moral code of ethics that believes that “Honor is the language we speak...A cadet will not lie, cheat or steal, nor tolerate those who do.”

Most of the military share these ideals. They are believed. They are sought. They are real. They are strived for *every* day throughout life. The military finds great strength in these shared values. They are a way of life.

The People Framework:

Learning Model

“The Learning Model describes how product development knowledge and lessons learned are not only captured and documented, but also how it is continually transferred from project to project, from member to member and from team to team. Thus, it is not only about for management of product development knowledge but rather about the use and re-use of product development knowledge and experiences.”

The GM Model

Knowledge is a value of the entire military establishment. Peter Senge, author of *The Fifth Discipline*, the book that firmly established “learning organization” concepts, once said, “The U.S Army is the best learning organization in the world.”

Today, the military establishment is, indeed, a “learning organization” in the Senge sense. ***Joint Professional Military Education is seen as a value that the military establishment invests a great deal in. In fact, all education and training programs within the military establishment are valued. The military knows what its core competencies are and they nurture those core competencies.*** They also know what their core competencies are not, and where fiscally more important, those non-core competencies are outsourced, where appropriate.

Most institutional knowledge is transferred to the troops through education, training programs and the education of doctrine. Training programs are thorough and include every element of combat from how to shoot a weapon to the geographical areas an individual is being sent to. Nothing is left out that a warrior will need. If they need foreign language training, they receive it. If they need to learn how to operate high technology equipment, then that is the training they will receive. Most soldiers learn numerous skills for every engagement they are sent to.

According to Doctrine:

“Military Competencies at Senior Levels include...The Chairman of the Joint Chiefs of Staff, the other members of the JCS, and the combatant commanders have unique responsibilities for planning and directing the employment of the Armed Forces of the United States. This is their core competency. The combination of joint professional military education, as

well as progressive and sequential assignments toward higher levels of joint operations, supports the development and continuous revitalization of this core competency. It is supported by systems that prepare and assign the most competent officers to the staffs that support these senior military leaders...Military Components of the Armed Forces include the Services, the U.S. Special Operations Command, and defense agencies (e.g. Defense Intelligence Agency, Defense Logistics Agency) that develop and provide force elements to combatant commands have the primary responsibility for organizing, training and equipping forces for joint employment in accordance with joint doctrine... The combatant commanders are responsible for the integration of military core competencies across all the forces at their disposal. This integration should be based on joint doctrine and take account of all force characteristics (including personnel and materiel, training, and leader development) in order to facilitate coherent joint operations.”

In addition to the development of the core competencies of the military, which are universally understood and taught, the military expends a great deal of its annual budget teaching the principles of strategic leadership and strategic visioning to its entire leadership community. ***This is because without leadership, the military cannot execute its missions.***

What is strategic leadership and what is a strategic leader?

According to the U.S. Army War College, “*Strategic leadership* is the process used by a person in a position to affect achievement of a desired and clearly understood vision by influencing the culture, allocating resources, generating activities, and building consensus within a volatile, uncertain, complex and ambiguous global environment. A *strategic leader* is the effecting, influencing person at the point of merger of institutional, situational, and environmental reality, capable of communicating and actualizing a vision with the help of all constituents.”

Strategic visions in the military have the following characteristics:

- They are applied at the executive level of the services
- They describe future characteristics and capabilities of the services, including the building of relationships inside and outside the organization

- They normally are focused 10-20 years in the future
- They constitute a proactive effort to influence trend lines and change the available futures
- They are designed to optimize organizational success within a group of possible alternative futures
- They guide current organizational decisions and actions
- To be effective, they must be uniquely attractive, “energizing,” intellectual and experienced
- They provide meaning to the organization.

All leaders are managers even if all managers are not leaders. All strategic leaders are strategic managers. What is strategic management and how does it relate to strategic leadership? Strategic leaders utilize “holistic,” systems approaches and processes to manage their organizations as open systems, adaptable to their environments. Strategic leadership is a process by which an individual or group of individuals steer and focus an organization to accomplish a strategic vision. Strategic leaders possess knowledge of:

- Their vision, and doctrine, clearly articulated to the troops
- Long time horizons
- The global interdependence of all things
- The country’s external threats and opportunities
- The military’s internal capabilities, strengths and weaknesses
- The second, third and fourth order effects of decisions;
- The basic human and moral values; living the beliefs
- The need for processes to be integrative and participative
- Paradigm questioning in an environment of volatility, complexity, uncertainty, and ambiguity
- The need to always be learning (based on theory)
- Constancy of purpose, consistent communications and feedback
- The fact that they are responsible for their troops
- Continuous improvement of core competencies and Doctrine
- Setting limits and boundaries through policies/processes

Strategic leaders:

- Understand their world and see the big picture and how all the pieces fit together in order to optimize the “whole”
- Must take initiative (when in charge -- take charge!)

- Need to tell the troops the vision over and over again (constancy of purpose) and what they need to do to support the vision; the “how to” plan
- Teach and learn, model behavior, coach and mentor
- Learn from history (but do not be tied to it)
- Listen to the troops and what “intelligence” is saying
- Build a team and nurture it
- Make decisions even when consensus is elusive
- Take time to look for and think through new paradigms and strategies
- Use power effectively
- Instill love and devotion, commitment and passion

These are the principles that are taught within the military establishment. In *Strategic Leadership and Decision Making: Preparing Senior Executives for the 21st Century*, a text book for senior military leaders at the National Defense University, “The challenge to strategic leadership is recognizing that the decision maker cannot have a ‘stand-alone’ perspective, and that effective strategic decisions must flow from a managed process that produces a perspective through consensus that is broader than any single person probably possesses.”

To develop National Security Strategy, the text book states, “Volatility, uncertainty, complexity and ambiguity (VUCA) are not interdependent concepts. While each may describe certain aspects of a decision task, each feeds the other. Strategic policy objectives are formulated within the context of this VUCA world.”

“Coping with VUCA is the essence of strategic leadership. And, if the United States is to aspire to permanent global leadership, VUCA requires understanding different cultures, different kinds of national objectives, and different means other nations employ to achieve their objectives. And the logic for working effectively with nations around the globe must include not only competitive advantage for the United States, but ‘value added’ for other nations.”

“We know what our existing knowledge lets us know and we see from our own perspectives, sometimes dimly. We make assumptions about other cultures, often mistakenly, based on what is reasonable in our own culture.

We infer intentions based on what our intentions would be in that situation, ‘if we were they.’ Strategic leadership must, of necessity, be based on a broader frame of reference. Using a VUCA Time Horizon will help provide that reference.”

This is the basis for how learning occurs within the military in today’s environment.

The People Framework:

Staffing Model

“The Staffing Model describes how a product development team is formed. It begins with the process of identifying the specific work load, the specific people, names and titles, their necessary skills, knowledge and temperament. It continues with the balancing of the resource needs of the corporation and ends with the process of scheduling the assignments synchronous with all other ongoing product development activities.”

The GM Model

The Manpower and Personnel Directorate, the J-1 is “charged with manpower management, the formulation of personnel policies, and supervision of the administration of personnel of a command including civilians under the supervision or control of the command.” All manpower and personnel decisions are made in accordance with each Service’s Manpower and Personnel policies, since each command has employees of the various services reporting to it. Most staffing decisions are made by the Services. A commander tells the Services what he needs in skill sets and numbers of troops, and the Services comply within their capability. All of this is negotiated through the Joint Chiefs of Staff at the highest levels.

According to the Pentagon, “Officer career progression begins within American society—in the general population of young people qualified, available, and interested in joining the military and becoming officers—and it continues through the highest levels of military leadership for a small fraction of those who entered. An individual’s progression through the

military's officer corps can be marked at points of recruiting, precommissioning, commissioning, promotion, and retention. Unlike the practices of other organizations or employers in American society, entry into the military occurs almost exclusively at the junior enlisted and officer grades—with very limited lateral entry.”

“Aside from direct appointments—for persons who are professionally qualified in medicine or other health fields, in law, and as chaplains—commissioned officers begin their military career at the lowest grade. No one is ‘hired’ to be a major or colonel or admiral. Senior positions in the organization’s rank structure are filled through a system that advances personnel strictly from within, based on time in service, ability, and performance criteria. Thus, the military’s majors, colonels, and admirals must be a subset of the human resources that enter the system at its origin.”

It is also important to understand that every few years, if an officer isn’t promoted twice, they are usually forced into retirement. There are 10 grades or levels of officers. O1 is a second lieutenant grade, the very bottom of the officer ranks. O6 is a colonel. O7-10 is the general officer or admiral level. The Defense Officer Personnel Management Act (DOPMA) has provided for an officer management system shared by all Services since 1981. DOPMA contains specific rules relating to the training, appointment, promotion, separation, and retirement of military officers.

According to Rand, “The vast majority of officers selected for promotion are in the ‘primary zone’ (those eligible for promotion.) In 1990, for example, only about 8 percent of officers selected for promotion to O-4 were considered from ‘below zone,’ 5 percent were ‘above zone,’ and 87 percent were ‘primary zone.’ For newly commissioned officers who complete basic military and advanced occupational training, promotion from O-1 to O-2 is virtually automatic. In contrast, promotions to O-3 and O-4 are considered competitive since candidates face a promotion board review process. In reality, though, O-3 promotion is essentially assured since DOPMA sets the promotion rate goal at 95 percent. In contrast, promotion to O-4 is the first truly competitive point as 20 percent of officers reviewed by the promotion board will not be selected. Further, attainment of the senior ranks of O-5 and O-6 requires demonstration of a sustained high level of performance overall, as well as in difficult or key assignments, to include Joint Duty. To be

competitive, officers must also acquire certain credentials—professional military education courses and/or other civilian advanced degrees. Approximately half of all serving O-5 officers will be selected for O-6.”

According to a Rand Corporation study, “The ‘up’ portion of the ‘up or out’ system provides that, in general, officers move through the system in ‘cohorts’ originally determined by the year of commissioning, and compete for promotion to the next higher grade against other members of the group at set years-of-service (YOS) points. The ‘out’ portion of the ‘up or out’ system provides that ‘officers twice passed over for promotion, after a certain number of years, depending upon their particular grade, are to be separated from active service, and if eligible retired.’”

Enlisted individuals are not bound by the “up or out” system. These practices are necessary to understand in order to prepare for joint warfare.

Individuals are not only rated by their supervisors, they have 360 degree rating, that is by their peers, by their services by their combatant commanders and by their subordinates with a great deal of feedback.

Doctrine states that the “campaign is the central organizing instrument for joint warfare. Campaigns, by their nature, are joint undertakings. They are planned and executed by applying operational art. The joint operational art encompasses the translation of national security and military strategies into operational design for the joint employment of forces at all levels of war. Combatant commands develop command and theater strategies to apply the joint operational art to their contemporary missions and situations. The purpose of these command and theater strategies is to assure unified action by all command components and supporting commands. Unified action under the overall direction of the combatant commander will then be able to encompass the actions of military, interagency, multinational and nongovernmental organizations in execution of the campaign plan...”

“Military plans and operations serve to support the attainment of the overarching political objectives that give rise to military involvement. Therefore, military plans and operations must focus both on achieving the political objectives and on establishing the military conditions necessary to sustain the objectives following cessation of military operations. This calls for planning based on the desired end state, ensuring that the longer-term

postconflict environment, called for by U.S. political objectives, is preserved following conclusion of military involvement. Military plans at all levels should therefore include consideration of conditions under which conflict termination and termination of military involvement can be executed.”

Success is so well defined, the military knows when its job is done, and a new phase of activity should begin.

There are three types of operations with three sets of principles that impact staffing because they impact the mission:

- The Principles of War
 - Objective
 - Offensive
 - Mass
 - Economy of Force
 - Maneuver
 - Unity of Command
 - Security
 - Surprise
 - Simplicity
- Principles of Military Operations Other Than War
 - Objective
 - Unity of Effort
 - Security
 - Restraint
 - Perseverance
 - Legitimacy
- Fundamentals of Joint Warfare
 - Unity of Effort
 - Concentration
 - Initiative
 - Agility
 - Extension
 - Freedom of Action
 - Sustainment

- Clarity
- Knowledge

All staffing decisions are meant to accomplish effectively and efficiently, the Principles of War.

The Economics Framework:

Feasibility Model

“The Feasibility Model describes the processes and approaches used to establish that a new product idea should be further pursued. It includes the idea selection criteria and decisions that are made given various corporate business objectives; the balance of corporate resources of all forms, and the need to account for corporate financial and regulatory objectives.”

The GM Model

According to Doctrine, the “Considerations for use of military force include:

- Advances National Interests
- Clearly Defined and Achievable Mission
- End State, Termination Conditions, and Exit Strategy Clear
- Decisive Means Available
- Campaign Plan Showing Path to Success
- Milestones to Measure Success
- Alternative Courses of Action if Military Unsuccessful
- National and International Agencies Ready for Their Roles
- Support of Allies, Friends, International Institutions
- Support of American People”

The major feasibility tests have to do with technological capability and readiness of weapons systems and the training and doctrine that go along with them.

To address these technological issues, the United States military establishment regularly develops the Joint Vision Implementation Master Plan (JIMP) that is used to provide guidance for implementing the Chairman of the Joint Chiefs of Staff's (CJCS) long range vision. Today's CJCS vision is the *Joint Vision 2020*. According to General Henry H. Shelton, Chairman of the Joint Chiefs of Staff, writing in April, 2001, "The purpose of the JIMP is to define a process that will translate emerging joint operational concepts into joint warfighting capabilities as a result of joint experimentation and assessment recommendations. The JIMP describes the generation, coordination, approval, and implementation process for joint Doctrine, Organizations, Training, Materiel, Leadership and Education, Personnel and Facilities (DOTMLPF) recommendations and defines roles and responsibilities within that process."

While writing on transformation in the Spring, 2002, issue of *Joint Forces Quarterly*, the current Chairman of the Joint Chiefs of Staff, General Richard B. Myers, writes, "...we need to synchronize and leverage ongoing service transformation through continuous joint experimentation under U.S. Joint Forces Command (JFCOM). I firmly believe that by integrating combat power and the core competencies of the services, we will accelerate transformation and create the changes necessary to address an array of both current and future threats to national security."

Doctrine states that the implementation goals are:

- “1. Exploit experimentation and assessment to field integrated joint operational capability swiftly and efficiently.
2. Integrate the capabilities of the Armed Forces to achieve full spectrum dominance.
3. Prepare for the future using a deliberate *Joint Vision* synchronization implementation process that balances modernization, ongoing mission responsibilities, and current readiness.
4. Provide joint concepts and capabilities necessary for joint operations.”

The Joint Experiment and Assessment process is an accelerated learning process based on a Dr. Deming Plan-Do-Study-Act Cycle. The experimentation process takes new technologies and applies them in field conditions to see if they are ready for use.

According to Doctrine, “Joint Experimentation and Assessment leverages a wide range of DoD capabilities to examine, test, and evaluate alternatives developed during joint concept development. Appropriate objectives, goals criteria, and tasks are developed to focus evaluation efforts. Wargames, warrior and senior-leader seminars, working groups, qualitative and quantitative modeling and simulation analysis, and combatant command exercises explore a variety of potential future operations, innovative concepts, and options. Joint and Service advanced warfighting experiments (AWE), advanced concept technology demonstrations (ACTDs), advanced technology demonstrations (ATDs) and joint warrior interoperability demonstrations (JWIDs) investigate projected technological capabilities and architectures. Modeling, simulations, joint exercises, and actual operations assist in evaluating new operational concepts, technologies, information processes, and organizational structures and help further refine joint future operations concepts.”

According to Doctrine, “The key goals of Joint Experimentation and Assessments include:

- (a) Gain insights and an understanding of what concepts and capabilities, with measures of merit (metrics) to achieving the desired operational capabilities, are in the ‘realm of possible’ given the current state of a specific technology, the potential developments within a technology, and the integrated effects of combined technologies.
- (b) Permit the exploration and co-evolution of new concepts, processes, capabilities, technologies, and joint DOTMLPF in a future joint environment.
- (c) Provide for a cohesive joint operational concept development and experimentation environment through the integration Service and joint experiments.

- (d) Facilitate the eventual development of Service-derived key performance parameters migrating into families of *Joint Vision* concept-related requirements documents.”

The overall experimenting and assessment event is used to identify “measurable requirements.” The overall process is an accelerated learning process, completely documented and coordinated with other key learning events to gain maximum benefit. An event is always data driven and enormous amounts of data to be analyzed are an outcome of each event. Most events are designed to capture and analyze data. Validation is another important function of the events. Frequently, a series of events occur to provide “the continual refinement of joint operational concepts, and joint desired capabilities.

To understand the evolution of the joint experimentation model, it is helpful to remember the many years that American statistician, Dr. W. Edwards Deming worked with the Armed Forces of the United States. His relationship, especially with the U.S. Army dated back from the early 1980’s and continued to his death in 1993. The development of data based processes is a key to understanding the data-rich culture of today’s military.

There are eleven types of assessment events. According to Doctrine, “the following events can be used to develop, refine, and validate joint concepts and associated capabilities:

- (a) Studies. The close and careful examination of a given subject to increase understanding and knowledge of that subject. For the purpose of *Joint Vision* assessments, studies represent an inexpensive and broad resource mechanism for identifying areas of possible exploitation and analysis.
- (b) Wargames. Wargames are carefully constructed simulations that allow experienced civilian and military players to make decisions regarding the use of forces, formation of alliances, implementation of national military strategies, and introduction of weapons systems and operational procedures in the context of possible future conflict scenarios. Used to explore a future security environment and the relative merits of alternative concept for meeting critical military challenges over the longer term, they can be invaluable guides to joint concept development.

- (c) Modeling and Simulations (M&S). A technique for testing or analyzing a logical representation of a system, entity, phenomenon or process. For the purpose of *Joint Vision* assessments, M&S will provide readily available, operationally valid environments approved by warfighters to explore concepts and refine capability requirements in preparation for field experimentation. M&S tools will be used that accurately capture current and future Joint and Service capabilities, doctrine, and tactics.
- (d) ATD (Advanced Technology Demonstration). The demonstration of advanced technologies with the potential for enhancing military operational capabilities or cost effectiveness, characterized by four parameters: 1) large scale, both in resources and complexity; 2) user involvement from planning to final documentation; 3) specific cost, schedule and metrics; 4) a clearly defined transition target. For the purpose of *Joint Vision* assessments, ATDs may be incorporated into experiments or conducted as a stand-alone product, and would be especially useful in identifying the feasibility of radically new concepts and/or architectures.
- (e) ACTD (Advanced Concept Technology Demonstration). Funded jointly by the Under Secretary of Defense for Acquisition, Technology and Logistics, the Services, and Defense agencies; ACTDs provide an early evaluation of mature advanced technologies by warfighters to determine military utility. ACTDs are structured and executed so that, when successful, formal acquisition can be rapidly initiated. For the purpose of *Joint Vision* assessments, ACTDs may be embedded within joint or Service experiments to assess integration of new and/or revised operational concepts.
- (f) Exercises. Command post exercises (CPX) and field training exercises (FTX) can provide some limited ability for experimentation. Exercises by their nature are intended as training events to maintain current Combatant Commander capabilities. Carefully constructed exercises can, however, provide opportunities for parallel experimentation using fully trained and deployed troops.
- (g) AWE (Advanced Warfighting Experiments). AWEs are Service experiments involving carefully formulated hypotheses or operational concepts, which are examined empirically, to show how those concepts can co-evolve

to provide major improvements in future capability. AWEs may involve virtual, constructive, and/or live simulations, or be embedded in joint force exercises.

- (h) Joint Warfighting Experiment (JWE). These Joint large-scale culminating events that integrate related Service, combatant command, and other joint assessments of *Joint Vision* concepts and capabilities in a variety of scenarios across the full range of military operations. JWEs employ constructive, virtual, and/or live simulations often embedded in a joint exercise. The results of these experiments will confirm, refute, or modify the capabilities required by the 2020 force.
- (i) JWID (Joint Warrior Interoperability Demonstration). A means to demonstrate technology that could help implementation of *JV2020*.
- (j) Joint Test and Evaluation (JT&E) and Combatant Commander Field Assessments (CFA). Both JT&E and CFAs bring warfighting capabilities into use for DoD forces.
- (k) Real World Operations. Real-world operations can provide the opportunity to assess extremely promising operational concepts. Both peacetime and, when required, combat conditions may be appropriate for concept validation.”

Joint experimentation provides a comprehensive, data driven series of events to try out new technologies, emerging technologies for feasibility under the entire spectrum of possible scenarios. Everything is documented, with lessons learned through “after action reports.” These lessons are then fed into new doctrine, new training programs and new operational concepts.

The Economics Framework:

Financing Model

“The Financing Model describes the various approaches to finance or fund the development of a new product.”

The GM Model

The United States Congress provides the financing of all Department of Defense operations. The law states that through Congressional

appropriations, all programs and initiatives of DoD are funded. For that reason, it is incumbent upon the DoD leadership to educate members of Congress so that they understand the needs of the Department.

The Department of Defense, in addition to its thousands of pages of Doctrine has also published *A Guide to Federal Requirements For Financial Management Systems*. Treated as though it is Doctrine, most members of the Financial Community treat the *Guide* as if it were Doctrine.

According to *A Guide to Federal Requirements For Financial Management Systems*, “Financial reporting represents the culmination of the various processes that initiate, record, classify, and summarize an agency’s financial transactions. An agency’s core financial system is required to provide financial information in a timely and useful fashion to (1) support management’s fiduciary role; (2) support budget formulation and execution; (3) support fiscal management of program delivery and program decision-making; (4) support internal and external reporting requirements, including the requirements for financial statements prepared in accordance with the form and content prescribed by the Office of Management and Budget (OMB,) reporting requirements prescribed by the Treasury, and legal, regulatory and other special management requirements of the agency; and (5) monitor the financial management system. Naturally, information maintained in the core financial system must be provided to users in a variety of formats according to their needs. The general ledger, summarized in the form of a trial balance, provides financial data by fund, fiscal year, etc., for various reporting purposes. DoD, like other federal agencies, is required to periodically prepare a number of financial reports, including annual financial statements, budget execution reports, obligation reports, year-end closing statements, reports on reimbursements, and receivable reports. In addition to these reports, core systems are required to provide various management data to program and fiscal managers.”

“Federal agencies have traditionally prepared financial reports to monitor and control obligations and expenditure of budgetary resources. However, with the enactment of the Chief Financial Officers Act of 1990, the Congress called for the production of annual financial statements that fully disclose a Federal entity’s financial position and results of operations. The Act also requires agencies to provide information with which the Congress, agency

managers, the public and others can assess management performance and stewardship.”

In the Chief Financial Officers Act of 1990, the law required integrated financial systems of all governmental departments and agencies and mandated financial audits on a pilot basis. The Government Management Reform Act of 1994 expanded financial audits requirements to all “CFO ACT” agencies including DoD. The Federal Financial Management Improvement Act of 1996 mandated Federal financial management systems requirements, Federal accounting standards and the U.S. Government Standard General Ledger. In 1998, the National Defense Authorization Act mandated a biennial Financial Management Improvement Plan. The plan’s purpose is to provide a “blueprint” for financial management improvement efforts, describe major financial systems initiatives underway and planned, and document and measure progress.

The overall objective of the Financial Management System, is to provide reliable, consistent and timely financial data to improve decision making and accountability. The overall system consists of three major pillars:

1. Financial Transaction Processing consisting of:

- Inventory Accounting
- Property Accounting
- Payroll
- Payables Disbursements
- Receivables Collections

2. Accounting and Financial Reporting consisting of:

- General Ledger
- Cost Accounting
- Funds Management
- Funds Control
- Financial Reports/Statement

3. Program Management consisting of:

- Inventory Management
- Property Management
- Cost Management
- Personnel

Acquisition

The three pillars rest on a base consisting of

- Organizational Infrastructure
- Information Systems
- Internal Controls
- People
- Policies

According to Ron Brooks, Office of the Under Secretary of Defense (Comptroller) in a June, 2001 presentation, “The most carefully configured, state-of-the-art information system possible will not be able to produce reliable management information and auditable financial statements without proper policies and internal controls guiding competent people working with those systems, all operating within an effective organizational infrastructure. The key to success is active senior leadership participation in the process and application of adequate resources.”

According to the June, 2001 *Guide to Federal Requirements For Financial Management Systems*, “The Department of Defense (DoD) is one of the largest and most complex organizations in the world. DoD annually reports hundreds of billions of dollars in assets. The Department is responsible for liabilities of about one trillion dollars. Each fiscal year, DoD recognizes several hundred billion dollars of revenues, financing sources, and incurred expenses.”

“The Department, through its war-fighting entities – the Army, the Navy, the Air Force, and the Marine Corps – carries out program and financial operations on a worldwide basis. The scope of DoD’s operations dwarfs those of many large corporations and autonomous countries. Obviously, it is critical that DoD have high quality financial management systems to support its financial operations and to provide financial management information to financial and program managers, and congressional decision-makers.”

According to the DoD Systems Integration Directorate, “DoD operates hundreds of automated information systems – financial, non-financial, and mixed – in executing its missions and programs. Although the Defense Finance and Accounting Service (DFAS) is responsible for the majority of

the Department's finance (i.e. entitlement and disbursing) and accounting systems, DFAS is not responsible for all of the systems that produce financial management data. Non-DFAS systems that support other functional area(s), including acquisition, logistics, property management, and personnel, generate and process a significant amount of financial data that are ultimately used by the Department for management, analysis, and financial reporting.”

As is the normal practice of the Department, Doctrine defines the financial management of the organization and its operations. The major objective of the Financial Management (FM) system and process for the Department is “to support mission accomplishment by providing necessary FM capabilities.” That is, *provide the resources necessary to successfully execute operations*. In a joint environment according to Doctrine, “The comptroller is the officer responsible for providing the elements of resource management (RM) and finance operations. The RM process of the joint force comptroller is normally comprised of costing functions, and the effort to leverage appropriate fund sources. Finance operations provide the necessary funds to conduct contracting and the full range of pay support needed by members of the joint force.”

There are four common objectives of joint FM that provide a unity of effort in using fiscal resources. According to Doctrine, “These objectives are:

- (1) Ensure that mission essential funding is quickly provided in the most efficient manner;
- (2) Reduce the impact of joint operations funding requirements on readiness,
- (3) Prevent funding shortfalls from compromising mission success; and
- (4) Conduct detailed FM planning and coordinate efforts.

Because the nature of the business of the Department of Defense frequently yields unpredictable situations, contingency operations and sources of funds are planned for.

According to Doctrine:

“Preventing funding shortfalls during contingency operations presents unique challenges. In the past, supplemental funding of contingency operations has been uncertain and untimely. Financial resources, therefore, are not always identified as being specifically available for these operations in the annual budget requests of DoD components. When financial resources have not been programmed and made available in a budget request, components must accomplish directed contingency using military pay and operation and maintenance funds.” They are replaced later so as to not jeopardize an operation or the lives of the troops. The authority for such transactions comes from the Secretary of Defense.

Doctrine specifically states, “The joint force comptroller must perform two key functions for the commander: first, ensure that resources are available when and where they are needed; second, aid the commander in maintaining his or her fiscal responsibilities.”

The Economics Framework:

Budgeting Model

“The Budgeting Model describes the processes and methods to allocate the resources to accomplish the objectives of cost, speed and quality.”

The GM Model

The Planning, Programming, and Budgeting System (PPBS) provides for a cyclic process that provides the operational commanders-in-chief the best mix of forces, equipment, and support attainable within fiscal constraints. It is the major budgetary system of DoD.

PPBS is fundamentally a system that is used by the Department of Defense to allocate resources needed by the military establishment to carry out the National Security Strategy (NSS). It is important to understand that every time the NSS is published, the Department of Defense then puts together a National Military Strategy (NMS) to accomplish its portion of the NSS.

Doctrine dictates, “The PPBS enables the Services and selected commands and agencies to develop and sustain necessary military capabilities. Under this system, the Department translates requirements for forces, personnel,

materiel, and facilities into budgetary requirements to be presented to the President for approval and to the Congress for authorization.”

According to Doctrine:

“The PPBS, presided over by the Secretary of Defense, has as its primary objective the allocation of resources needed by the Armed Forces of the United States to execute military aspects of the NSS and the National Military Strategy (NMS). The PPBS enables the Services and selected commands and agencies to develop and sustain necessary military capabilities. Under this system, the Department translates requirements for forces, personnel, materiel, and facilities into budgetary requirements to be presented to the President for approval and to the Congress for authorization and appropriation. The principal participants in this system are civilian leaders in the Office of the Secretary of Defense, and the individual Services and U.S. Special Operations Command (USSOCOM). The PPBS system assures professional military advice by the participation of the Chairman of the Joint Chiefs of Staff and the other members of the JCS, the combatant commanders, and the selected Defense agency officials.”

The “program” is the unit used for the development of the tools that run the Pentagon, *whether it is a current or new* weapons system, vehicle, ship, plane or a computer system. Programs are budgeted for and developed through PPBS. Today, the PPBS system is undergoing a major transformation of its own.

Vice Admiral Arthur Cebrowski, USAF (Ret), Director of the U.S. Office of Force Transformation, “In this age of strategic uncertainty, risk is managed by increasing the breadth of capabilities, no matter the imperfections, even at the expense of buying highly effective but limited capabilities in quantity. The real issue is not how much is enough, but whether we have the breadth of capabilities necessary to address strategic gaps.” This process uses the PPBS system, and as the risks in the environment change, so, too, does the PPBS system. Admiral Cebrowski recently described the process, in *Defense News*, “The program is the most important and highly visible of the many products in the Pentagon. It is the bureaucratic vehicle for pushing a capability or system from inception through the Pentagon and into the operating forces. The program becomes the yardstick to measure success or failure. To attain the lofty status of being a “program of record” decision-

makers must be assured of the system's military value and need, even if the capability will not arrive in the operating forces for another 15 to 25 years. Once these future predictions attain an aura of certitude, the program is given a Program Element number (PE), the bureaucratic parking space for money being allocated to it."

PPBS was developed in the early 1960s. Today's PPBS is changing:

- To make the requirements process more future oriented, entrepreneurial and more focused on top-level concepts and decision logic
- To also seek to reduce the acquisition capabilities cycle times for programs
- To improve personnel management policies to provide continuous training and early executive education for the civilian DoD work force and broaden the acquisition base for uniformed personnel

These changes will transform the PPBS into a tool to support the emerging network-centric warfare of the 21st Century.

The overall PPBS system includes the following four major steps:

- Determining requirements for total obligational authority and manpower for each program
- Allocating required resources to specific purposes
- Requesting the resources from Congress through their committee structure
- Monitoring the application of approved resources for their intended purposes

PPBS, according to Doctrine, "serves as the primary management system to

- (1) Develop defense guidance for Department planning, programming and budgeting,
- (2) Define the National Military Strategy and force levels to support U.S. foreign policy objectives
- (3) Establish balanced and integrated military forces to execute the strategy
- (4) Maintain the level of forces and state of operational readiness to deter aggression or prevail if hostilities occur."

Fundamentally, PPBS is a five year planning process for all the programs and the expected budgets for those programs. The summary includes separately published areas for procurement, construction, research, development, test and evaluation (RDTE). It enables decision making at all levels of the Pentagon with regard to its programs using the FYDP or Five Year Defense Program. According to Doctrine, “the FYDP,

- (1) Gives totals for each resource category by prior year, current year and budget year
- (2) Extends total obligational authority and manpower totals 4 years beyond the budget year
- (3) Extends force totals 7 years beyond the budget year.”

“The FYDP is issued three times a year.

- (1) The first issue records resource levels supporting the President’s budget submission to Congress in January or February. Congress, which does not receive the FYDP, has visibility of resource data as follows:
 - a. Total obligational authority and manpower for only the prior year, and budget year plus 1 year past the budget year
 - b. Procurement, construction and RDTE for 4 years past the budget year
- (2) The two subsequent issues of the FYDP record resource levels submitted by defense components in their Program Objective Memorandum (POM) in May and budget estimates in September.”

The Economics Framework:

Accounting Model

“The Accounting Model describes the systems and approaches to account for and track the costs during the development of a new product.”

The GM Model

According to *A Guide to Federal Requirements For Financial Management Systems*, “The general ledger, as the central function of a core financial system, is the highest level of summarization within the system. The general

ledger provides financial accountability for budgetary resources, stewardship over assets, tracking of cash/fund resources, and control of costs. The general ledger maintains account balances by fund structure and individual general ledger accounts. All transactions to record financial events should post, either individually or in summary, to the general ledger regardless of the origin of the transaction. The general ledger is supported by subsidiary ledgers at various levels of detail. Such subsidiary ledgers may be maintained in the core financial system or in other systems. For example, detailed property records supporting the equipment account in the general ledger may be maintained in a system devoted to controlling and maintaining equipment.”

“The U.S. Government Standard General Ledger (U.S. SGL), under Volume I of the Treasury Financial Manual (TFM) Supplement Number 2, provides a uniform Chart of Accounts to be used in standardizing federal agency accounting which supports the preparation of standard external reports required by central agencies. The OMB Circular A-127, ‘Financial Management Systems,’ and the Federal Financial Management Improvement Act of 1996 (FFMIA) require implementation of the U.S. SGL at the transaction level throughout an agency's financial management systems. The U.S. SGL is composed of five major sections: (1) Chart of Accounts, (2) Account Definitions, (3) Accounting Transactions, (4) Data Elements, and (5) Report Crosswalks. The Chart of Accounts and Account Definitions are maintained by those federal executive agencies that serve on the U.S. SGL Board.”

“The general ledger, as the ultimate overall control for capturing the effects of all financial events, ensures that debits equal credits for every recorded transaction in a single journal entry. The general ledger maintains accounts for assets, liabilities, equity, revenues, expenses, gains, losses, budgetary data, and ‘memorandum’ information. The general ledger defines the chart of accounts and transaction posting rules. It is used to update multiple accounts, including budgetary and proprietary accounts, for a single transaction or financial event. It provides for entering journal entries to post transactions, record account adjustments, and perform periodic closings. The general ledger is used to produce external financial reports.”

“By law each agency of the federal government is responsible for establishing and maintaining systems and internal controls that ensure that it

does not obligate or disburse funds in excess of those appropriated and/or authorized by the Congress...an agency's fund control system is the primary tool for ensuring that it complies with Congressional spending mandates.”

“For purposes of budget formulation and execution, an agency's systems of accounting and internal controls should provide information on actual obligations, outlays, and budgetary resources. An agency is required to use United States Standard General Ledger accounts for budgetary accounting and reporting purposes.”

“Financial management systems must be able to record and keep track of financial transactions and related information in order to provide a basis for central financial control. Audit trails-- documentation of transactions from their inception to final disposition and reporting in the books of original entry--are critical to providing support for transactions and account balances. While audit trails are essential to auditors and system evaluators, they are also necessary for the day-to-day operations of systems. Reliable audit trails permit verification of transactions to ensure that they are properly recorded, classified, coded and posted to all affected accounts. Additionally, audit trails allow for the detection and tracing of rejected or suspended transactions and correction in a timely manner. All transactions, including computer-generated computations, must be traceable to individual source records. Adequate audit trails allow tracing from source documents of financial events to general ledger account balances through successive levels of summarization and financial reports/statements...Commensurate with reliable documentation for transactions are adequate systems controls and documentation. Financial management systems must comply with a myriad of functional and technical requirements to ensure that DoD's financial management and accounting objectives are met in an economical and efficient manner.”

Development of the F-22 Aircraft

Introduction:

This portion of the research analysis and report on the Military/Defense Industry for the R&D Work Systems Innovation Project – “21st Century Product Development Work Systems” examines the F-22, Advanced Tactical Fighter (ATF) product development process. This will illustrate how a typical defense product is conceived, designed, engineered, manufactured and produced on an ongoing basis in today’s environment, though it must be noted that since the development of the F-22. designing software programs have continued to evolve thus improving the overall process and reducing the timing.

The same topic areas addressed are the framework of Process, People and Economics, and include the GM model specifics though in a different order:

Methodology

Overview – The Context

Feasibility

Organizing

Coordinating

Phasing

Enabling

Reward

Recognition

Learning

Staffing

Budgeting

Accounting

A Parting Thought

Methodology/Sources

This part of the study used the “Voice of the Lessons Learned,” a book written by Colonel Michael D. Williams, USAF, *Acquisition for the 21st Century: The F-22 Development Program*. Col. Williams wrote the book as a student at the Industrial College of the Armed Forces. He played a critical role on the F-22 Advanced Tactical Fighter program leading the avionics development and serving as Chief of the F-22 Support System Integrated Product Team.

Lessons Learned are an integral part of the way in which the Pentagon operates. A book such as this one, becomes the Voice of the Lessons Learned, and is almost used as doctrine, and frequently influences doctrine changes.

Two other experts aside from Dr. Ronis were consulted. Colonel Genaro Dellarocco of the U.S. Army, who is currently involved in a number of advanced technology acquisition strategies for the Pentagon, and Major General Harold Mashburn, the current Commandant of the Industrial College of the Armed Forces.

Overview – The Context

The DoD Acquisition Process has traditionally been one of the most dysfunctional in existence typically taking decades to develop anything new. For many years, there have been acquisition reform efforts, most of which have failed. DoD tried to learn how other industries buy materials and complex, high technology systems.

The Pentagon studied Toyota since DoD acquisition experts believed there were lessons to learn. While studying Toyota, they learned about the consultant who had worked with Toyota during the Marshall Plan and afterwards, Dr. W. Edwards Deming. So they hired Dr. Deming as well in the early eighties.

Dr. Deming philosophy had a significant influence over the changes that were made for the development of the F-22 – he personally worked with the Department until his death in 1993.

A Brief History

In the late seventies, the need for air superiority and air supremacy was clear. There was great competition from Russia and France and the Cold War was still a reality. The Air Force realized it needed an Advanced Tactical Fighter (ATF) to maintain a U.S. advantage. A Statement of Need was written in 1981 and first monies for development were authorized for 1983 for the Initial System Program Office.

A host of new technologies were identified as required for the ATF, which eventually evolved into the F-22. These technologies included:

- New approaches to avionics
- Jet propulsion
- Flight controls
- Airframe materials
- Supersonic cruising
- Low-observable or stealth capability.

In 1983, the Air Force initiated a Request for Information from industry. This is a meeting of the entire industry that describes what is needed and asks industry to respond with ideas.

In September of 1983, the Air Force awarded seven \$1 million firm fixed-price contracts to deliver conceptual designs in May, 1984 to determine the design options for the Advanced Tactical Fighter.

By October of 1986, the Air Force gave approval to enter the demonstration - validation phase to two teams who would build two prototype aircraft each. The two teams were Lockheed-General Dynamics-Boeing and Northrop-McDonnell Douglas. Each of the two teams would put a GE engine in one of their prototypes and a Pratt & Whitney engine in the other.

The years 1986 to 1990 were spent making trade-off decisions that culminated in the decision to proceed to the engineering and manufacturing development phase. In April, 1991, the prototypes flew and the Lockheed team won the competition with a Pratt & Whitney engine design in it. A week after the award, the new Commander of the Tactical Air Command met with the contractor and key individuals from the Air Staff and OSD to

go over his expectations of the program. In December of 1991, the Requirements Design Review Update occurred. In July of 1992 the Critical Design Review of the engine occurred as well as the Initial Production Readiness Review.

The Preliminary Design Review was completed in April of 1993 and the Last Critical Design Review was finalized in May of 1995.

The first flight of the Engineering and Manufacturing Development aircraft took place in 1997 and preparation for construction began in 1999. In August of 2001, the Defense Acquisition Board gave the green light for 295 of the planes.

Feasibility

Williams states, “After defining the requirements of the weapon system, the second element of the Advanced Tactical Fighter (ATF) program approach to risk management was to develop and prove the technology required for the design and production of the weapon system...The contractors could not propose a solution for the engineering and manufacturing development (EMD) phase unless they had sufficiently proved the technology during the demonstration/validation phase...The plan called for the competing contractors to conduct Critical Technology Demonstrations aimed at the highest risk area, primarily avionics. The contractors were to use computer models to assess the aerodynamic performance of their proposed aircraft.”

“The ATF program office included the development, fabrication, and test of two prototype air vehicles in the demonstration/validation program. Each contractor was to ‘fabricate and demonstrate a ground based prototype Avionics Integration Laboratory, and conduct active sensor testing aboard an Avionics Flying Laboratory,’ and develop initial system specifications.”

In addition to the planes, two prototype engines were developed.

The elements of the ATF Demonstration/Validation Phase include:

- Prototype air vehicles
- Radar cross-section models
- Test engines

- Avionics prototypes
- Reliability, maintainability, and support
- Materials.

The F-22 is a stealth aircraft that is supposed to be highly maneuverable. There had never been such an aircraft built before so there were many challenges in the experimental areas.

Modeling and simulation played a significant role in the design and development of the technologies. The design and effectiveness models for aerodynamic, structural, and avionics proved to be useful in predicting the prototype performance, validating the models, and improving the aircraft.

An additional benefit according to Williams was “Making the multi-company teams design and build a test aircraft forced them to create a business and working arrangement that allowed multi-company design and construction to take place. This prototype process saved significant time in the EMD phase because the hard business decisions had already been made and the procedures had been developed and refined.”

Financing

The United States Congress provides the financing of all Department of Defense operations. The law states that through Congressional appropriations, all programs and initiatives of DoD are funded. For that reason, it is incumbent upon the DoD leadership to educate members of Congress so that they understand the needs of the Department.

Through the Demonstration and Validation phases, dollars are considered “experimental” and come out of the R&D budget. The program becomes a line item in the budget at the Engineering and Manufacturing Phase.

The original budget was \$99.1 billion making it the most expensive weapons system in history.

The F-22 was a line item in the Congressional authorization that permitted its development to occur.

Organizing Model

The Aeronautical Systems Center at Wright-Patterson Air Force Base in Dayton, Ohio developed the aircraft. The program involved several large contractors spanning the country:

- Lockheed Martin Aeronautical Systems in Marietta, GA: F-22 program management, the integrated forebody (nose section) and forward fuselage (including the cockpit and inlets), leading edges of the wings, the fins and stabilators, flaps, ailerons, landing gear and final assemble of the aircraft.
- Lockheed Martin Tactical Aircraft Systems in Fort Worth, TX: Center fuselage, stores management, integrated navigation and electronic warfare systems (INEWS), the communications navigation, and identification (CNI) system, and the weapon support system.
- Boeing in Seattle, WA: wings, aft fuselage (including the structures necessary for engine and nozzle installation), radar system development and testing, avionics integration, the training system, and flight-test development and management.
- Pratt & Whitney in East Hartford, CT: F119-PW-100 engines that power the Raptor.

The F-22 program wanted better project management control. The management team developed a management system that focused workers at all levels on their product. The F-22 is the first program to use an IPT, the integrated product team. The organization is commanded by an Air Force officer, with a contractor deputy. More than 80 permanent teams were completely responsible for its ‘product’ (i.e. avionics, cockpit, airframe, utilities and subsystems, etc.) – from engineering a part or system, controlling its cost and schedule and insuring that it can be manufactured and supported once in use.

The most important organizing action within each team is the clear definition of each organization’s role as team members. The Air Force’s F-22 System Program Office has teams that mirror the organization on the contractor side, improving communications across the team.

As Williams states in his historic documentation of the F-22 project *that is used as though it is doctrine*, “The major organizations making up the weapon development team (the integrated product team) are the users, the program office, and the contractor.”

The Users

“The most important member of the development team is the user. The system exists to fulfill the users’ need, and users define the requirements. To help ensure the best product, the users need to state their requirements in a functional manner...without specifying the solution. As part of this process, the users, with the help of intelligence specialists, such as the service intelligence experts and the Defense Intelligence Agency, define potential threats, determine likely scenarios in which they will use the new weapon system, describe where and how they will use it, which defines the operating environment, and define how they intend to maintain the equipment and what level of skilled technicians will repair it.”

“The users also need to work closely with the program office to understand available options to fulfill their requirements, to understand the effect of their requirements on the cost and complexity of the weapon systems, and to be ready to adjust requirements to balance operational capability against weapon cost and complexity.”

The Program Office

“The systems program office has the responsibility to make sure the users get what they need. Its role is to form the acquisition team, establish the team environment, and work with the users as they identify their needs and define their requirements. The program office must then translate those requirements into terms and a structure that are meaningful to the contractor. In so doing, they must make sure the contractor fully understands what the users need.”

“The program office also needs to work with the contractor to develop and provide options to the users and explain how long each option will take to deliver and how much each will cost. With a full set of options the users can determine the cost of meeting their requirements and decide which option is

best, given the available government funding. The program office must also ensure the contractor has laid out a sound program with an appropriate level of risk.”

“Finally, as the prime agent responsible for delivering the equipment, the most important role of the program office is to set and meet everyone’s expectations.”

The Contractors

“The contractors have the hardest job: to understand the user’s requirements and generate the options to fulfill them. They must develop the ideas and find, or develop, the necessary technology to transform them into an actual weapon. The contractor lays out a program to develop a system that will meet the operational requirements with the appropriate amount of risk, conducts the program, and produces the actual weapon system.”

The contracts are generally restricted to only a few companies capable of developing specialized military aircraft at competitive prices. Contractors include commercial aircraft corporations to improve efficiency in both entities due to the immense scale of funds involved. Contractors receive Request for Proposals (RFPs) that list performance requirements for aircraft, equipment, follow-on support, replacements, future delivery, budget parameters, multiple-source restrictions, and legal remedies. Although these specifications/solicitations are for specific aircraft, development and production efforts are entangled with past histories of other programs.

The last prong of managing risk is using a product-based management system. Even though the Pentagon had improved a great deal in keeping its costs, schedule, and technical performance under control, the F-22 program wanted even better controls. What they really wanted was to give every person on the F-22 team a “strong commitment to their task and a sense of pride and ownership in what they did for the F-22. As a result, the management team wanted to develop a management system that focused workers at all levels on their product.” In addition, half of the twenty Deming-based principles relate to the management system. These management principles are:

- Integrate the entire system

- Ensure ownership
- Use a disciplined approach
- Understand what is really required
- Take a long-term view
- Have what you need for the effort
- Ensure everyone knows what it takes to meet the goal
- Use an event-based schedule with defined success criteria
- Define success and be able to measure it
- Reward success.

Coordinating

The F-22 success rested on the implementation of multifunctional teams empowered to make decisions. The teams reported to the Government's Front Office Group (FOG) that officially managed the program.

According to Williams, "The F-22 program office needed to establish a way to allow the Government to participate but not to be a roadblock. Information had to flow quickly within the Government/contractor team to allow time-sensitive decisions to be made. The only way to accomplish these objectives was to depend on the working-level managers to provide data as well as make decisions...for them to succeed, the program leadership needed to empower them to make decisions in their areas while keeping higher levels informed. Each team had to understand their roles, their decision-making authority, and they had to understand when to elevate issues to higher level decision-makers."

The teams are given norms to follow. They include:

- Integrity
- Teamwork
- Logic.

The operational definitions are:

Integrity translated into "every team member conduct all business relationships honestly and ensure that the receiver of a message understands it."

Teamwork translated into “the open, timely and effective communications between and among the contractors and all Government team members.” This was especially important because on the F-22 program, the contractor organization divided major responsibilities among three large contractors spanning the country, Lockheed in Marietta, GA; Boeing in Seattle, WA; and General Dynamics in Fort Worth, TX. In addition, the senior leadership expected that early problem identification and resolution would be better and less expensive in the long run. So, people needed to communicate regularly and develop relationships that would be lasting and based on trust. And, the senior leaders expected that team members would build relationships to their users as well as team members to facilitate understanding and communication. This included both government and contractors working together.

Logic, or common sense, translated into the senior leadership’s philosophy that rules and regulations were guidelines to be used with judgment. When rules and regulations appeared to be arbitrary and things didn’t make sense, the teams just didn’t do them. It led to great success on the F-22 program, and the elimination of a lot of waste.

Phasing

According to Williams, “The Integrated master plan (IMP) is an event-driven planning document prepared by the contractor and used by the Integrated Product Teams (IPTs) to manage the development effort.” Then, the Integrated Master Plan develops an Integrated Master Schedule (IMS). These two documents outline the phases of the work and the metrics, or technical performance measures (TPMs) that are used to ensure the work is on track.

According to Williams, “The IMP contains all program activity and does not contain calendar dates.” It does contain all events. “The IMP is part of the contract so that no one can change the program activities without agreement between the contractor and the Government. It expands on the tasks in the statement of work needed to design, test, and produce the F-22 weapon system. As described in the ATF request for proposal, the IMP is defined by four elements – events, significant accomplishments, accomplishment

criteria, and detailed tasks – that describe the activity and define its successful completion. Their specific definitions follow:

- Event: The conclusion or initiation of an interval of major program activity
- Significant accomplishment: A desired result at a specified event that indicates a level of design maturity (or progress) directly related to each product or process
- Accomplishment criterion: A definitive measure or indicator that the level of maturity (or progress) has been achieved
- Detailed tasks: Detailed work to be completed in support of a specific significant accomplishment.”

The Integrated Master Schedule (IMS) provides “the tasking and timing of the work effort required to support the IMP events. The IMS is not part of the contract, which allows the IPTs the flexibility to manage their program without constantly changing the contract. The IMS lays the foundation for budget and schedule planning and links directly to the reporting of cost and schedule.”

Metrics are a critical element of these processes.

“Technical performance measures (TPMs) are a tool to track technical progress toward meeting the weapon system specifications. The F-22 program uses TPMs at all levels to display results-to-date along with projected results, to show the technical maturity of each product, and to present trends as well as projected performance that the IPTs expect their product to achieve. An important benefit of TPMs is that they provide an historical record of a product’s performance.”

The statement of work describes all the pieces that are tracked representing the phases of the work. In fact it describes, “the minimal essential requirements of the program – that is, what the contractor must do.” According to the 1500 Vehicle Management System (VMS) statement of work for the F-22, “The contractor shall design, develop, integrate, test, qualify and prepare for production of a VMS that meets the Weapon System

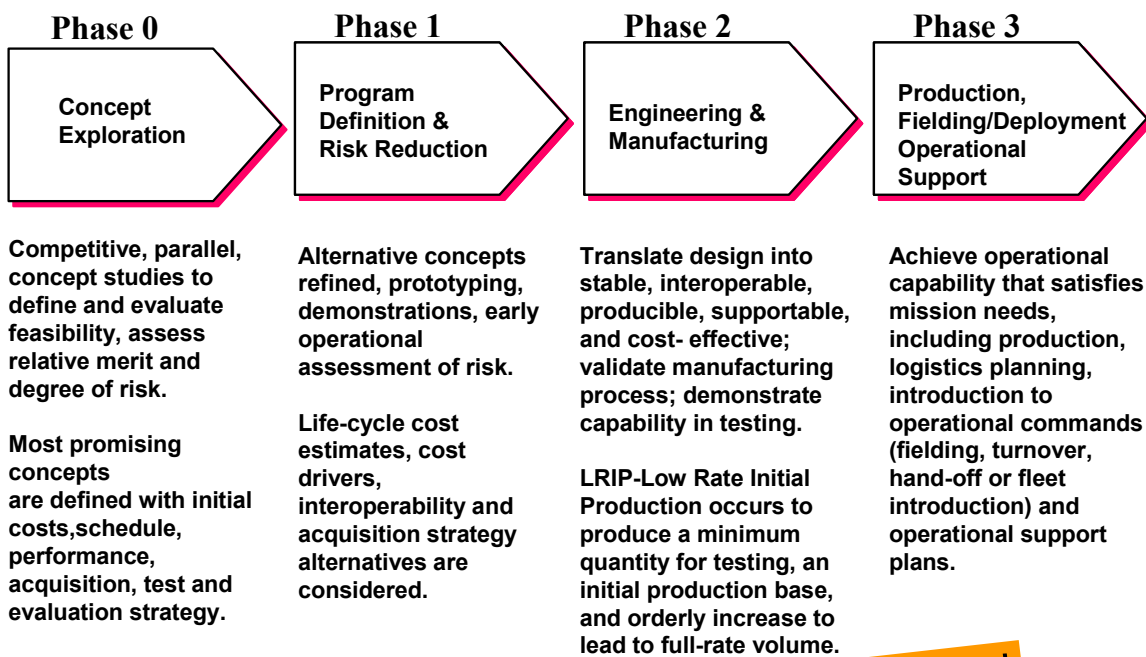
Specification, in accordance with the activities described in the Integrated Master Plan. The contractor shall analyze, verify, and document the design of each vehicle management system configuration item and integrate them within the VMS. The contractor shall integrate the VMS with other ATF subsystem elements, the air vehicle, and the support and training systems. The contractor shall develop the requirements for, coordinate the use of, and control configuration of an integrated VMS test facility for the purpose of verifying and validating certain VMS requirements and the integration of the VMS with other sub-system elements.”

Because the contractors wrote their own statement of work, and since they were the experts in designing, engineering and building fighter planes, this system worked better than any other. Historically, the Government would write detailed specifications regarding what they wanted, when they didn't know how to write such statements of work, and only had a general idea of what they wanted.

The senior leadership of the Air Force put it this way, “When you go out and build a house, you don't schedule the jobs and tell the general contractor what they're to do. You tell them to build you a house. The general contractor figures out how to build it – it's their job. They are the expert! To have the Government come in and tell the contractor how to build a weapon system by giving them a statement of work is just plain stupid!”

Phasing

Program Development Phases



Mapping Suggested

Enabling Model

There are two major enabling processes used in the development of the F-22:

- Risk Management, which will be discussed here.
- Concurrent Leadership, which is discussed under the people section.

These two central methodologies were used to augment the 20 principles that formed the Deming-based system of the F-22.

The F-22 had a three-pronged approach to risk management:

1. Refine and understand the requirements of the program.
2. Manage the needed technologies.
3. Use a product-based management system.

Refining and understanding the requirements of the program necessitated involving everyone, ensuring ownership, using a disciplined approach and understanding what is really required; four of the twenty Deming based principles. It is critical that everyone understand and “buy into” the requirements of the program.

Since the F-22, a supersonic, highly maneuverable, stealth fighter clearly required new technologies, it was essential to manage them. This meant meeting the requirements with technology that also met other objectives of the program even if that technology wasn't the latest and greatest. To do this properly meant setting realistic expectations and meeting them, having what you need for the effort, ensuring everyone knows what it takes to meet the goal and guaranteeing open communications; another four of the Deming based principles. Williams elaborates on this last point saying, “During the demonstration/validation phase, the ATF development teams consisted of many different contractors. Each contractor had its own technology development laboratories staffed by hundreds of scientists and engineers knowledgeable about different materials and approaches applicable to challenges of designing a new fighter aircraft. Because the lead contractors (Lockheed and Northrop) clearly communicated the challenges and the approaches to each member of their team, each competing team could take

advantage of a large body of knowledge, which solved many demanding problems. Whether an effort involves many contractors or just many people, open communication and clear statements of what it takes to meet the goals draws in everyone to help develop the needed technology.”

According to Williams, “To manage cost, schedule, and performance and follow the ten principles, the F-22 program developed several management tools and procedures. These include an event-based schedule coupled with success criteria and measures of effectiveness, and a means to track performance, hold individuals accountable, and reward the performance of the team. The F-22 program organization empowered the lowest tier members of the team while it also ensured a well-balanced approach to the product.”

The integrated management system looked at all the elements of the program and product that needed to be tied together. This way, the whole was managed at the same time and trade-off decisions could be made based on the data of the program itself. Defining success in every aspect was a key element so people knew what success meant. When there was a problem, they knew it and could measure what they had versus what success was. It enabled problem solving in a myriad of ways just by helping the team members to see the program in its entirety and how they fit into it.

Sealed Envelope Predictions are another enabling process. Under the old model, specifications were developed, designs were created to the specifications, models were built and tested. They called this approach “fly-fix-fly” and it was found to be too expensive and led to the development of simulations in a computer, but the models had to predict performance of the hardware and software accurately. To reinforce the need for accurate predictions, the program office uses “sealed envelope predictions” to establish contractor accountability. This process gave contractors an incentive to try to predict their hardware and software performance knowing that source selection included this process. It is an indication of the contractor’s knowledge of its own design and process capabilities.

Reward Model

Rewarding success is an element of the risk management process. As Williams points out, “With success defined and measured, the next step is

for the management system to reward members, both individuals and teams for their performance. The rewards vary. The challenge for the program leadership (both the contractor and the Government) is to develop rewards that motivate future high-level performance. The contractor, as a company or group of companies, can be rewarded financially through an award-fee or incentive-fee contract. The contractor could choose to allocate this award to key performers responsible for the team's success. Or the Government and the contractor could recognize team members through a team awards program. Whatever methods one chooses, the key is to recognize and reward the performance of both individuals and teams.”

It must be understood that the teams are from multiple organizations in the contractor and government sectors. The interdisciplinary, multifunctional and multi-organizational teams brought their own rewards programs with them. They were not evenly distributed. *As long as the teams worked together and were rewarded together, as much as possible, the other variables did not seem to matter.*

Recognition Model

Beyond the “rewarding success” element of risk management, there is little discussion of recognizing individuals for their work as described above. It is important to understand that in an “integrated” product and system environment, based on data, there is a continuous stream of feedback from the system to the individuals in it about how things are going. In addition, success is clearly defined and continually measured.

As Williams writes, “For a management system to hold an individual responsible for a product (really a sub-product of the final product delivered to the customer), the system must determine how well that product is progressing compared to the projected targets for cost, schedule, and technical performance. First, the system must define success – that is, define the product requirements in terms of cost, schedule, and technical performance. It's important to note that requirements for lower tier products (sub-products) are based on performance targets for higher level products (for example, the cost, schedule and performance requirements of the cockpit must support the cost, schedule and performance requirements of the overall airframe), which tie into the overall, top-level product requirements.

The management system must track how the product is meeting its targets at each level.”

When an individual does an exceptional job, that is, works well with people and is able to accomplish the objectives set out for that individual, it is very common for them to be asked to participate in other projects and frequently lead teams. These individuals can also be given large financial incentives by their respective companies.

Learning Model

It is important to remember that the military is a learning organization. The military’s norm is to document and share knowledge between one team and another by writing a “Lesson’s Learned” book after every program. Sometimes two or three separate studies are commissioned to compare and contrast points of view.

The fact that the F-22 team asked Lieutenant Colonel Michael D. Williams, USAF, to write the “lessons learned” that this paper is based on, is an example of how the military documents and shares knowledge between one team and another. Williams, an Air Force Colonel, today, works for the Assistant Secretary of the Navy for Research, Development, and Acquisition on another joint service activity, the Joint Strike Fighter Program. The book this paper is based on was written when Col. Williams was attending the Senior Acquisition Course at the Industrial College of the Armed Forces at the National Defense University. It is read by most integrated product teams before they begin their work to help spread the lessons learned from one program to another. Col. Williams lead avionics development on the Advanced Tactical Fighter program and then served as Chief of the F-22 Support System Integration Product Team.

In addition, taking people who have had experience and/or knowledge of one program and assigning them to another when the first is completed, is the norm. Thus, knowledge of the processes is transferred from one program to another.

Staffing Model

The F-22 team was developed in an interdisciplinary way. Concurrent leadership is a description of leading interdisciplinary, multifunctional and multi-organizational teams. Integrating teams at all levels of management and working groups is the secret. Yes, these integrated teams are hierarchical. That is, the product teams have similar teams at senior levels of management and at the working level. The total of the integration is called concurrent leadership.

Team members in IPTs need the following characteristics and people with these characteristics are highly sought after:

- An ability to work well with people
- An interdisciplinary orientation
- A multifunctional appreciation
- A multi-organizational set of experiences
- An ability to work with both contractor and government cultures
- An understanding of the multilevel integrating teams from management to working groups

As Williams describes the role of the team leader, he writes,

“Surprisingly, the biggest difference between concurrent leadership and traditional leadership lies not at the working level but at the management level. Concurrent leaders are not directors but facilitators and coaches. The leaders bring in the right people and functional disciplines to help solve the problem. They do not bring every member of their team in on every problem, only those whose expertise or responsibility is needed. Therefore, the team’s emphasis will change depending on the problem to be addressed.”

“In concurrent leadership, individuals at the worker/action level from different functional areas work together to identify problems and develop solutions. Their team focuses on a specific product, process, or issue. A multidisciplinary team manages an item based on a range of viewpoints, experiences, and expertise. Each functional area has its own requirements, constraints, strengths, and weaknesses. A great engineering solution may not be affordable, and the finance officer can rapidly identify that. A contractual solution proposed by a manager may violate the Federal

Acquisition Regulations, which the contracting member of the team can point out. A manufacturing teammate can refine the design engineer's proposed solution to meet the performance requirements and still allow the part to be easily machined. An important aspect of concurrent leadership is that the roles of the team members differ from the roles found in the traditional leadership model."

"Another major difference is that the leader does not make the decisions. To do that would take ownership away from the team members. Instead, the leader's job is to make sure that the team makes a good decision."

Williams describes the role of the team members by saying, "The concept of concurrent leadership derives its strength from the power that each member brings to the team. Typically an individual on a team is the lone expert on that team in a particular field. Thus, all team members need to be proficient in their specialty. However, the members must be able to grasp issues in ways that go beyond their narrow expertise. As in the ATF demonstration/validation phase, members must work out each problem from their teammates' viewpoint. The design engineer must think about the cockpit canopy from a maintenance technician's point of view. The program manager must see the issue as the financial member of the team would see it. This broad perspective is critical to ensure that a balanced solution emerges. The final responsibility of team members in concurrent leadership is to take ownership of each of the team's actions and outcomes and to actively contribute their expertise to the team's product."

Budgeting Model

This is a cost plus contract. There is little budgeting, except overall in the line item Congressional bottom line approximation. At the R&D level, the budgeting is approximated when the preliminary contractors submit their statements of work and budgets required. Each phase is budgeted based on the contractor's budget statements in their statements of work.

This process at the R&D level is not a blank check, but based on thousands of subcontractors whose statements of work are added up with a small fee for coordination of the work.

It is important to remember that the military understands that a budget is a guesstimate and is the best that can be obtained, which may be why programs so frequently go over budget.

Accounting Model

For the F-22 development, both the Budgeting and Accounting Models are described in the Cost/Schedule Control Systems Criteria Integrated Tool Set. The F-22 program monitors cost performance in three ways:

1. Through the cost performance report
2. The overhead cost report
3. The design-to-cost status report.

According to Williams, “The primary method of cost tracking comes from the contractor’s internal cost control system as validated by the Government to meet defined cost/schedule control systems criteria. Each month, the contractors generate a cost performance report that shows their expenditures to date compared with their planned expenditures and, thus, their progress in terms of cost and schedule variance.”

On the F-22, there was also a report that showed the cost status by IPT for further control by the IPTs themselves so that they could monitor whether they were performing to their plans.

On a monthly basis, the Program Director and the Government/contractor IPTs get a preliminary cost performance report, “called a flash report, no later than 10 days after the contractor accounting month ends. This report is unaudited but serves to give the IPTs and the Government and contractor Program Directors early insight into cost and schedule issues. Both contractors deliver the final cost performance report 30 days after the close of the accounting month.”

The two contractors for the program created an overhead cost report. Williams writes, “The contractors initially defined their overhead rates at the start of the EMD contract... Then, they submit the report only when their overhead rates change from the initial baseline to document what changed and why. The Government and contractors then together define actions to control and reduce the growth in overhead costs.”

The process includes the design-to-cost report. This allows the IPTs “to focus on a life-cycle perspective. To make decisions properly the IPTs need to know the cost of the decisions, not just for the immediate future (the development cost), but also for downstream production. Through the use of design to cost, the IPTs establish production cost as another performance variable. The monthly design-to-cost status report allocates production cost targets and identifies critical areas and problems that may cause the IPTs to exceed their goals. The IPTs also prepare a Technical Performance Measurement (TPM) to track their product’s projected production cost. The regular reporting of this TPM gives the IPTs a clear way to document the actions they’ve taken to reduce production costs.”

There are two other tools in the budgeting/accounting area, closure plans, and award fees.

Closure plans are used for the over 30,000 items on the F-22. As Williams describes it, “As detailed as that may at first appear, sometimes it requires judgment to determine when an IPT can declare an item complete. The closure plan is simply a formal agreement between the contractor and the Government specifying actions that will occur before completion of an item. The Government and contractor team members jointly prepare and sign this plan to define their course of action. Closure plans give the IPTs the flexibility to manage their portions of the program within a formalized agreement.”

To be fair to both the Government and the contractor, the Government decided to use a cost-plus-award fee contract for the F-22. “With this type of contract, the Government agrees to pay the contractors all of their allowable costs and to pay an award relative to how well they meet their cost, schedule, and performance requirements... The F-22 contract specifies a 4 percent fixed fee to cover the contractor’s unallowable but required costs and a 9 percent award fee, a percentage of the contract value. The award fee established a pool of money available for the contractor to earn based on performance.”

Williams notes, “The award fee is the primary tool for motivating contractor performance. Meeting contractual requirements including those for cost, schedule, and technical performance results in an award of 100 percent of

the award fee pool. The Government determines, and pays, the award fee every six months. Monthly, the IPTs record contractor performance, citing both strengths and weaknesses, and the IPT leaders pass the assessment directly to their contractor counterparts as feedback. Three months and 6 months into every period, the contractors and the Government award fee board meet to exchange views on contractor performance. In this way, the contractor gets regular information on how it is doing and where the Government believes the contractor needs to improve. The objective of the Government is very clear: for the contractor to earn 100 percent of its profits, it must fully meet its cost, schedule, and performance requirements...”

This process worked very well on the F-22 program. Over a four-year period, the contractor never once protested the award they received.

“The program office designed the award fee process to be a win-win relationship, a vital part of the integrated management framework. The integrated tool set helped evaluate contractor performance objectively, and the award fee program promoted frequent communication, early problem identification and resolution, proactive management, and the teamwork needed to develop the weapon system and engine.”

Parting Thoughts...

The F-22 is a typical example of the development process of a tool, vehicle or weapon system that the Department of Defense needs in its effort to carry out its mission.

The process has political, economic, technological and military aspects.

The acquisition process of the Department of Defense has historically been viewed as a lengthy, political and costly process that produces systems that are obsolete when they are finally into production. Because of this history, the F-22 represents the new way in which systems are developed. In the eighties and nineties, a series of acquisition reform efforts by Congress tremendously improved the processes. Nevertheless, the lessons of the F-22 continue to improve the acquisition processes at the Pentagon regularly because these lessons have been documented and shared.

In addition, the work of the late American statistician, Dr. W. Edwards Deming had a profound impact on the way in which any system is developed within the Pentagon community. In fact, his “lessons learned” are well documented with the Boeing Company, as well as the F-22. In a National Defense University publication that compares the DoD C-17 development with the Boeing 777, author A. Lee Battershell writes, “Today, many organizations – including Boeing and DoD – are reorganizing under the W. Edwards Deming model, the so-called ‘Japanese style of management and organization.’ Because Deming is a statistical mathematician, one might suppose that science and math would form the theoretical foundations of his theory. However...Hodge and Anthony classify Deming as a behaviorist because, ‘the essence of this approach is that people will work harder and with more of a sense of commitment if they have job security...and feel they have a significant part to play in decision making and group activity.’”

Dr. W. Edwards Deming as Statistician and Philosopher

In 1950, at the request of General George C. Marshall, American statistician, Dr. W. Edwards Deming, came to Japan to teach the Japanese people how to improve the quality of their products and, therefore, their economy. Dr. Deming told the Japanese people that the most important system to optimize was Japan, and, that Japanese companies needed to learn to cooperate with one another.

As a statistician, Dr. Deming took the statistical process control concepts that he, Dr. Walter A. Shewhart and Dr. Joseph M. Juran had perfected in the United States before the war and taught them to Japanese industry.

According to “The Revolution in Business Affairs: A Discussion,” a paper written for the Institute for National Strategic Studies at the National Defense University, that reiterated lessons learned in the previous decade,

“While Dr. Deming was at work in Japan, the U.S. economy was the only strong economy in the world. U.S. corporations were not concerned with the painstaking processes and discipline that Dr. Deming was teaching. They believed it was unnecessary. After all, whatever products were produced had a market. Everything manufactured was sold because there was so much pent up demand from the war years. U.S. corporations believed their

success was due to their excellence and brilliant management.”

“It was not.”

“While Dr. Deming was helping the Japanese learn the disciplines of statistical process control and systems thinking, U.S. corporations were continuing with their mass production manufacturing blitz. Disciplined thinking was not at the core of how they managed, and, by the 1960s, many engineers who were beginning to see what was occurring in Japan, began to try to help U.S. corporate leaders understand that their skills were ‘out of date and noncompetitive.’ U.S. corporate leaders laughed. Their profits were at an all time high, and the warnings from engineers were ignored. When Japanese companies began to take market share away, corporate America remained asleep at the wheel. *Their arrogance remained the single most devastating characteristic that prevented them from accepting the truth.*”

“Only in the seventies and eighties, with major disruptions in their ability to compete, would America wake up. This was especially true after the TV special, ‘If Japan Can, Why Can’t We?’ Dr. Deming became a popular figure in U.S. industry, but, except for a few isolated instances, the senior leaders of America would not listen well enough or long enough. Patience and discipline were not virtues of American industrial leadership. Only on the brink of bankruptcy would some corporate leaders be willing to change and many never would.”

For those who understood the ramifications of the teachings of Dr. Deming, the “revolution” in U.S. business was about to begin based on all his principles. Many of Dr. Deming’s students knew that understanding the principles and philosophies of Dr. Deming, was at the core of using his methods, like statistical process control.

In the years prior to his death, Dr. Deming was working on what he called, the System of Profound Knowledge; the integration of four major disciplines, systems theory, the theory of knowledge, the theory of variation, and the theory of psychology. He began to learn that the true secrets of “revolutions,” what he called, ‘transformations’ were about the changes that occur inside the minds and hearts of people. Dr. Deming came to believe that his methods, such as statistical process control were not of long-lasting

use unless the human transformations of the leaders and the people of the enterprise also took place. Leaders had to first change themselves before they could expect others to change, and change is a very difficult process that is sometimes painful.

Operating as an integrated system, with Dr. Deming's principles became de rigeur at the Pentagon on all programs.

Perhaps, the company which embraced Dr. Deming's principles most was the Toyota Motor Company. In addition to learning and executing Dr. Deming's philosophies, Toyota implemented the discipline of his methods, especially statistical process control. Although applying statistical tools to process control was powerful, the concept of documenting processes, alone, was even more critical. For the first time, the ways in which people conducted their work was documented, and made visible. It captured the learning in the process and enabled improved deployment. This created the opportunity to develop many different ways of *improving* the processes and ultimately making them more and more efficient and effective.

At Toyota, the Toyota Production System was being developed and taught. It transformed the entire mass production system in the plants to a "lean" system by increasing efficiency and effectiveness. Ultimately, Toyota was developing the ideas of "lean" which the rest of the world would soon use as the standard against which everyone would be measured. In addition, Toyota began to apply many of the "lean" principles to other elements of their systemic business. To optimize Toyota required an optimization of the Toyota system. That system was larger than the car company, itself. It included the Toyota keiretsu system of suppliers, Mitsui, Toyota's international trading company, and the Japanese governmental agencies; the Ministry of International Trade and Industry (MITI) and the Ministry of Foreign Affairs, etc. All these elements, together, comprised the Toyota System. And, an efficient Toyota system became increasingly strong and difficult to compete against. This was especially the case since it was very complicated trying to determine where Toyota left off and the Japanese government began.

Benchmarking Toyota and creating lessons learned based on the work of Dr. Deming was the philosophical framework used at the Pentagon in all of its new weapon systems and platform program beginning in the mid-

1980s. This included the ideas of Integrated Product Teams and their associated systemic management approaches.

Michael D. Williams, in his National Defense University lessons learned book on the F-22 Development Program, describes the theory that developed in the integrated framework the Pentagon uses based on systems thinking and the theories of Dr. Deming. The Department decided to create a philosophical framework within which to create their “ideal acquisition and development process.” In accordance with Dr. Deming teaching, they developed first their “Principles of Acquisition.”

Twenty operating principles were first identified and articulated. They directly evolved out of Dr. Deming’s Fourteen Points for Transformation of American Industry, and other Deming theories published in his 1986 book, *Out of the Crisis*. They are:

1. Operate with Integrity.
2. Work as a team.
3. Use logic and common sense.
4. Involve everyone.
5. Integrate the entire system.
6. Ensure ownership.
7. Use a disciplined approach.
8. Understand what is really required.
9. Set realistic expectations and meet them.
10. Provide realistic options.
11. Take a long-term view.
12. Do it right the first time.
13. Have what you need for the effort.
14. Ensure everyone knows what it takes to meet the goal.
15. Use an event-based schedule with defined success criteria.
16. Define success and be able to measure it.
17. Reward success.
18. Focus on a win-win relationship.
19. Guarantee open communications.
20. Achieve success with a positive attitude and focus.

These twenty program principles of acquisition for the ATF/F-22 guided the rest of the process and the behavior of individuals for what was one of the

most successful programs of all time at the Pentagon.

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RESUME

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Joining the University of Detroit from Ameritech Publishing, Inc., where she was a Strategic Planner, she worked at AT&T and Michigan Bell before that, helping the corporation during its divestiture years. Prior to her Bell System tenure, Dr. Ronis directed a national energy program for the U.S. Energy Research and Development Administration (ERDA - now the Department of Energy), in Oak Ridge, Tennessee and Washington, D.C. While an administrative associate at The Ohio State University, she chaired the Legislative Affairs Committee, acting as the legislative liaison between the University Senate, the Ohio General Assembly, the Governor’s Office and the Ohio Board of Regents. Dr. Ronis began her career working at North American Rockwell in Columbus, Ohio.

Dr. Ronis has worked with many organizations; public, private, large, small, profit and nonprofit. These include: General Motors Corporation, Ford Motor Company, the Department of Defense, the Department of Energy, the Federal Laboratory Consortium For Technology Transfer, U.S. Institute of Peace, USAID, Ameritech, USCAR, the Interstate Commerce Commission, the Institute for National Strategic Studies at the National Defense University, the National Science Foundation, and The State Council of The People’s Republic of China.

Dr. Ronis began working with the U.S. automotive industry in 1985. This included Ford Motor Company as well as several automotive suppliers.

In 1988, she began working with the Cadillac organization at General Motors on helping to fix the Allanté two years after start of production. She then became involved in the Cadillac 2000 project on behalf of the Chief Engineer of Cadillac, Mr. Robert L. Dorn. In 1993, Dr. Ronis helped to revamp the General Motors corporate intelligence function. From 1994 to 1996, The University Group became a captive supplier to General Motors working on a number of corporate functions. Since that time, Dr. Ronis has continued to work with GM on a number of Quality Network projects.

In 2000, Dr. Ronis was asked to assist the Ford Motor Company in improving its corporate intelligence function, and strategic visioning processes.

Dr. Ronis began working in the national security community during the divestiture years of the Bell System that included her participation in the decisions related to the security of the nation’s telecommunications infrastructure.

For more than a decade, Dr. Ronis has been working directly with the U.S. Department of Defense and the national security community. Her first assignment was teaching “grand” strategy as it is viewed in global business to the Management Faculty at the U.S. Army War College in Carlisle, Pennsylvania. She was also

instrumental in the development of the first Strategic Leadership Symposium at the Army War College under the command of Major General Paul G. Cerjan.

In 1993, Dr. Ronis began her work with the National Defense University (NDU) in Washington, D.C. She has played a role in bringing industrial knowledge of the transportation industry to the Industrial College of the Armed Forces (ICAF) and NDU and currently serves on the NDU Foundation Board of Directors.

In 1996, Dr. Ronis was asked to deliver a paper on “National Security and the Theories of Dr. Deming” by the W. Edwards Deming Institute. The paper was read by General John M. Shalikashvili, Chairman of the Joint Chiefs of Staff and was widely distributed throughout the Pentagon as an example of applying strategic systems thinking to matters of national security.

At DoD, Dr. Ronis has worked with the Air Force Special Operations Forces at Robins Air Force Base and Wright Patterson Air Force Base, and the U.S. Army Tank-Automotive and Armaments Command (TACOM). She was asked to write a “white paper” about the need to define and retain Department of Defense core competencies and what happens when outsourcing occurs. At the Pentagon, she has worked in support of projects at the Office for the Secretary of Defense on visioning for the Department, and has supported the work of the Defense Reform Task Force. Her work for the Secretary of Defense included a written operational definition of the Revolution in Business Affairs that was used to support the Revolution in Military Affairs for the Quadrennial Defense Review. In addition, she was a team leader as a part of the “red team” that critiqued the Joint Vision 2010 work for the Joint Staff, J-7.

In the last few years, she has also supported the work of the Hart-Rudman Commission on U.S National Security for the 21st Century.

Dr. Ronis has also worked on behalf of the economic and transportation elements of national security supporting the original work to create USCAR, the United States Consortium for Automotive Research, and its major initiative, the Partnership for a New Generation of Vehicles. In addition, she helped the Federal Laboratory Consortium for Technology Transfer (FLC) with a master plan and vision for the future. Her work with FLC included a paper on how national laboratories and scientific researchers can legitimately comply with the Government Performance Results Act (GPRA).

Known as a systems security strategist, Dr. Ronis has authored 112 papers. Her paper delivered at the Pentagon entitled, “Economic Security is National Security: A Discussion of Issues Surrounding the Global U.S. Corporation” helped to re-think industrial base policy. Her paper presented at the U.S. Army War College, “Visioning for the 21st Century: A Process for National Security” outlined the way in which an interagency activity might produce a more holistic national security strategy for the United States. Her paper on “Shaping in the 21st Century” delivered at the Army’s conference at the Walker Institute of International Studies examined the new roles that the Department of Defense would need to play in the Post Cold War era.

Dr. Ronis also has published the scenario “Crisis on Asimov” in *Automotive Industries Magazine*, and the *Financial Times Automotive World*, in London that is a strategic futurist’s look at transportation in the world of 2085 that uses a Department of Defense visioning process. In addition, Dr. Ronis worked with the late Dr. W. Edwards Deming including co-authoring the paper “Preparing Cadillac for the 21st Century: Systems and Strategic Thinking.” Dr. Ronis sits on the Boards of Directors of the National Defense University Foundation, Detroit Institute of Ophthalmology (DIO), The Strategy Forum and is the former Vice Chairman of The Ohio State University Alumni Association. She is a former board member and life member of The Economic Club of Detroit. She is a member of the Detroit Association of Business Economists, Society of Automotive Engineers, the National Defense Industrial Association, the Defense Orientation Conference Association, and the Society of Automotive Analysts. She is a member of the Phi Kappa Phi Honor Society. Dr. Ronis is a frequent guest on several Detroit area TV and radio news programs.

RESUME

JAMES R. LOCHER III

Born August 21, 1946, in Lancaster, Pennsylvania, James R. Locher III has more than twenty-five years of professional experience in both the executive and legislative branches of the Federal Government. He graduated from the United States Military Academy in 1968 and received an MBA from the Harvard Graduate School of Business Administration in 1974.

Mr. Locher began his career in Washington as an executive trainee in the Office of the Secretary of Defense. Subsequently, he served in the Executive Office of the President as executive secretary of the White House Working Group on Maritime Policy. Returning to the Defense Department, Mr. Locher worked in the Office of the Assistant Secretary of Defense for Program Analysis and Evaluation. As an operations research analyst in the Mobility Forces and Naval Forces Divisions, he evaluated selected Navy and Marine Corps programs and helped pioneer use of net assessments to compare U.S. and Soviet capabilities.

In 1978, Mr. Locher joined the Senate Committee on Armed Services as a professional staff member. Initially, he served as senior adviser on international security affairs and force projection program analyst. In 1985, the committee assigned Mr. Locher responsibility for strategy, organization, special operations and low-intensity conflict reforms, and Persian Gulf issues. He directed the bipartisan staff effort that resulted in the Goldwater-Nichols Defense Reorganization Act of 1986.

President Bush appointed Mr. Locher to the post of assistant secretary of defense for special operations and low-intensity conflict in October 1989. He supervised the special operations and low-intensity conflict activities of the Department of Defense, performed as the principal civilian adviser to the secretary of defense on these matters, and represented the secretary in senior subordinate groups of the National Security Council. He served as assistant secretary throughout the Bush administration and first five months of the Clinton administration. During the latter period, Mr. Locher also served as acting under secretary of defense for policy. Upon leaving government service in June 1993, he was awarded the Department of Defense Medal for Distinguished Public Service, the department's highest civilian award.

Since 1993, Mr. Locher has been writing, lecturing, and consulting. In 1994-95, he served as a senior consultant to the Commission on Roles and Missions of the Armed Forces. In 1996, Mr. Locher assisted the Federation of Bosnia and Herzegovina in drafting its defense law and organizing its Ministry of Defense. He served on the secretary of defense's Task Force on Defense Reform and the National Security Study Group of the U.S. Commission on National Security/21st Century. A distinguished visiting fellow at the National Defense University, Mr. Locher lectures at military colleges of the Department of Defense, civilian universities, and Department of State programs for senior foreign leaders. His book, *Victory on the Potomac: The Goldwater-Nichols Act Unifies the Pentagon*, was released in December 2001.

In 1999, Mr. Locher joined the board of directors of Power Medical Interventions, a medical device company. Subsequently, he was elected as the company's secretary and later as vice chairman of the board.

Mr. Locher and his wife, Norma Lynn, have one son and reside in Springfield, Virginia.