The Future of the Marine Aviation Logistics Support Program

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Subject Area Logistics

EXECUTIVE SUMMARY

Title: The Future of the Marine Aviation Logistics Support Program

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Thesis: In order for the Marine Aviation Logistic Support Program to remain effective, meet current needs, and future warfighting doctrine, the component programs must be analyzed in relation to each other, and modern business practices applied to develop a more effective aviation logistics system.

Discussion: As the military services transform into a more responsive force to meet current needs and developing threats our current aviation logistic support programs must evolve. Our ever-changing military with the focus towards seabasing compels us to break our assumptions, apply simple methodologies to improve, and work smarter. The proven methods of businesses that transitioned from "good to great" and the Theory of Constraints (TOC) provide a line of attack that encourages common sense instead of common practice. Current practices in aviation logistics are failing to adequately support the warfighter and the current metrics in Marine Aviation do not accurately display how to effect positive change in performance.

Recommendations: Aviation logistics requires a paradigm shift in its procedures in order to improve aircraft readiness. Courageous leaders effect change by not accepting the status quo, and seek to revolutionize the aviation logistics business. A process of ongoing improvement demands

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never being satisfied with the system's capability, and application of proven business practices will enable continuous improvement. To improve our support capability, our leadership must institutionalize the goal to optimize effectiveness across all levels of support to keep airplanes flying, which requires a change of approach to leadership and management.

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Preface

The leadership of the Marine Corps has stated that the evolving strategic environment highlights the need for more responsive aviation logistics capabilities that are optimized for the developing warfighting doctrine. As part of the strategy for transforming military forces within the Department of Defense, logistics must reduce the footprint requirements and ensure timely preplanned or on-call delivery of material through strategic and global sourcing networks that are capable of leveraging the sea base. In order for aviation logistics to meet the demands of the future operational environment, aviation logistics programs must evolve to lighter, more deployable, and more responsive support packages. The major components of the Marine Aviation Logistics Support Program (MALSP) are addressed, starting with inception in the late 1980s to meet the threat with the capabilities of that time. From this analysis it can be determined how MALSP must evolve in order to be compatible with technological changes and incorporate successful business practices to be compatible with developing warfighting doctrine. The recommendations presented will generate debate within the Marine Corps Aviation Logistics community on methods for evolving MALSP, with the desired result of establishing a common goal of greater effectiveness, deployability, and warfighting capability.

Chapter I

The Marine Aviation Logistics Support Program

As the Marine Corps develops the seabasing concept the Marine Air-Ground Task Force (MAGTF) commander will place a greater reliance on the Aviation Combat Element (ACE) for power projection, force protection, and many of the logistic support functions. As a result there will be an increased burden on the aviation logistic community to provide cost-effective, strategic lift efficient, Seabased capable, on-time support for the MAGTF.[1] The ACE will rely on the seabase as much as possible while maintaining the ability to go ashore with tailored support packages as necessary. The primary aviation logistic support will come from the Seabase while retaining the capability to employ tailored ashore aviation logistics from existing airfields, expeditionary airfields, and austere sites.[2]

The Marine Aviation Logistics Support Program (MALSP) provides a capability to task-organize sustainable aviation maintenance capabilities tailored to support Marine aviation. It enables aviation logisticians to rapidly task organize, deploy, and sustain an ACE ranging in size from a composite squadron in a Marine Expeditionary Unit (MEU), to a composite Air Group in a Marine Expeditionary Brigade (MEB), or one or more Wings in a Marine Expeditionary Force (MEF).[3] MALSP is an umbrella program that encompasses four different sub-programs: the Marine Aviation Logistics Squadron (MALS) program, The Contingency Support Package (CSP) program, the Aviation Logistics Support Ship (T-AVB) program, and the Maritime Pre-

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1 U. S. Marine Corps, *MAGTF Aviation and Operational Maneuver From the Sea* (Wash. D.C. February 1999), 8.
2 U. S. Marine Corps, *United States Marine Corps Warfighting Concepts for The 21st Century* (Quantico, VA. 2001), 56.
3 U. S. Marine Corps, *Marine Corps Warfighting Publication 3-21.2*, *Aviation Logistics* (Wash. D.C. 2002), 1-6.

positioned Force (MPF) program.[4] These sub-programs enable aviation logistics to rapidly deploy and sustain a deployed MAGTF ACE as well as support day-to-day operations at home.

MALSP began in the early 1980s with the goal to organize aviation logistics into predetermined notional support packages called Contingency Support Packages (CSP) for rapid deployment. Deployment tailoring must be pre-planned since aviation supply does not possess War Reserve Material (WRM), and the aviation logistics spare parts and repair material used for deployment is the same as that used to maintain aircraft in garrison on a daily basis. The need to develop a systematic plan for deployment of aviation logistic support was envisioned in order to develop support packages that could be designed and measured in terms of people, spare parts, support equipment, and facilities (Mobile Maintenance Facilities (MMFs)). Prior to MALSP there was no standard method of task-organizing aviation logistics support and the experience of the unit supply and/or maintenance officer was the basis for decision making as to what assets to take when organizing for deployment. As a result, the time required to assemble aviation logistics (AVLOG) support packages exceeded all other phases of task-organizing an ACE, resulting in AVLOG support that was neither responsive nor effective.[5]

Three Levels of Maintenance

Naval aviation maintenance is organized into three levels: organizational level (O-level), intermediate level (I-level), and depot level (D-level). The O-level is the operational squadron's organic aircraft maintenance consisting of the capability to launch and recover aircraft, perform on aircraft maintenance, servicing, and preventive maintenance. The O-level maintains an

[4] U. S. Marine Corps, *Aviation Logistics*,1-6.
[5] Ibid.

assigned number of aircraft with Marines trained in specialized aviation skills. D-level maintenance is performed on material requiring major overhaul or rebuilding of parts, assemblies, subassemblies, and end items. The D-level can be government operated depots, contracted to private industry, or the original manufacturer, and includes manufacturing parts, modifying, testing, inspecting, sampling, and reclamation of major weapons systems and end items.[6] D-level maintenance supports O-level and I-level maintenance by providing engineering assistance and developing repair methods beyond organizational and intermediate level capabilities.

The MALS program consists of squadrons in each MAG that link the O-level with the D-level by providing off aircraft maintenance, supply, and ordnance/armament support for the aircraft and aeronautical equipment in the flying squadrons. Each of the MALS provide a core group of supervisory and support personnel who, when augmented by aircraft specific maintenance personnel from the O-level, constitute an intermediate maintenance capability for either fixed-wing or rotary-wing aircraft. The I-level mission is to enhance and sustain the combat readiness and mission capability of supported activities by providing quality and timely material support at the nearest location with the lowest practical resource expenditure.[7] I-level maintenance consists of on and off equipment material support, and serves as the screening and shipping point for retrograde material to the D-level.

[6] U. S. Marine Corps, *Aviation Logistics*,1-7.
[7] Ibid.

Contingency Support Packages

A key feature of the MALSP concept is the continuous development of logistic support that is capable of rapid task organization and deployment. The primary means for accomplishing this enhancement is a series of standardized, predetermined logistics support packages containing all elements required to support any contingency that the Marine Corps may be tasked to execute. The contingency Support Package Program (CSP) consists of the primary MALSP building blocks which contain negotiated allowances of spare parts, support equipment (SE), Expeditionary Air Field (EAF), Mobile Maintenance Facilities (MMFs), and the personnel needed to sustain Marine aviation in combat.[8] The CSPs are drawn from various MALS, with one designated as the host MALS for deployment which allows the ACE to rapidly establish a comprehensive support package for any aircraft mix.

Within the CSP are several types of tailored support packages designed to support specific type and number of aircraft at a predetermined level of repair. These allowances are designed to be mutually supportive and fit together like building blocks to form a solid aviation support foundation. The CSP program is composed of support packages made up of: Fly-in Support Package (FISP), Peculiar Contingency Support Package (PCSP), Common Contingency Support Package (CCSP), Follow-on Support Package (FOSP), Remote Expeditionary Support Package (RESP), and Training Squadron Allowance (TSA).[9] These packages are established for either a fixed-wing or rotary-wing composite MAG, but are not ideally suited for an ACE that is a composite MAG or squadron with both fixed-wing and rotary-wing aircraft.

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[8] U. S. Marine Corps, *Aviation Logistics*,1-7.
[9] Ibid.

Aviation Logistics Maritime Program

The Maritime Pre-positioned Force (MPF) for aviation logistics is comprised of the Maritime Pre-positioned Squadron (MPS) program, and the Aviation Logistics Ship (T-AVB) program. MALSP relies heavily on the MPS and T-AVB ships in order to establish in-theatre I-level maintenance and repair capability. The I-level can be either afloat or land based in the theatre of operations, provided a host nation grants access to ports and airfields. The MPF program supports MALSP through the deployment and assembly of a MAGTF into a permissive area using a combination of strategic airlift and forward deployed Maritime Pre-positioned Force ships. The three key aviation logistic support elements spread loaded among each MPS Squadron are aviation Support Equipment (SE) such as tow tractors, class V(A) ordnance, and EAF material.[10] These assets have a longer storage life than aircraft parts and supplies and when combined with support items from the fly in echelon (FIE), provide complete logistic support during the first 30 days of an MPF operation.

The second element of MPF is the T-AVB program which is comprised of two ships, the USNS Curtis and USNS Wright. These ships are converted 1969 vintage commercial container vessels that were modified in the mid-1980s to transport intermediate aircraft maintenance and aviation supply support to a contingency environment. These ships fill the strategic lift void that Transportation Command (TRANSCOM) cannot meet.[11] The capabilities of the two T-AVB ships significantly reduce the airlift required to transport maintenance facilities, support equipment, parts and personnel into theatre, and serve as logistic force multipliers that offer maximum flexibility.[12] The T-AVB ships are designed to be activated in support of MEB or

[10] U. S. Marine Corps, *Aviation Logistics*,1-8.
[11] Ibid.
[12] Ibid.

MEF operations with a task organized MALS aboard consisting of MMFs, SE, spare parts, and skilled personnel for support of the deployed aircraft mix.

The current method of employing aviation logistics for a major contingency requires existing aviation material in the CSPs of the MALS to be embarked on the T-AVB ships that arrive in theatre after 30 days of aircraft deployment. Once embarked, the T-AVB, with its detachment of Marines from the various home base MALS, sail into the operational theatre to provide intermediate level aviation logistics support via one of three methods of employment: operational mode, transport mode, and combination mode, based on the number of MMFs being transported. In the operational mode a fixed number of MMFs can be deployed with electrical power and operate as an Intermediate Maintenance Activity (IMA) afloat. The transport mode allows more MMFs to be loaded aboard for transport and off-loaded at a secure port, then re-establish as a MALS ashore. The combination mode allows a portion of the IMA afloat to operate with the remainder un-powered for transport then off-load and re-establish as a MALS ashore. The use of the T-AVB ships complements MALSP by providing packaged logistic support in-theatre to specific mixes of aircraft for a deployment involving contingency operations or exercises for a determined duration.

Warfighting Concepts

The Marine Corps' future warfighting concepts require aviation logistics to plan, organize, and equip for the future. In order to project and sustain Marine forces, logistics must be provided independent of host nations and against distant objectives across the breadth and width of theater operations. For aviation logistics to accomplish the support task of Expeditionary

Maneuver Warfare (EMW), the Marine Corps will rely heavily on seabasing to reduce the requirement for port facilities and/or host nation support. For seabased logistics to become a reality, the Marine Corps will have to develop a new generation of maritime pre-positioned ships and the ability to move material to and form those ships while at sea. Rather than off-loading large quantities of supplies and equipment ashore, logistics operations will deliver tailored support packages from the seabase or from small detachments ashore to widely dispersed, highly mobile combat forces operating hundred of miles inland.[13] The Maritime Pre-positioned Force-Future (MPF-F) ships being designed now will replace the current fleet of pre-positioned vessels by combining the capabilities of the T-AVB ships with the current MPS ships and must include a flight deck capability to provide a capable seabase that reduces the requirement for in-theatre ports and airfields.

Statement of the Problem

MALSP was designed during the era of the Cold War to support a major regional conflict. As originally designed, MALSP is too large, too heavy, and too expensive to move into theatre, and requires a large footprint ashore in a relatively benign environment. Since the conclusion of operations Desert Shield and Desert Storm, articles and research papers on the topic of aviation logistics have focused on the individual component programs of MALSP. Recent operations have shown a need for an aviation logistics capability that is more rapidly deployable, has reduced transportation requirements, and has greater flexibility. The leadership within the aviation logistics community must develop a clearly defined goal and concept of operation. Other key considerations are that not every contingency can be supported by MPF ships due to

[13] Department of the Navy (N78*), Naval Aviation Vision* (Washington, D.C., May 2003), 34.

port facility location and/or a benign port environment for offload; current support packages are not adequate for short intense combat operations followed by sustained lower intensity operations; and lastly, recent operations illustrate that MALSP must not only be responsive to composite squadrons or groups, but to single type aircraft deployments in squadrons or detachments from squadrons.

Thesis Statement

In order for the Marine Aviation Logistic Support Program to remain effective and meet the developing operational warfighting doctrine, the component programs must be analyzed in relation to each other and modern business practices applied in order to develop a more effective aviation logistics system.

Chapter II

Transforming Aviation Logistics

"One of the constants of warfare is that the outcome of warfare is greatly influenced by the success or failure of logistics."[14]

There are many challenges and technology limitations associated with developing a large seabased force that can allow all elements of the MAGTF to conduct sustained operations from ships to the objective area. For aviation logistics one of the most difficult hurdles will be adequate spares parts and adequate lift to transport that material form the seabase to shore and United States based depots.[15] The level of logistics support required to sustain the MAGTF may over-stress the seabase unless the leadership within the Marine Corps aviation logistic community adopts proven business methods to configure and transform the organization, personnel skills, and aviation maintenance support concepts.

It is not practical to pre-stock adequate aviation specific parts on ships due to cost, life limits, and configuration management requirements for safety of flight. This factor will require the ability to move material rapidly from the depots to the seabase. The needs of aviation sustainment for the ACE will require aviation logistics activities to physically integrate, prepare, deploy, supply, train, maintain, reconstitute and re-deploy the force at sea in order to support the MAGTF throughout OMFTS. These requirements combined with the leadership within DoD stating the need to transform business practices to become more efficient and more capable are

[14] Martin Van Creveld, M. *Supplying War* (Cambridge, UK. 1977), Introduction.

[15] U. S. Marine Corps, *Marine Aviation Logistics Support Program and Remote Expeditious Support Package* (Washington, D.C., Oct. 2003), PowerPoint Presentation obtained Dec. 2003.

driving change from the top. The leadership within the Marine AVLOG community must lead the transformation of the culture, business practices, processes, and organizations in order to sustain successful and relevant Marine aviation in the future.[16] Two complimentary methods to improve performance that are useful now is to implement the practices of businesses that transformed from being merely good to becoming great, and the practices of Goldratt's Theory of Constraints.

Good to Great

The first method that will assist in the transformation of aviation logistics is to develop the culture of great companies as determined by the research findings in the book, *Good to Great*, according to Professor Jim Collins: "Good is the enemy of great" and the vast majority of companies never become great because the vast majority become quite good and that is their main problem."[17] The research was conducted by setting high benchmarks to identify a set of elite companies that made the leap from good to great and sustained those results for at least 15 years. After the leap the good to great companies generated cumulative stock returns that beat the general stock market by an average of seven times in fifteen years, better than twice the results delivered by a composite index of the world's greatest companies, including Coca Cola, Intel, General Electric and Merck. Mr. Collins found that, "Greatness is not a function of

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[16] U. S. Marine Corps, *United States Marine Corps Warfighting Concepts for The 21st Century* (Quantico, VA. 2001), 88.

[17] Collins, James C. *Good To Great: Why some companies make the leap….and others don't* (New York, 2001), 59.

circumstance, rather that Greatness is largely a matter of conscious choice"[18] and from this he determined that the great companies exhibit five key characteristics.

The first characteristic is leadership, which includes having the right people on the team. The good to great leaders exhibit certain qualities that make them Level 5 leaders, and the businesses that made the transition had the right person in charge of the transition. Level 5 leaders are those that combine extreme personal humility with intense professional will, they shun the attention of celebrity and channel their ambition toward the goal of building a great company. The good to great leaders also understand three simple truths; If you begin with the "who" rather than the "what", you can more easily adapt to a changing world: if you have the right people in the right place, the problem of how to motivate and manage people largely goes away; and if you have the wrong people, it doesn't matter whether you discover the right direction, you still won't have a great company. In order to make the transformation the leader must set the goal and with his team of disciplined people and develop the plan for transformation. Another successful practice of the leaders of these businesses that should be familiar to military leaders is to put the best people on the biggest opportunities, not the problems.

The second characteristic common to making the transition is to have disciplined thought, and the ability to confront the facts. All great companies began the process of finding a path to greatness by confronting the brutal facts of their current reality. Collins found that when a company starts with an honest and diligent effort to determine the truth of its situation, the right truths become self evident. The leader must foster a climate where the truth is heard. One of the primary tasks in taking a company from good to great is to create a culture wherein people have

[18] Collins, 30.

a tremendous opportunity to be heard and , ultimately for the truth to be likewise heard. The leader must have faith that the team will prevail in the end. Disciplined thought includes developing a Hedgehog mentality wherein you understand what your organization can be the best at and pursue that. At the same time the leadership of the organization must determine the other activities you perform and may be competent in, but others do better and leave those activities to others to perform for you.

The third characteristic is one of disciplined action, where the company has developed a culture of self-discipline. Collins writes that to create a culture of discipline, successful leaders: build a culture around the idea of freedom and responsibility within a framework; fill the company's culture with self disciplined people who are willing to go to extreme lengths to fulfill their responsibilities; and avoid confusing a culture of discipline with a tyrannical discipline. The leader instills an ethic of entrepreneurship.

The fourth characteristic is to think differently about technology. The great organizations think differently than others regarding technology and technological change. They avoid fads and bandwagons that typically arise from new technology, instead becoming pioneers in the application of carefully selected technologies. Leaders of good to great companies respond with thoughtfulness and creativity, driven by a compulsion to turn unrealized potential into results. They act in terms of what they want to create, and how to improve their companies, relative to an absolute standard of excellence. The great companies avoid technology fads, apply carefully selected technologies, and determine if the technology fits in with the Hedgehog concept.

The fifth concept is known as the "flywheel" and the "Doom Loop", based on the principle where a steady force will move the flywheel and build momentum. Good to great transformations often look like dramatic, revolutionary events to those observing from the outside, but they feel like organic, cumulative processes to people on the inside. Collins writes that the great companies had no name for their transformations, there was no launch event, no tag line, no programmatic feel whatsoever. Each company went through a quiet, deliberate process of figuring out what was needed to be done to create the best future results, then simply took those steps, one by one over time until it hit breakthrough moments. Those who launch radical change programs and wrenching restructurings will almost certainly fail to make the leap from good to great.

Theory of Constraints

Theory Of Constraints (TOC) evolved from the theories and teachings of Dr. Eliyahu M. Goldratt, a physicist who realized that scientific principles and the rules of logic could be applied to a process in order to provide ongoing improvement for the system as a whole. It has one clear objective: to succeed in achieving more of an organization's goals by focusing on the areas that have a dramatic impact on the whole unit. The TOC philosophy has been applied to many manufacturing businesses around the world by using techniques for identifying constraints within an organization and focusing steps for improving an organization's performance. It is more than a production shop floor "bottleneck" optimization program, it is about making decisions in a fast-paced, ever-changing world. Insight comes from recognizing that diagrams can be made that get at the root cause of an organization's problems. Whatever the nature of business, TOC establishes a framework and suggests methodologies for achieving optimal solutions for any organization.

Theory of Constraints enables an organization to develop a superior system for generating continual logistical improvements. Strategic Planning and Thinking Processes are the vehicle and roadmap for the goal. The process of ongoing improvement provides the leadership with guidelines for identifying chokepoints within the procedures and exploiting these constraints so that maximum output is achieved from the system. Theory of Constraints walks an organization through the crucial stages of a continuous program: the five steps of focusing; the process of change; how to prove effect-cause-effect; and how to invent simple solutions to complex problems.

The core constraint of virtually every organization is that organizations are structured, measured and managed in parts, rather than as a whole. This constraint impacts the organization through lower overall performance results, difficulty in holding a strategic advantage, financial hardships, focus on current emergencies, not meeting customer expectations, constant shifting of constraints, and conflicting views between people in different parts of the organization. Once the barriers that block those parts from working together as an integrated system are removed, significant and sustainable improvement in each and every problem area is the result. A lack of focus can cause increases in inventory, excess time and effort, and limits the productivity of the system as a whole. "The theory of constraints is an approach for enacting a process of continuous improvement that focuses on the factors that limit a systems performance." [19]

First, TOC requires that the overall goal for the organization as a whole be clearly identified and brought into focus by everyone. Next, the organization sets the course toward the goal through TOC Thinking Processes (TP). Furthermore, these "logic trees" map the path and discover the constraints. TOC identifies poor management practices and processes in an organization and ensures that the leadership recognizes which management approaches are in need of correction. By establishing a process of ongoing improvement, you derive a superior

[19] Eliyahu Goldratt and Robert Fox, *The Race* (New York: North River Press, 1986), 1.

system for generating continual logistical improvements is derived. “Determination or recognition of a system’s goal is the first and most critical task of anyone who wants to improve a system.” [20]

Systems. Systems are composed of interdependent parts, and organizations functions as whole systems. “For our purposes, we’ll consider a system to be a number of connected or interrelated elements that could be seen as working together for the overall objective of the whole.” [21] TOC is designed to improve the capacity of a system. “A system takes inputs of some kind, acts on them in some way, and produces outputs. These outputs are supposed to have a greater value than the sum of the inputs, so the system might be said to add value to the inputs as it turns them into outputs.” [22]

Constraints. Identifying constraints is critical in TOC methodology. What is a constraint? A constraint is a bottleneck or chokepoint, or “Anything that limits the organization from achieving higher performance versus its goal.” [23] TOC describes when “something is constraining your system – it keeps it from realizing its maximum potential.”[24] If the system is viewed as a chain, then the weakest link would be the constraint. “It prevents us from satisfying a necessary condition or reaching our goal, or from reaching it more quickly or decisively. Moreover, the constraints in any system are the factors that determine how much the system can accomplish” [25]

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[20] H. William Dettmer, *Breaking the Constraints to World-class Performance* (Milwaukee, WI: 1998), 5.
[21] Ibid. 3.
[22] Ibid. 3.
[23] James Michael Beck, *Applying Theory of Constraints to an Aircraft Remanufacturing Line* (Naval Postgraduate School, CA: 1993), 43.
[24] H. William Dettmer, *Eliyahu M. Goldratt’s Theory of Constraints: A System’s Approach to Continuous Improvement*, (California, 1995), 1-5.
[25] Dettmer, *Breaking the Constraints*, 6.

<u>TOC Principles.</u> The list in Figure 1 is a partial list of TOC Principles as described by H William Dettmer in his book, *Eliyahu M Goldratt's Theory of Constraints: A System's Approach to Continuous Improvement.* It provides the main beliefs of the TOC system improvement philosophy.

<u>Enacting Process Improvement</u>

Process improvement provides the unit's leadership with guidelines for identifying chokepoints within existing procedures and exploiting, or as H. William Dettmer describes it, "wringing every bit of capability out of the constraining component as it currently exists," so that maximum output is achieved from the system.[26] TOC enacts continuous process improvement and focuses on the factors that limit a systems performance. [27] Typically, the individual at the local level is not supporting the greater good. Good local performance always hurts global performance, "because of interdependence and variation, the optimum performance of a system as a whole is not the same as the sum of the local optima." [28] One must ensure that local actions are in alignment with global performance. Systems are like chains or networks of chains, and like a chain, a system's performance is limited by the performance of its weakest link.[29] The first step toward improving the system's ability to achieve the goal encompasses the unit's leadership agreeing on that ultimate goal.

<u>Strategic Planning.</u> Once the vision is defined, a strategy for how the organization will achieve its goal must be defined. This leads to a strategic plan focused on a specific goal. Three questions must be asked: What is the goal? What is the current status? What is the magnitude

[26] Dettmer, *Breaking the Constraints*, 1-7.
[27] Dettmer, *Eliyahu M. Goldratt's Theory of Constraints*, 1-9.
[28] Ibid. 1-8.
[29] Ibid. iv.

and direction of change needed? "No matter what you consider the goal, all other related factors become conditions necessary to achieving that goal." [30] A key to operational management is strategic planning, and tactical implementation of the plan comprises setting the parameters, owning the process, and rewarding behavior that positively effects the system's achievement of the organization's goal. Operational management and tactical implementation can have strategic implications and are key to the strategic plan. "After the goals and the measurement criteria are determined, management can begin the process of analyzing constraints." [31] There must be a cause-and-effect relationship between subordinates' goals, the superior's goals, and the organization's goal.

Throughput. Throughput is how we get to the goal. As the vehicle to the organization's goal, TOC's conceptualization of throughput places priority on identifying where and why delays occur in a system and on ascertaining how to alter the process to reduce or eliminate delays.[32] In other words, it is the rate at which the system achieves its goal through production and distribution, which can be beneficial to commercial industry or military logistical systems. As such, it measures the total volume of production through a facility. Figure 2 (page 23) illustrates throughput as the instrument to take the system (supply chain) to its goal of effecting aircraft readiness.

Thinking Processes. Once the goal and the vehicle to get there are decided upon a course must be set to travel to the goal. Thinking Processes (TP) help map the course toward achieving the goal. The TOC thinking process is composed of five logical tools: the Current Reality Tree (CRT), the Conflict Resolution Diagram (CRD), the Future Reality Tree (FRT), the Prerequisite

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[30] Dettmer, *Eliyahu M. Goldratt's Theory of Constraints*, 1-5.
[31] Goldratt. *Theory of Constraints*, 3-4.
[32] Chakravory and Verhoeven, *Learning the theory of constraints with a simulation game*, 3.

Tree (PRT) and the Transition Tree.[33] For the purpose of this essay, simplicity, and to serve as examples to reinforce these concepts, I will only focus on the CRT and FRT.

An organization uses the logic trees to comprehend the way business is currently accomplished, identify the Undesirable Effects (UDE) and their root causes, and implement positive change. Logic trees use blocks to describe causes that bring about a logical effect. The CRT helps determine how the system is currently operating and the undesirable effects. "The CRT is a problem analysis tool that helps us examine the cause-and-effect logic behind our current situation." [34] As a result, the FRT demonstrates what the system strives to achieve in a cause and effect in a diagram (Figure 3). This process involves using Thinking Processes (TP) or logic trees to comprehend the way business is accomplished today. Once the constraint is identified, its elimination would be pursued. From the FRT, a constraint is determined, and agreed upon by the organization's leadership and key personnel.

The Five Focusing Steps

1. Identification. Identify the system's constraint(s). The first step is self-explanatory. The constraint must be identified and then prioritized according to its effect on the system. Constraints can be categorized as either physical or policy constraints. Physical Constraints are those things in the system that limit the production capability. They can be resources that are in short supply, vendor limitations, the demand for the product, or long processing time, which affect the flow of material to the system. Policy constraints include all rules levied on the organization by management that limit the system.

[33] Dettmer, *Breaking the Constraints*, 27.
[34] Dettmer, *Goldratt's Theory of Constraints,* 1-15.

2. The Exploitation Step. Decide how to Exploit the system's constraint(s). "By 'exploit' Goldratt means we should wring every bit of capability out of the constraint as it currently exists. In other words, 'what can we do to get the most out of this constraint without committing to potentially expensive changes or upgrades?"[35] Most organizations wish to get rid of the constraint once it has been identified; instead, the system's constraints should be fully exploited so that the maximum output is achieved. In most cases it is not possible to easily or immediately eliminate the constraint. We have to live with the constraint that limits the performance of the organization. Nonproductive time for the constraint is the same as nonproductive time for the whole system. On the surface it appears that the easiest type of constraint to exploit is a policy constraint since the policies that govern an organization are controlled or influenced by management, but these constraints are the least obvious since they are imbedded in the structure of an organization. The decision of how to exploit the full potential of the constraint will place limits on all other decisions affecting the operation of the system. The constraint is the limiting factor of the system.

3. The Subordination Step. Subordinate everything else to the above decision. The subordination step is the most revolutionary step: changing the objective of the non-constraints to support the exploitation of the constraint. If other processes are not directly the constraint, they must be focused to synchronize their efforts around the capacity and pace of the constraint itself. "We adjust the rest of the system to a 'setting' that will enable the constraint to operate at maximum effectiveness."[36] The organization focuses its energies on the productivity of the constraint. For example, if the constraint is in engine production, all non-constraints should be aimed to do things that protect and enable continuous engine productions. Planning the material

[35] Ibid. 1-9.
[36] Ibid.

requirements carefully to ensure the availability of materials ahead of the constraint is a subordination process of the utmost importance. Subordinate everything else to the above decision.

4. The Elevation Step. Elevate the system's constraint(s). The fourth step is the strategic one. A constraint means a limit imposed on the organization. The term "elevate" means to elevate the limit — increase it to a higher level. If we can elevate to reduce the impact of the constraint's limiting effect, the system's performance improves. "It is not until this step that we entertain the idea of major changes to the existing system - reorganization, divestiture, capital improvements, or other substantial system modification."[37] If the constraint can be sufficiently elevated it will eventually be broken, in other words, it no longer limits the systems performance. When a test-bench is the constraint, purchasing another machine is an obvious step toward elevating the constraint. Moving from one shift to two shifts is another way of elevating the capacity of a constrained resource. "Elevating the constraint means that we take whatever action is required to eliminate the constraint." [38]

5. The Closing Of The Loop, If in a previous step a constraint has been removed, return to step 1, but do not allow inertia to cause another constraint within the system. The fifth step includes a warning. Elevation of a constraint may shift the system constraint somewhere else. If in the previous steps a constraint has been broken, go back to the first step. The constraint that has been broken in the preceding steps will no longer be the limiting factor in the system, but there will be other constraints on the system.[39] Should the global performance of the

[37] Ibid. 6.
[38] Ibid. 8.
[39] Captain Lynn A. Sines, USAF, *Comparison of the Operational Characteristics of the Theory of Constraints and Just in Time Scheduling Methodologies*, (Air University, Air Force Institute of Technology, Ohio: 1991), 2-8.

organization improve when the constraint is elevated, then the process in question is a genuine constraint.

The five focusing steps are an ongoing process and a dynamic problem-solving tool. The focusing process is iterative: once a constraint is identified, exploited, and broken, a new constraint is identified and the process continues. Only when you find and fix the weakest link do you find other constraints, and then the organization positions the constraint where they want and can best manage it. "No matter how much effort you put into improving the processes of a system, only the improvement to the weakest link will produce any detectable system improvement."[40] The goals of the organization will drive the decisions of how to manage the system's constraints.

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[40] Ibid. Preface.

TOC Principles

- Systems thinking is preferable to analytical thinking in managing and solving problems.

- An optimal solution deteriorates over time as the system's environment changes. A process of ongoing improvement is required to update and maintain the effectiveness of a solution.

- If a system is performing as well as it can, not more than one of its component parts will be. If all parts are performing as well as they can, the system as a whole will not be. THE SYSTEM OPTIMA IS NOT THE SUM OF THE LOCAL OPTIMA.

- Systems are analogous to chains. Each system has a "weakest link" (constraint) that ultimately limits the success of the entire system.

- Strengthening any link in a chain other than the weakest one does NOTHING to improve the strength of the whole chain.

- Knowing what to change requires a thorough understanding of the system's current reality. its goal, and the magnitude and direction of the difference between the two.

- Most undesirable effects within a system are caused by a few core problems.

- Core problems are almost never superficially apparent. They manifest themselves through a number of undesirable effects (UDE) linked by a network of cause-and-effect.

- Elimination of individual UDEs gives a false sense of security while ignoring the underlying core problem. Solutions, which do this, are likely to be short-lived. Solution of a core problem simultaneously eliminates all resulting UDEs.

- Core problems are usually perpetuated by a hidden or underlying conflict. Solution of core problems requires challenging assumptions underlying the conflict and invalidating at least one.

- System constraints can either be physical or policy. Physical constraints are relatively easy to identify and simple to eliminate. Policy constraints are usually more difficult to identify and eliminate, but they normally result in a larger degree of system improvement.

- Inertia is the worst enemy of a process of ongoing improvement. Solutions tend to assume a mass of their own which resists further change.

- Ideas are NOT solutions.

Figure 1

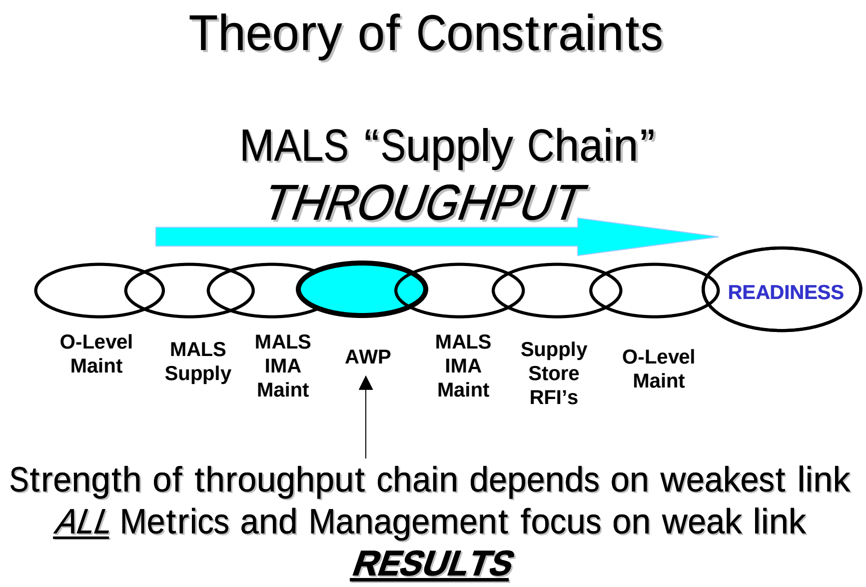
Theory of Constraints
MALS "Supply Chain"
THROUGHPUT
READINESS
O-Level Maint
MALS Supply
MALS IMA Maint
AWP
MALS IMA Maint
Supply Store RFI's
O-Level Maint
Strength of throughput chain depends on weakest link
ALL Metrics and Management focus on weak link
RESULTS

Figure 2

Chapter III

Recommendations

The Transformation of Aviation Logistics requires the application of continuous process improvement to the Marine aviation logistics system, without requiring additional resources, money, or manpower. The current methods of pursuing efficiency at the expense of effectiveness, and the reactive metrics used to measure combat capability highlight the flaws in the naval aviation logistics methodology to support aircraft. In order to positively influence aviation logistics by improving our support system, which will increase combat readiness, we require a vision and a strategy to get to that goal. The requirements of aviation logistics must be validated by the leadership of the Marine Corps with input of all the military services for future integration in joint logistics programs. The methods of great businesses along with TOC are the tools to transform aviation logistics for viability in the future, and it teaches us where our management approaches are flawed.

The Marine Corps prides itself on its tradition of fostering great leadership characteristics in its Marines. In the same way, aviation logistics must apply both characteristics and use each to balance the other. The strategy for improving how Marine Corps Aviation sustains its aircraft must embrace improving leadership and managerial skills. "Leadership is about coping with change, while management is about coping with complexities."[41] Ultimately both, in different ways, will decide what needs to be done, create networks of people to accomplish the mission, and ensure that the job gets completed.[42] The commander, his staff, and the officers and staff noncommissioned officers in the MALS will guide the transformation responsible for

[41] John Kotter, "*What Leaders Really Do*", *Harvard Business Review*, December 2001, 86.
[42] Ibid.

subordinate departments and divisions must take the lead in reaching the MALS goal of increased aircraft readiness.

Apply Great Business Practices

In the past, DoD policy stipulated that the military services establish organic support for the logistical sustainment of new major weapon system end items as soon as possible after fielding. Specifically, DoD Directive 1130.2, *Management and Control of Engineering and Technical Services*, required the military to achieve self-sufficiency in maintaining and operating new systems as early as possible and limited the use of contractor field service to 12 months thereafter. The purpose of this directive was to ensure the military services did not come to rely too heavily on the use of civilian technicians to support their systems. Today, the directive is no longer in force. Congressional language now requires that maintenance and repair for all new major weapon systems be under contractor support for at least four years.[43]

With the decline of manpower as a result of the military drawdown, the Marine Corps needs to consider privatizing more of its organic maintenance support through “contracting out”. In the past, maintenance functions required a military or organic capability because it was combatant in nature, and required potential deployment into harm’s way. In light of the directive changing to four years of contractor support for a new weapon system, there exists the opportunity to privatize organic support.

Downsizing has made it a necessity that contractor personnel go to the deployed site to support their weapon systems and perform functions the same as military members. The greatest

[43] Air Force Congressional Issue Papers Extract, *Outsourcing and Privatization* (Dept. of the Air Force, Wash. D.C. 1998), 2.

risk is that the contractor will not be there to perform or will leave when hostilities break out. As a result of downsizing, privatization, and modernization, there are no DoD resources available to fill potential voids. Legally, contractors cannot be compelled to go into harm's way, even when under contract, unless there is a formal declaration of war. The point is contractors do not have to stay, and the DoD needs to work to minimize the risk that fact presents. There is no doubt that the systems supported and the functions being accomplished are prosecution of the battle. But, without contractor support, the unit the contractor supported may experience mission degradation.

Competitive Sourcing and Privatization (CS&P) is essential to meeting future support requirements. Outsourcing lowers costs, streamlines the labor force, and facilitates access to cutting-edge technologies. By partnering with industry, the Marine Corps can buy aircraft with much greater capabilities and realize force structure cost savings because of the fewer number of Marines required to turn wrenches through the use of outsourcing. The DoDs experience with competitive sourcing and privatization seems to confirm savings are substantial when comparing organic support to contractor-provided support. Cost comparisons conducted between 1978 and 1994 show savings of about $1.5B a year. The military departments and defense agencies that took advantage of outsourcing via competition have reduced their annual operating costs by about 31 percent.[44]

Interestingly, outsourcing and privatization are really not new concepts at all. Prior to World War II, the US military routinely relied upon the private sector for much of its support. Former Secretary of the Air Force, Sheila Widnall, commented: "Lest you think this is a new

[44] Department of Defense, Office of the Undersecretary of Defense for Public Affairs, News Release No. 185-96, Washington DC, 4 Apr 96.

phenomenon, let me take you back to the era before World War II when private support was standard. It was only during the Cold War when we realized the huge buildup of government operations that we came to think of government support as the norm. In a sense, we're going 'back to the future'."[45] A case in point is the Douglas Aircraft Company. During World War II, Douglas Aircraft set up a factory in North Africa for the dual purpose of conducting the final assembly of aircraft and performing aircraft maintenance and repair.[46]

<u>Combat Readiness and TOC – the Smart Business Approach.</u>

Achieving combat capability through smart business practices provides the rationale for using TOC. "Sustained competitive advantage in such a turbulent environment calls for a process of continuous improvement."[47] TOC defines the throughput to the goal in aviation logistics - increased aircraft readiness – as the entire chain of events: filling all required aeronautical parts to the flying squadron now and in the future, on-aircraft troubleshooting, on aircraft maintenance, quality control, production control in the MALS, repair (production) within the MALS, and scheduling within the MALS.

TOC best applies to production and distribution organizations. The MALS provides production through their Intermediate Maintenance Activity (IMA), and distribution resides with the Aviation Supply Department for the MAG. The MALS, in its entirety, gives intermediate level logistics support to the MAG through third and fourth echelon maintenance and aviation supply support. TOC enhances combat readiness by identifying typical production problems: missed due dates, priorities are constantly shuffled, difficulty responding to urgent orders,

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[45] Sheila E. Widnal, *Privatization-A Challenge of the Future*, Remarks at McClellan AFB, CA, 7 February 1996.
[46] "Outsourcing and Privatization," 1998 Air Force Congressional Issue Papers Extract, undated.
[47] Chakravory and Verhoeven, *Learning the theory of constraints with a simulation game*, 223.

frequent material and parts shortages, too much expediting, production lead times are too long, and when the backlog is too high. TOC deals with common distribution problems as well, for instance, frequent out-of-stock conditions, and too many emergency shipments. Finally, TOC challenges the typical assumptions - that good local performance means good global performance, and a resource standing idle is a bad thing - if the local performance does not improve the performance of the constraint and the system achieving its goal.

Reduce Levels of Maintenance

Every organization has a goal. To get to that goal requires a vision and a strategy or philosophy to get there. The aviation logistics organizations have artificial barriers that consume resources with short term performance targets that do not allow them the time to plan for long term success, or they have future plans but are faced with difficulties of balancing risks of change with the opportunities they create – if it aint broke, don't fix it!" The MALS is an example of a complex system, because as a production and distribution unit, it is designed to sustain and support Marine Corps Aircraft, so they are ready for training and operations. That being said, every system has constraints. "All systems – commercial corporation, not for profit or government agencies, even families – operate under constraints."[48] This is where the utility of TOC comes in.

Naval Aviation's current three level maintenance structure (organizational, intermediate, and depot) needs to transform before the next generation of aircraft are delivered to the fleet. Current initiatives within the depots to support existing weapons systems such as the Integrated Maintenance Concept, Reliability Centered Maintenance, and Contractor Logistics Support, as

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[48] H. William Dettmer, *Breaking the Constraints to World-class Performance,* (ASQ Quality Press, Milwaukee, WI: 1998), 6.

well as the introduction of new platforms like the MV-22B Osprey, F-35 Joint Strike Fighter (JSF), and C-130J Hercules, with new logistical support that includes power by the hour, and contractor sourced repair are changing the requirement for MALS level logistical support. Intended to improve aircraft readiness while reducing operating cost and deployment footprint, these concepts are the emerging examples upon which future Marine aviation programs will be modeled.

These new logistic support programs will eliminate repair tasks normally carried out by the MALS. As legacy platforms are phased out, Marine aviation will move to a two-tiered maintenance structure of tactical and depot/contractor levels. What exactly will become of the excess force structure is unclear. There have been various recommendations to have all tactical level logistics support at the organizational level or to consolidate all logistics functions in one command. It is estimated that over 2000 maintenance billets from the current structure will be eliminated.[49] Within the Marine Corps aviation community, there is concern that a large scale reduction to MALS manning would severally restrict the flexibility of the Marine Corps' aviation maintenance capability.

As aircraft age, they become increasingly more difficult to maintain: Aircraft structure and avionics systems degrade through prolonged applications of stress and fatigue. Typically, this results in increased maintenance man-hours per flight hour and decreased aircraft reliability. To reverse this trend, preventive maintenance must be carried out in an effort to stop faults from developing into costly repairs or impeding flight safety. Within the Naval Aviation Maintenance Program, these inspections are done at the Organizational level (O-level) by highly trained technicians. As aircraft age, the frequency and duration of these inspections increase and

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[49] Diaz, *A Modest Proposal for the Future of Aviation Logistics,* 40.

eventually infringe on the operational availability of the aircraft. At this point, a balance between maintenance and operations must be reached to ensure properly maintained aircraft and combat trained aircrew for the MAGTF.[50] This balance is under constant pressure due to continually changing priorities that are influenced by a shortage of spare parts, maintenance personnel, and time. Due to the dynamic nature of the O-level, this delicate balance is sometimes lost, and the squadron commander must redefine his priorities, resolve disputes, and restore the balance.

New technologies and business practices are changing the way the military procures, maintains, and supports its aircraft. As new aircraft with increased capabilities and reliability enter service and computer technology becomes further integrated with maintenance procedures, Marine aviation is left with little choice but to consider changing its 20th century philosophy of maintaining aircraft which support new technologies in a 21st century environment. For aviation logistics to improve, we must apply scientific principles and the rules of logic to the support processes within the MALS. The result will be more available mission capable aircraft, increased combat readiness within the MAG at no additional cost or manpower, all of which can be accomplished by transforming our processes into a simple focused methodology. Improvement starts with the leadership: "The steps required to adopt and manage a process of ongoing improvement are a management responsibility."[51]

Technological and logistical changes have had an impact at reducing the requirement for I-level repair. Efficiencies and cost savings can be gained by naval aviation transitioning to a two level maintenance concept. Although I level repair of components will be reduced, the I-level as an organization must continue as the organization that supports the operational level squadrons.

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[50] Deputy Commandant for Aviation, *"Marine Aviation Campaign Plan"* Washington, D.C., 2002, 23.
[51] Goldratt and Fox, *The Race,* 35.

Another factor that likely will not change in aviation maintenance is that aircraft age, and over time require more maintenance. The I-level is the one organization that is best suited to be flexible and adaptable to the changes in maintenance and logistic support as aircraft age, depot and manufacturer support changes with funding, personnel, and contracts over time.

As the focus of support moves from the O-level to the I-level, the squadrons will retain the flightline servicing, launch, and recovery of aircraft with much smaller line maintenance shops. Where the I-level role should expand is in the performance of scheduled inspections, modification, and repair of aircraft after mishap or combat damage. The transition to the Integrated Maintenance Concept where depot level maintenance and inspections are performed at the home base, MALS will need to evolve into an organization that supports and deploys detachments with the operational squadrons to maintain aircraft and perform all logistical functions for the squadrons. As part of this effort the I-level of maintenance should focus less on repair of retrograde material and more on repair, preventive maintenance, and inspection of the aircraft and major components, leaving the component re-work to the depot level.[52]

Reducing the number of levels that currently perform aviation maintenance would be beneficial because it will increase maintenance effectiveness and efficiency while simultaneously reducing the current logistics footprint and costs. For example, the process of repairing parts, usually done by Marine technicians at the I-level, is eliminated due to delivery of parts from the vendor directly to the squadron. The processes sing of parts, usually done by supply Marines, is eliminated due to delivery of parts from the vendor directly to the squadron. In both situations parts repair, inventory, and delivery is the responsibility of the vendor. The elimination of these two functions removes a layer from the logistics process.

[52] Deputy Commandant for Aviation, *"Marine Aviation Campaign Plan"* 8.

A two-level maintenance concept will also reduce manpower needs, and maintenance and supply effectiveness and efficiency will be increased. Logistics efficiency and effectiveness will benefit through aircraft that incorporate more replaceable components vice a large quantity of smaller piece parts have a smaller inventory to store and keep track of which reduces the logistic footprint. Advanced technology, Rear Admiral Bennitt said, "will minimize maintenance requirements, reduce infrastructure, and lower manning levels due to the development of more reliable, repairable, and automated systems."[53]

This transition is most apparent with the entry of the MV-22 Osprey, the KC-130J, and the F-35 Joint Strike Fighter aircraft into Marine inventories; these aircraft will be less maintenance and supply intensive than our existing inventory of fixed-wing and rotary-wing aircraft, thereby effectively negating the requirement for three levels of support. Data will be downloaded and transmitted to maintenance and supply systems to provide information to technician and logisticians to assess the system's performance, make any adjustments, diagnose malfunctions, order parts, and make repairs. The data also interfaces electronically with the supply source so that the correct part can be identified, ordered, and provided, all without the need for error-prone manual input of data. Compared to the way maintenance is conducted today, newer aircraft technologies offer the convenience of less maintenance and less parts inventory.

The MALS will continue to play a vital role in aviation logistic support to the MAG, but external changes in aviation logistics will affect its role. Design technology plays the biggest role in what maintenance and repair will be done at the MALS level. Computerization and miniaturization will continue to reduce the repair work that can be done in the field, and self diagnosis of faults will allow more predictability of material requirements. I-level maintenance

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[53] RADM Brent M. Bennitt, "Making Joint Fleet Aviators," *Naval Aviation News 76,* No.6 (Sept-Oct 1994), 1.

will depend on remove and replace actions rather than troubleshooting, repair and adjustment. Because of these changes in maintenance there will be greater emphasis on supply issue retrograde of material and multi-skilled technicians.

One of the keys to providing a better way of performing maintenance lies in the strategy of providing the right responses, the right parts, the right people, and the right skills in order to ready the aircraft for the next mission. During the 1990’s the United States Air Force (USAF), exerted considerable effort in recognition of the advent of technological innovation to move the Air Force maintenance philosophy from three levels of maintenance to two. Much like the Marine maintenance concept, Air Force organizational-level maintenance performs aircraft servicing, minor repair of structures, and the removal and replacement of defective components. Air Force intermediate-level maintenance troubleshoots defective structural, electro-mechanical, or avionics components using extensive layers of personnel and support equipment. Depot-level maintenance shops consolidated at three major installations in the continental United States to perform repairs or modifications beyond the organizational or intermediate level. Field teams can be deployed to the on-site location when it is not feasible to return the aircraft to the depot.

In 1992, the Air Force commissioned the Rand Corporation to conduct a study of the feasibility of converting from three levels of maintenance to two levels of maintenance.[54] The Rand Study concluded that two-level maintenance would save resources and still meet all the Air Force’s needs. Air Force aircraft maintenance for most avionics and engines now utilizes two levels of maintenance versus the previous three levels of maintenance. Avionics and engine maintenance previously done by the intermediate level is now done either on the flight line or in

[54] J.B. Abell, and H.L. Shulman, , *Evaluations of Alternative Maintenance Structures* (Rand Corporation Rep No. R-4205-AF), Santa Monica, CA: Rand Corporation, 1992, 19.

depot repair shops. Under two-level maintenance, depot repair is tied directly to the Air Force flight-line and unit sortie generation capabilities. Readiness is maintained by improving pipeline processes, moving repairable items to depot repair centers using high velocity parts movement, and state-of-the-art communications and computers for in-transit visibility and control of assets. The results of the RAND study are driving the Air Force to rely on contractor support, at least during the initial fielding phase of a system if not possibly for the entire life of the major weapon system.

The specifics involved in standing up the MALS(F) vary since they are aircraft dependent. In particular, the aircraft induction interval, authorized inspection depth, team composition, and team size all require thorough examination to ensure the right combination. Capable of performing both large-scale repairs and incorporating technical directives, the MALS(F) would focus on aircraft health. It could fix discrepancies that remain uncorrected at the O-level due to time constraints or depth of repair. The MALS(F) would utilize a number of avionic, powerplant, and egress technicians, but would consist primarily of airframe trained Marines. The aircraft would come to the MALS-(F) on a scheduled interval that could be coordinated to occur in conjunction with other scheduled events such as depot level work under the integrated maintenance concept (IMC).

The single biggest benefit of the MALS(F) concept is improved aircraft material condition and therefore, readiness. The sooner a problem is diagnosed and corrected, the less likely it will develop into a serious fault that could adversely affect aircraft readiness. Tables one and two are provided to illustrate this point. The MALS detailed inspections are carried out, discrepancies are repaired, and modifications incorporated. This maintenance is carried out in an environment void of the competing pressures experienced by the O-level squadron.

Another benefit is the savings gained from a reduction in depot-assisted repairs and a streamlined maintenance training system. On-aircraft work provides an excellent opportunity for enlisted Marines to expand their knowledge and understanding of their trade. Unlike the O-level, where technicians spend much of their day preparing and launching aircraft, the MALS(F) would present improved chances for learning advanced aircraft repairs. This further enhances each Marine's on-the-job (OJT) training opportunity. Additionally, the aviation maintenance training system would need to undergo changes to include the increased requirement for O-level trained personnel at the MALS(F).

Each squadron has, on average, one hard-down aircraft at all times, and that is often referred to as the "hangar queen", and is cannibalized for parts. It takes great maintenance effort only after several days of dedicated effort, provided the necessary parts can be found is the aircraft able to fly. Instead of sitting neglected in a hangar at the O-level, this aircraft could be moved to the MALS to undergo inspection at the MALS-(F). During the inspection, aircraft parts could be removed for cannibalization by the O-level on an as needed basis. Cannibalized parts would be replaced at the end of the inspection cycle from supply stock or the next aircraft entering the cycle.

Change is a necessary part of any organization, and just like today's successful corporations, other organizations must adapt to remain viable. The Naval Aviation Maintenance Program is no different and faces many hard choices over the coming years. The next generation of Marine Corps aircraft will dramatically change the structure of the MALS as new logistics concepts emerge. To remain flexible and keep pace with change, our programs must adapt. The best option in light of these changing times is the creation of a MALS(F).

A reduction of on-hand spare parts due to on-aircraft monitoring and replacement before failure with just-in-time delivery of parts from the manufacturer, aviation supply can be much smaller than the current supply department of the MALS. In reorganizing the MALS, there needs to be a reduction of occupational specialties to airframes, powerplants, avionics, and ordnance by type aircraft. Current MALS staffing require Marines with similar skills in their occupational field (e.g., avionics and airframes) to support the maintenance effort.

Detailed self-diagnosis systems allow technicians to rapidly identify defective components and aid in subsequent repair. Microcircuit maintenance allows the technician in the squadron to repair or replace a damaged component resulting in a significant reduction of intermediate-level maintenance needs. Further, it would reduce the need to maintain costly spare part inventories and expensive test equipment. The reduction of repair requirements at the I-level will allow this organization to focus efforts on phase inspections, and depot level repairs, upgrades, and modifications, and for the flying squadrons to focus efforts on sortie generation. Staffing of the MALS and the squadrons with the same type aircraft MOS's will allow movement of technicians between levels, allowing greater flexibility in assignment for rotation purposes, training, and operational requirements. Additionally the I-level could have a percentage of billets filled by depot, OEM, or contractor personnel for continuity of skill, training providers, IMC, forward deployment needs of military personnel, etc.

Contingency Support Packages

In order to sustain the ACE from the seabase, resources will be acquired from sources internal or external to the ACE through reach-back capabilities that will ensure accessibility to distant resources and may even employ commercial carriers to expedite deliveries. ACE supply systems will need to connect with Joint, automated systems that can identify, request, acquire, track, receive and distribute resources through total asset visibility. Once located, the ACE will assign assets to move and distribute resources in support of itself and of the MAGTF as a whole. Deliveries will be tailored into specific support packages that maximize "in-time" delivery and economy of lift. ACE maintenance provides the actions necessary to classify discrepancies, perform necessary repair or modifications, and dispose of unusable material.

A reduction of on-hand spare parts due to on-aircraft monitoring and replacement before failure with just-in-time delivery of parts from the manufacturer or depot will result in a much smaller aviation supply department than the current supply department of the MALS. Increasing need for forward basing of material and integration of joint DoD aviation logistics support will require the CSP's to have greater focus on rapid movement to the theater of operations the spare material required, as well as establishing priority and movement of repair and retrograde material to and from the CONUS supply centers. The RESP should become the focus as the primary building block of the CSP since the requirement for I-level repair is eliminated and the savings in lift required for the MALS MMF's is shifted to more material. The shift in focus to the RESP will drive the requirement to develop smaller, lighter shipping containers that can be moved more readily by a variety of means to forward operating areas.

MPF(F)

The current aviation logistics ships are primarily used for transport of maintenance facilities that perform aviation material repair at sea, pier side, or when offloaded and established at an airfield. The transition to two-level maintenance will have a positive impact on requirements for MPF(F). These changes will require less deployed manpower, facilities, and equipment and replace them with additional assemblies and components for repair of aircraft and major end items such as engines and result in increased need for faster cycle time of retrograde, repair, and return to the seabase. This change in concept will result in a reduction of the logistics footprint which is especially important in the early stages of a conflict when airlift assets are scarce and before a sea-lift bridge can be established.[55] These ships must be capable of supporting the ACE with hangar space for conducting maintenance. The MPF(F) sea-base must support air operations (flight deck, elevator, lighterage and selective offload), and the MV-22/CH-53E must be able to access the sea-base and transport MAGTF supplies. In order to provide maintenance and logistic support for the ACE it must be determined what on aircraft maintenance capabilities will reside on each ship.

Increasing the shelf life of aviation material in order to pre-load and pre-position essential supplies and capabilities aboard the sea-base will support rapid force closure, expeditionary operations, and reconstitution. Follow-on sustainment should be effectively provided by a robust reach back capability that ensures cycle-time of material is less than 30 days to/from any location in the world. The transformation that technology and modern logistic methods bring, will result in less need for I-level maintenance of components in the theatre of operations. This in turn will require increased movement and staging of repair material forward on the MPF-F ships and a theater support base to get items to the seabase, in addition to dedicated transport between the MPF-F ships, theatre support base, and CONUS to maintain a flow of logistic support. As a result, systems that predict, measure force requirements, and prioritize need must be established. Due to competing needs for transportation support of material between the services should be a

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[55] Dr. Jan P. Muczyk, "*The Changing Nature of External Threats, Economic and Political Imperatives, and Seamless Logistics,* 15 Mar 2000.

driving factor in more fully integrating the logistics system within DoD, particularly aviation logistics.

The primary function of the air capable MPF(F) ships will be to serve as an in theatre logistics hub for material being sent forward to operational squadrons and for the retrograde of material requiring depot or manufacturer rework and repair. The secondary function of the MPF-F ships is for the I-level to conduct phase inspections, major component removal and installation, test and check, and field level depot repair as necessary to return aircraft to service after minor mishaps or battle damage. MPF(F) should combine the requirements for sea based logistics as envisioned in the employment Expeditionary Maneuver Warfare. A fully air capable MPF(F) ship will also be utilized to move equipment and material from the sea based assembly area to the objective area. In addition a ship of this type should be capable of moving material between ships as called out for in the sea basing conceptual documents. The MPF(F) ship will serve as the link from the forward operating tactical units to the theatre support base for the movement of repair material and retrograde parts to and from CONUS based depots and industrial activities.

Chapter IV

Conclusion

The Marine Aviation Logistic Support Program must evolve as part of an integrated and joint aviation logistics system within DoD. The Marine Corps must work with all services to develop a system where the flow of material to and from the war fighter can be prioritized and expedited from any point in the logistic chain. MALSP must be configured with smaller building blocks that can support all types of aircraft in a detachment at a remote expeditionary site to multiple squadrons of rotary-wing and fixed-wing aircraft as part of the MEF ACE. The result of the recommended actions for transformation will require our current systems and new weapon system technologies to use demand pull logistics. MALSP must be part of an enterprise-wide approach of applying best practices to the entire DoD aviation logistics system. The recommended changes will allow the Marine Corps to uniquely tailor the requirements for an improved aviation logistics system.

The desire to continually look for better methods to project combat power is the cultural foundation of the Marine Corps. This passion for excellence has been the catalyst for new technologies throughout the Marine Corps and nowhere more than in the aviation community. From the days of World War II in the Pacific Islands to today in Southwest Asia, Marine Corps aviation has evolved to meet the demands of combat. This evolution has fostered improvements in aircraft that have grown progressively more complex as a consequence. These complex aircraft systems have placed increasing pressure on the maintenance organization created to support them. Over the years, the Naval Aviation Maintenance Program, has evolved to keep pace with the technological advances in aircraft, and require significant change in order to support the next generation aircraft.

Current Marine Corps aircraft operate on yesterday's technology while at the same time new technologies are incorporated into avionics, engine, and structural components. The new technologies incorporated into existing aircraft along with introduction of new aircraft highlights the possibility of contractor support and the ability to transition from three-level maintenance to a two-level maintenance concept. Maintenance and supply governs the tempo and power of operations. We have to think about the partnership of maintenance and supply (government and civilian vendors) because they are the enablers for sortie generation. "As we select our forces and plan our operations… we must understand how logistics can impact on our concepts of operation.... Commanders must base all their concepts of operations on what they know they can do logistically."[56]

We should remember that since the amount of logistics support available to any commander is limited, the commander who utilizes his limited resources most efficiently will have the greatest freedom of action and combat capability. Real knowledge in this context is deep knowledge, not simply how long it takes a component to move from A to B, or the number of Marine maintainers to repair a component, but an understanding of the likely behavior and response of the logistics system in the face of the real demands, of real operations, as they develop and as they are executed. "At the tactical level… commanders and logisticians must plan and execute… aviation-peculiar logistical operations. These logistical operations must sustain the ACE as it provides support to the MAGTF anywhere in the world."[57]

[56] Diaz, *A Modest Proposal for the Future of Aviation Logistics*, 40.

[57] *MCWP 3-2,"Aviation Logistics"*,(Wahsington.D.C. HQ USMC, 23 October 1998), 6-1.

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