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Defining Self-Sufficiency in the United States Marine Corps

18 October 2013

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Abstract

The purpose of this project is to define *self-sufficiency* as it relates to the Marine Corps, identify the primary elements of self-sufficiency, and describe the interrelationships among these elements. Upon reviewing applicable literature, we found three primary elements of self-sufficiency: environment, time, and supply chain. After analyzing these elements and their interrelationships, we present a framework of self-sufficiency that (1) Marine Corps units can apply to internally increase their self-sufficiency and (2) others can use to conduct further in-depth research on how to increase or optimize Marine Corps units' self-sufficiency.

Keywords: Self-sufficiency, supply chain, Marine Corps, environment, time, sustainment, expeditionary energy

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Table of Contents

I. Introduction 1

A. Motivation 1

B. Research Project Objectives 1

C. Research Questions 1

D. Scope 1

E. Methodology 1

F. Structure of the Project 1

II. Background 3

III. Literature Review 5

A. Marine Corps Doctrine 6

1. Expeditionary Identity 6
2. Maneuver Warfare 6
3. Marine Air-Ground Task Force 6
    a. Marine Expeditionary Force 7
    b. Marine Expeditionary Brigade 8
    c. Marine Expeditionary Unit 8
    d. Special Purpose MAGTF 8
    e. Air Contingency MAGTF 8
    f. Summary of MAGTFs 8
4. History of Logistics 9
    a. Pre-Modern Armies 9
    b. Modern Armies 9
    c. Industrial Revolution 10
5. Levels of Logistics 10
    a. Strategic-Level Logistics 11
    b. Operational-Level Logistics 11
    c. Tactical-Level Logistics 11
    d. Relationships of Different Levels of Logistics 12
6. Emerging Trends 13

a. Expanding Battlespace 13
b. Continuing Compression of Reaction Time During Operations 14
c. A Wide Variety of Missions 14
d. Expanded Use of Advanced Technology 14
e. Integration of Military Logistics With the Commercial World 14
7. Measuring Self-Sufficiency 15
B. Marine Corps Literature 15
1. The Current Context 15
2. How Did the Marine Corps Get Here? 16
a. Increased Reliance on Equipment 16
b. Forward Operating Bases 17
c. The Mission 17
IV. Analysis 19
A. Introduction 19
B. Defining the Elements 20
1. Environment 20
2. Time 21
3. Supply Chain 22
C. Interrelationships of Elements 23
1. Environment and Supply Chain 23
2. Supply Chain and Time 26
3. Time and Environment 27
D. Effect of Each Element on Self-Sufficiency 28
1. Environment 28
2. Time 29
3. Supply Chain 29
V. Conclusions and Recommendations 31
A. Conclusions 31
B. Recommendations 32
References 33

List of Figures

Figure 1. Representation of the Literature Review 5

Figure 2. Organizational Chart Outlining the Core Elements of the Marine Corps MAGTF 7

Figure 3. Focus of Each Level of Logistics 12

Figure 4. The Flow of Requirements and Support From the Different Levels of Logistics 13

Figure 5. The Current State of the Marine Corps With Regard to Its Expeditionary Roots 16

Figure 6. Relationship Among Self-Sufficiency and Its Elements 19

Figure 7. Interrelationships Among the Elements 23

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List of Acronyms and Abbreviations

ACE	Aviation Combat Element
BLT	Battalion Landing Team
BSSG	Brigade Service Support Group
CE	Command Element
CMC	Commandant of the Marine Corps
COIN	Counterinsurgency
CSSE	Combat Service Support Element
DOS	Days of Supply
EXFOB	Experimental Forward Operating Base
FOB	Forward Operating Base
FSSG	Force Service Support Group
GCE	Ground Combat Element
IT	Information Technology
MAG	Marine Air Group
MAGTF	Marine Air-Ground Task Force
MAW	Marine Aircraft Wing
MCDP	Marine Corps Doctrinal Publication
MCWP	Marine Corps Warfighting Publication
MEB	Marine Expeditionary Brigade
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MOS	Military Occupational Specialty
MSSG	MEU Service Support Group
OPTEMPO	Operational Tempo
ROMO	Range of Military Operations
SPMAGTF	Special Purpose MAGTF
USMC	United States Marine Corps

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I. INTRODUCTION

A. MOTIVATION

The definition of *self-sufficiency* is highly dependent on context. The Marine Corps expeditionary energy literature has popularized the term *self-sufficiency* in recent years. However, what does it truly mean to be self-sufficient? In each instance, the term could have a different meaning depending on the person who is asked. How do we put a definition to one term that applies to many different situations? (It is a question that we continually struggled with in the process of this research.) This question is the focus and driving factor for this paper.

B. RESEARCH PROJECT OBJECTIVES

1. Define *self-sufficiency* as it relates to the Marine Corps.
2. Identify and define the elements of self-sufficiency.
3. Analyze elements of self-sufficiency and their interdependence.

C. RESEARCH QUESTIONS

1. How does one define self-sufficiency?
2. How does self-sufficiency relate to the Marine Corps?

D. SCOPE

The scope of this project is limited to defining self-sufficiency as it relates to the Marine Corps. It encompasses a selective literature review and personal experiences of the authors to determine the factors that influence the Marine Corps' ability to be self-sufficient during military operations.

E. METHODOLOGY

This project utilizes a selective review of Marine Corps doctrine and literature to define self-sufficiency. Using our own personal military experiences, we then analyze the information provided in the literature review and apply it to the current operating environment of the Marine Corps.

F. STRUCTURE OF THE PROJECT

In Chapter I, we introduced our research topic by explaining our motivation, research objectives, research questions, scope of our research, and methodology. In Chapter II, we briefly discuss the background related to self-sufficiency. In Chapter III, we provide a selective literature review. In Chapter IV, we analyze the information from the literature review, identify trends, and use those trends to provide a

framework of self-sufficiency that can be generally applied to the Marine Corps. Finally, in Chapter V, we attempt to define *self-sufficiency* as it applies to Marine Corps operations and identify further research opportunities.

II. BACKGROUND

At the Marine Corps Energy Summit in 2009, then Commandant of the Marine Corps (CMC) General James Conway made expeditionary energy the top priority for the Marine Corps. Throughout the Marine Corps' analysis on minimizing the need for liquid logistics, the scope of the conversation grew to include increasing self-sufficiency for the Marine Corps. Currently, self-sufficiency is highly dependent on fuel and water requirements, because of their influence on day-to-day operations, and on supply lines to meet these needs. But what happens when the theater of operations changes? The ability of the Marine Corps to decrease the vulnerability of its supply lines requires an increase in the self-sufficiency of its Marines and ultimately its units. That is, the less reliant that Marines are on external support requirements, the less strain and vulnerability that exists on the supply chain.

As often happens with requirement generators, they envision a specific end state, but it is difficult to put into words how to achieve that end state. The term used to describe this end state is *self-sufficiency*. But what is self-sufficiency? What are the factors that influence it? How does one measure self-sufficiency? To what context is this term being applied?

These questions are a basis for this project, in which we attempt to define the term *self-sufficiency*. In doing so, we plan to improve understanding of this term, aiding others to improve practices within military logistics through a common understanding.

In this project, we use three perspectives to build a framework for defining self-sufficiency: environment, time, and supply chain. We chose these perspectives because they are commonly associated within applicable literature. We further expound on these perspectives within our analysis.

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III. LITERATURE REVIEW

This literature review provides the knowledge necessary to analyze and assist in defining *self-sufficiency*. The review incorporates Marine Corps doctrine as the baseline understanding of how the Marine Corps operates and logistically sustains its units. Figure 1 outlines the organization of the literature review. The first subsection in the review looks at how the Marine Corps operates to frame the nature and conditions levied upon Marines. Due to the relationship between self-sufficiency and logistics, Marine Corps Doctrinal Publication (MCDP) 4, *Logistics*, is the source of much of this portion of the literature review.

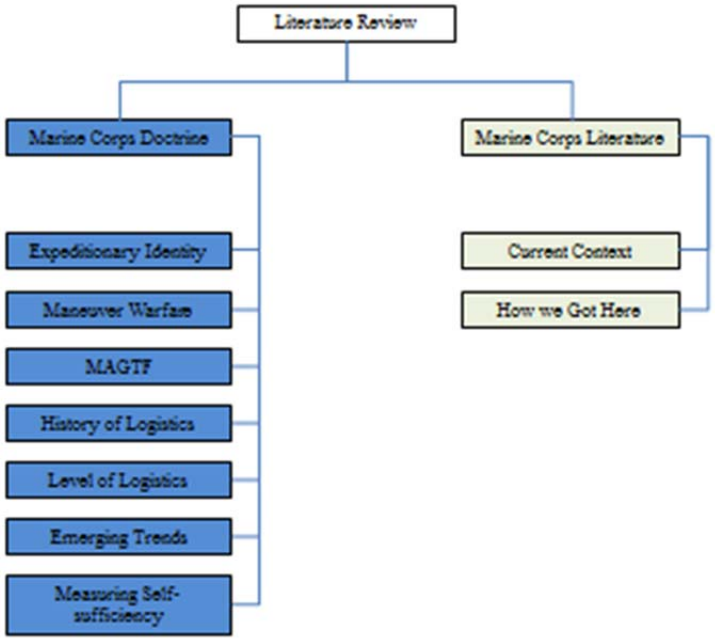

Figure 1. Representation of the Literature Review

After studying Marine Corps doctrine, we present the next subsection, which covers the Marine Corps literature. The subsection offers an overview of the current literature that has emphasized self-sufficiency within the Marine Corps. Most of this literature deals with the use of resources at the tactical level and how they affect the operational and strategic levels. Most of the literature reviewed in this subsection comes from recent discussions on energy and water efficiencies.

A. MARINE CORPS DOCTRINE

Marine Corps doctrine is a forum for ideals that the organization holds. It is not directive in nature but more of a case study of past experience and lessons learned that can be easily applied in today's environment. It talks in broad terms to help Marines understand the cultural aspects of the functional areas of the Marine Corps that traditionally stand the test of time. Doctrine is a place to find the spirit of an idea or concept. One will not find a direct definition in doctrine but rather a framework that incorporates ideas for success (United States Marine Corps [USMC], 1997b). The central theme of Marine Corps doctrine is the idea of being expeditionary and applying the concept of maneuver warfare. Based on the concept of maneuver warfare, one can derive the specific concept of logistically supporting and sustaining the force in the Marine Corps.

1. Expeditionary Identity

In MCDP 1, *Warfighting*, the Marine Corps hailed itself as the "expeditionary force in readiness" ready "for immediate employment in any clime and place and in any type of conflict" (USMC, 1997b, p. 53). This is equally a statement of its capability and of the culture of Marines. This concept of expeditiousness encompasses a broad range of environments within which the Marine Corps will operate. From amphibious, combat, humanitarian, and up and down the spectrum of conflict, Marines must be ready at a moment's notice to operate and execute within an array of situations. This framework is the bedrock for training Marine forces in being flexible, responsive, and aware of requirements for each situation.

2. Maneuver Warfare

Per MCDP 1, "maneuver warfare is a warfighting philosophy that seeks to shatter the enemy's cohesion through a variety of rapid, focused, and unexpected actions which create a turbulent and rapidly deteriorating situation with which the enemy cannot cope" (USMC, 1997b, p. 73). Different from the force-on-force fighting of attrition warfare, maneuver warfare does not strike at the enemy's strength. It focuses on using space to maneuver fighting units into an advantageous position to attack the enemy's weakness. Speed, focus, and surprise are key elements to the success of maneuver warfare (USMC, 1997b). Perhaps the most important element of maneuver warfare is that of leadership. A leader within maneuver warfare must be able to work in a decentralized command, understanding the intent of his or her higher command and in congruence with the larger situation (USMC, 1997a).

3. Marine Air-Ground Task Force

Because the success of Marine Corps operations depends on its ability to operate in any clime and environment and respond to any situation, the Marine

Corps organizes its units using the concept of the Marine Air-Ground Task Force (MAGTF). A MAGTF is a task-organized unit "consisting of ground, aviation, combat service support (logistics) and command elements" (USMC, 1997b, p. 55). The strength of this concept is in its ability to give a single commander the combined arms forces that can be tailored to specific situations (USMC, 1997b). Although the MAGTF has the ability to tailor a force to a specific situation, the organization "should be organized for warfighting first and then adapted to peacetime rather than vice versa" (USMC, 1997b, p. 55). The basic organization chart for a MAGTF can be seen in Figure 2. The core elements of a MAGTF are the command element (CE), aviation combat element (ACE), ground combat element (GCE), and combat service support element (CSSE; USMC, 2000).

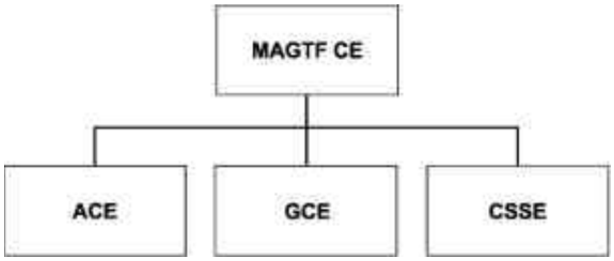

Figure 2. Organizational Chart Outlining the Core Elements of the Marine Corps MAGTF
(USMC, 2000, p. 2-3)

There are five typical MAGTFs that the Marine Corps utilizes to conduct operations: Marine Expeditionary Force (MEF), Marine Expeditionary Brigade (MEB), Marine Expeditionary Unit (MEU), special purpose MAGTF (SPMAGTF), and air contingency MAGTF (USMC, 2000). To understand how the Marine Corps operates and sustains its force, one must understand these five organizations.

a. Marine Expeditionary Force

A MEF is the largest and principal warfighting organization of the Marine Corps. It is used for larger operations and contingencies and is capable of executing all missions across the range of military operations (ROMO; USMC, 2002). It is centered on a permanent CE and is usually composed of one or more Marine force service support groups (FSSGs) as the CSSE, a Marine division as the GCE, and a Marine aircraft wing (MAW) as the ACE. A MEF can operate from sea or land (USMC, 2000). A MEF carries enough supplies to be self-sufficient for 60 days of operations (USMC, 2002). The most recent use of a MEF was in combat operations in Iraq to cover the Al-Anbar province.

b. Marine Expeditionary Brigade

A MEB is a medium-sized MAGTF that provides flexibility through its use of a reinforced Marine regiment as the GCE, a Marine air group (MAG) with both fixed- and rotary-winged assets as the ACE, and a brigade service support group (BSSG) as the CSSE. A MEB is smaller than a MEF but larger than a MEU. A MEB CE is commanded by a general officer and has the capability of 30 days of organic self-sustainment (USMC, 2000).

c. Marine Expeditionary Unit

A MEU uses a reinforced infantry battalion (which forms a battalion landing team [BLT]) as the core element, along with a reinforced helicopter squadron as the ACE and a MEU service support group (MSSG) as the CSSE (USMC, 2000, 2002). A MEU is utilized as a forward sea-based deployment requirement, allowing it to double as an immediate reaction capability in crisis response situations (USMC, 2002). A MEU is a key capability for national security due to the forward presence that MEUs give. MEUs carry 15 days of supply (DOS), which allows them to be self-sufficient for a shorter amount of time than a MEB or MEF but requires less time to execute missions due to their size (USMC, 2002).

d. Special Purpose MAGTF

A SPMAGTF is different from other MAGTFs—not in size but in its mission. A SPMAGTF is formed, trained, equipped, and task-organized to conduct missions of limited scope and duration (USMC, 2002). An example of a SPMAGTF is SPMAGTF HAITI, which conducted humanitarian assistance and disaster relief to the earthquake-ravaged country.

e. Air Contingency MAGTF

"An air contingency MAGTF is an on-call, combat ready MAGTF that deploys by airlift" (USMC, 2002, p. 2-7). The size of an air contingency MAGTF varies due to the mission requirements and available airlift capacity. Due to transportation restraints, air contingency MAGTFs are limited to organic logistical support and require operational logistics support.

f. Summary of MAGTFs

The Marine Corps fights in modular-type organizations that are able to "right fit" to meet mission requirements. It is important to understand this structure to understand or shape a framework of self-sufficiency within the Marine Corps. Due to the interoperability of units within a MAGTF, the logistical support required to sustain a MAGTF is expanded from supporting one specific type of unit (GCE, ACE, CE, or CSSE) to supporting all units simultaneously.

4. History of Logistics

In a military sense, self-sufficiency is deeply rooted in the realm of logistics. MCDP 4 provides a clear and detailed description of the history of logistics throughout the history of the Marine Corps.

a. Pre-Modern Armies

Prior to the 17th century, pre-modern armies needed little in the sense of logistical support because most members brought their own weapons and means of mobility (USMC, 1997a). Main concerns of the time were mostly limited to subsistence, which was fulfilled by foraging and local procurement (USMC, 1997a). Self-sufficiency during this time could be summarized into two categories: that of the individual and that of the unit. Individual self-sufficiency during the pre-modern era was determined by the supplies that the individual brought to the battle (weapons, a horse, and clothing). Unit self-sufficiency was determined by its ability to feed an army.

b. Modern Armies

The 17th and 18th centuries brought about a new type of warfare, necessitating the integration of logistics. The introduction of gunpowder and firearms, and the discouraging of pillaging and foraging, brought about the need for armies to be self-sufficient (USMC, 1997a). *Self-sufficient*, in this sense, meant that all necessary supplies needed to be procured from within the organization specifically for the use of the military. This meant that the soldier did not need to bring his own supplies because the organization took greater responsibility to provide the necessary goods. The individual soldier was instead dependent on the organization. This is where we find the origins of the supply chains in the military. MCDP 4 (USMC, 1997a) best described this as follows:

> This led to the creation of a logistics system consisting of fixed supply points called magazines and large, unwieldy baggage trains. The logistics systems required to sustain an army at once became a key limiting factor and a major vulnerability. The need to establish magazines in advance of any campaign restricted strategic mobility, while the requirement to transport large quantities of provisions and other supplies inhibited tactical mobility. (p. 38)

In the 17th and 18th centuries, logistics was becoming an ever-increasing part of military operations. The additional logistical support requirements could assist in winning a war, or could be the reason for demise. More thought was being given as to how logistics could be used to militaries' advantage. Timing and the environment were two big factors being considered.

c. Industrial Revolution

The industrial revolution had a profound effect on military logistics and sustainability for numerous reasons. First, the mechanization of process allowed for mass production never witnessed before. Also, technology made weaponry more lethal. Coupled with the mass production of ammunition, technology provided armies with the ability to project force at a larger scale. Lastly, the development in transportation allowed for larger armies and supplies to be connected on land and at sea with relative ease. As MCDP 4 (USMC, 1997a) stated, "As a result of these innovations, military forces grew larger in size, could deliver unprecedented firepower, and were increasingly capable of rapid movements" (p. 39).

The industrial revolution created a system to sustain the individual and the force with one process that met and managed all needs or requirements, from production until delivery to the end user. This was the beginning of the modern-day description of a supply chain. MCDP 4 (USMC, 1997a) referenced this as follows:

> The industrial revolution had transformed logistics from an important aspect of warfare to an essential prerequisite for the conduct of war. Mass armies consumed vast quantities of food, ammunition, and other supplies. Modern weapons and equipment created the need for new services such as maintenance and salvage as well as new commodities like fuel and spare parts. The management of rail and shipping networks became crucial to delivering forces to the battlefield and sustaining those forces once they arrived. Logistics consideration came to dominate the strategic and operational levels of war. The ability of a nation to translate industrial capability into military resources and its capacity to sustain the military effort became crucial factors in determining whether to go to war. (p. 39)

One historical discovery is that as the military realized advances in technology, the necessary logistical support became just as important as the technology itself. Logistics was not just a process that was necessary for self-sufficiency; it also involved the maintenance, salvaging, and disposal of items. Also, as more advances were made in technology, the individual would rely less on himself and more on the logistical system for needed resources to sustain him on the battlefield.

5. Levels of Logistics

Similar to operations, logistics is conducted in three levels: strategic, operational, and tactical. Each level plays an interrelated role in the conduct of logistics for a given campaign. Although scale may seem the differentiator between

the levels of logistics, it is their respective focus that differentiates them (USMC, 1997a).

a. Strategic-Level Logistics

According to Marine Corps doctrine, strategic-level logistics is the highest level of logistical support. “Strategic logistics encompasses the nation’s ability to raise, deploy, and sustain operating forces in the execution of the national military strategy” (UMSC, 1997a, p. 49). The focus of strategic logistics is to sustain the entire force throughout all theaters of operations. Examples of strategic-level logistics include the development and purchase of major end items, such as weapon systems, recruitment, and installations. Within the context of a company structure, strategic logistics would be the top executive level.

b. Operational-Level Logistics

The operational level of logistics links the strategic and tactical levels of logistics. “Operational logistics addresses sustainment within a military theater of operations” (USMC, 1997a, p. 50). The main focus of operational logistics is to sustain a theater of operations or a specific campaign by making available the resources of the strategic logistics to the tactical commanders (USMC, 1997a). Operational logistics would equate to middle management within a company.

c. Tactical-Level Logistics

Tactical logistics is concerned with sustaining the force in combat and draws upon resources made available by the operational level (USMC, 1997a). The focus of tactical logistics is to provide necessary resources and services in support of operations. Common phrases about the tactical level include the “tip of the spear” and where “the rubber meets the road.” Tactical logistics is arguably the most important level of logistics because it is incumbent on each commander, regardless of their military occupational specialty (MOS), to provide organic resources for tactical-level logistics (USMC, 2000). Tactical logistics is also referred to as the “last tactical mile” of the logistics model.

Tactical-level logistics is broken down into six functional areas necessary to sustain tactical units: supply, maintenance, transportation, general engineering, health services, and services. Resources from this level of logistics can be broken down into 10 classes of supply used to sustain military units conducting the six functions of logistics (USMC, 2000).

The importance of the 10 classes of supply is that the supplies are tangible items that are needed to sustain tactical units. Both strategic and operational levels of logistics are focused on making these items available to the tactical-level units so that the units may carry out operations.

d. Relationships of Different Levels of Logistics

Each level of logistics has a specific focus (see Figure 3) but relates to the level higher and lower. MCDP 4 (USMC, 1997a) stated that "strategic level logistics forms the foundation from which operational logistics enable and sustains tactical logistics" (p. 51). Although each level of logistics has a different focus, it is highly dependent upon the other levels; each level must provide what is required to ensure a more stable logistical support structure.

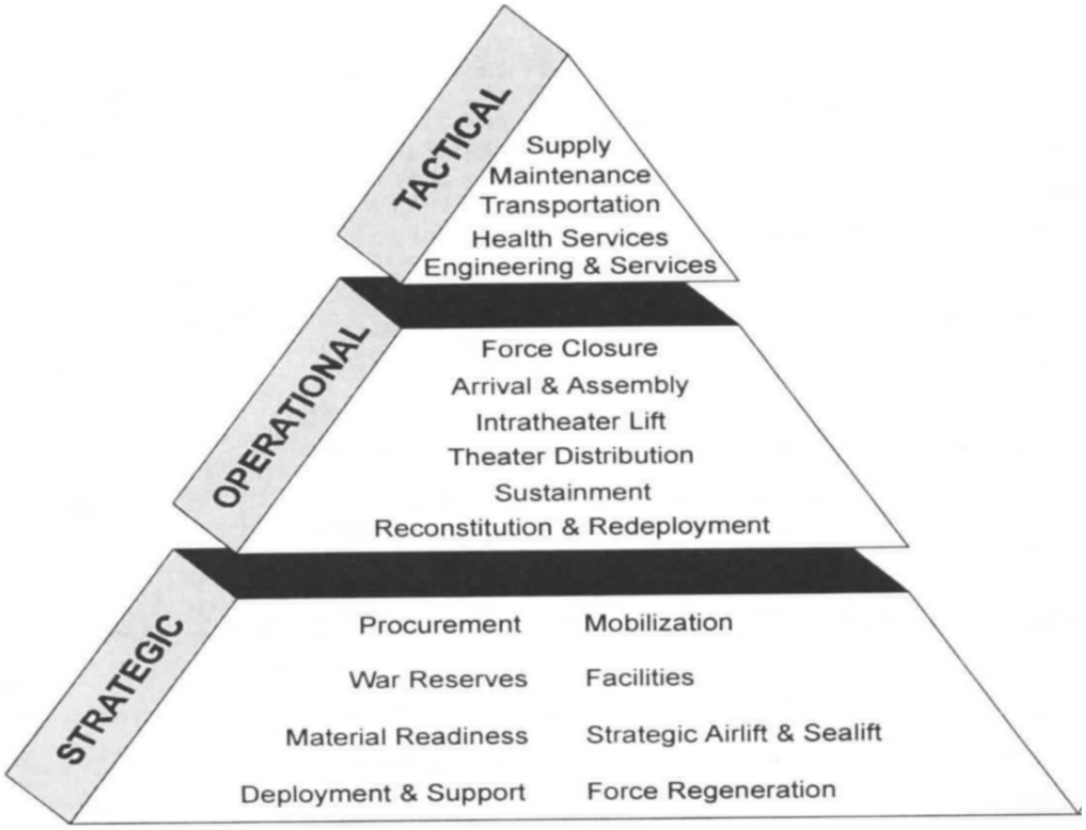

Figure 3. Focus of Each Level of Logistics
(USMC, 1997a, p. 52)

Figure 4 is an excerpt from Marine Corps Warfighting Publication (MCWP) 4-12, *Operational-level Logistics*, and helps one to better understand the interaction between the levels of logistics. As seen in the figure, requirements generated at the tactical level must be supported by the strategic level. All of these requirements are funneled through the operational level, which acts as an intermediary.

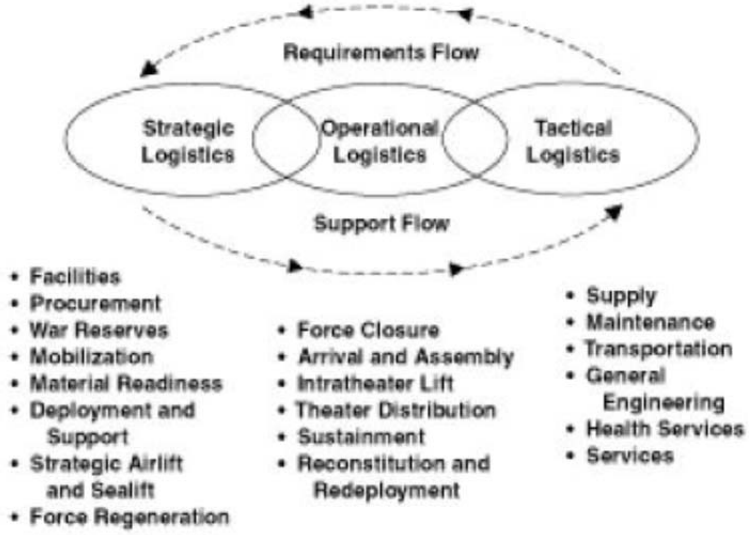

Figure 4. The Flow of Requirements and Support From the Different Levels of Logistics
(USMC, 2002, p. 1-2)

6. Emerging Trends

Although MCDP 4 was written in 1997, it did have ideas on emerging trends in the battlespaces in which Marines will fight. It described five emerging trends that are different from the traditional operating environment that existed at the time of the publication's release. The purpose of identifying these trends is to notify the logistician to prepare for the ever-changing face of warfare. Due to its foresight, MCDP 4 provided great planning considerations for the battlespaces of Iraq and Afghanistan that would ensue a few years later. These trends are important because they have been seen in the current battlespace, are still evolving, and will be seen in future operating environments.

a. Expanding Battlespace

Two technological advancements are expanding the battlespace as we know it. The first advancement is greater mobility. Mobility has allowed the military to travel greater distances faster (USMC, 1997a) and allows for greater distances between supply lines and operating forces, necessitating a greater focus on logistical planning.

The second advancement that is expanding the battlespace is weaponry. The increased lethality and range of weapons necessitates a dispersion of forces for survival purposes (USMC, 1997a). Offensively, advanced weaponry requires less manpower in the battlespace. Defensively, one well-placed munition could have devastating effects on military forces.

The expanding battlespace places a strain on the ability to sustain forces for numerous reasons, distance being the most evident. Longer distances require more resources to sustain the logistics elements that provide the necessary support to operating units.

b. Continuing Compression of Reaction Time During Operations

Compression of reaction time refers to the technological advances that increase the operational tempo (OPTEMPO) of units in battle (USMC, 1997a). This increase in OPTEMPO strains the supply chain by increasing the use of sustainment items through continuous operations. Increases in OPTEMPO also decrease the time to react to logistical requirements and the ability to anticipate these requirements due to the ever-changing environment.

c. A Wide Variety of Missions

The traditional view of warfare is that of massive land armies fighting in lines on a field of battle. The Marine Corps has fulfilled a wide variety of missions over time—from direct combat operations to humanitarian assistance. Each mission, from one end of the spectrum of operations to the other, requires different types of sustainment. To compound the complexity, there is a decreasing time frame in transitioning from one mission to another or between simultaneous missions throughout the modern-day battlefield (USMC, 1997a). The variety of missions necessitates a logistical system with the flexibility and adaptability to meet mission requirements.

d. Expanded Use of Advanced Technology

The expanded use of technology for the military has allowed for the combination of multiple capabilities into one platform. Military jet aircraft are a prime example of this, with some aircraft being able to provide air-to-air and air-to-ground support from one platform. The increase in the capability of one platform reduces the need for overall inventory, placing a greater emphasis on the operability and mission readiness of these platforms (USMC, 1997a). Despite reduced inventories of capabilities, the oversight and readiness that is demanded of these capabilities put a premium on the supply chain that supports them.

e. Integration of Military Logistics With the Commercial World

The U.S. military has undergone a recent move to outsource portions of military logistics to commercial vendors. This outsourcing provided the military with efficiencies that would otherwise go undiscovered due to the capabilities of industry (USMC, 1997a). The military requires the correct balance of outsourcing and organic logistics in order to be responsive to operations. Although commercial

logistics has great capabilities, it must have redundancy to account for contingent circumstances and the infrastructure to meet the needs of the military.

7. Measuring Self-Sufficiency

The ambiguity of *self-sufficiency* is further clouded by Marine Corps doctrine's not identifying a metric with which to measure self-sufficiency, possibly due to the broad nature of doctrine itself. S*elf-sufficiency* covers many areas and is relative to the situation in which it is discussed. Tactical requirements drive the sustainment needs of the operational and strategic levels, as seen in Figure 4. To satisfy the requirements of the tactical level requires all six functions of logistics. Each of those functions measures readiness in different ways, which allows individuals and units to be self-sufficient. Within a MAGTF, all four elements (GCE, ACE, CE, CSSE) must address the six functions of tactical logistics. By the very nature of the elements' missions, their measure of readiness/self-sufficiency may be different.

B. MARINE CORPS LITERATURE

The recent discussion of self-sufficiency throughout the Marine Corps comes on the heels of the Marine Corps' exploration of solving its "liquid logistics" issues (Marine Corps Expeditionary Energy Office, n.d.). At the heart of these issues is a strong reliance on a few tangible supplies (Class I and III) to conduct day-to-day operations, which not only strains the supply train but also leaves the force vulnerable to attacks. In this case, the relied-upon tangible supplies are fuel and water. The high demands for these items are based on the operating environment and increased use of computer-based assets. Due to this periodic requirement of fuel and water, supply lines have been easily targeted, resulting in one Marine being wounded or killed for every 50 water or fuel resupply convoys (Marine Corps Expeditionary Energy Office, n.d.). The purpose of this portion of the literature review is not to dissect the specifics of fuel and water efficiencies but rather to explore how recent operating environments have affected our understanding of self-sufficiency. This project uses concepts from recent summit-related discussions regarding fuel and water and expound on these concepts to help us define *self-sufficiency* as it pertains to Marine Corps operations.

1. The Current Context

Over the last 10 years, wars in Iraq and Afghanistan have ruled military operations. These prolonged wars have taken the Marine Corps away from its expeditionary roots of "fast, austere and lethal" (Conway, 2009, p. 6). Through fighting a counterinsurgency (COIN), the Marine Corps has become more lethal in its means to wage war but has become heavy and slower as it has ventured away from its expeditionary roots. The intent of the current CMC, General James Amos, is to

bring the Marine Corps back into “balance” by returning to its Spartan roots (Marine Corps Expeditionary Energy Office, n.d.). His intent is illustrated in Figure 5.

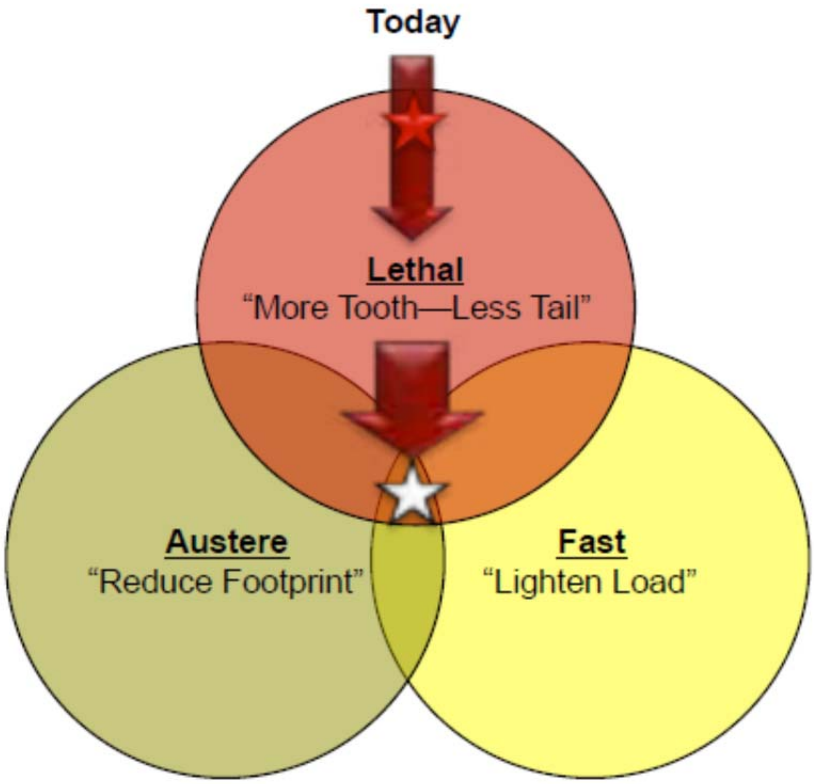

Figure 5. The Current State of the Marine Corps With Regard to Its Expeditionary Roots
(Marine Corps Expeditionary Energy Office, n.d., p. 13)

2. How Did the Marine Corps Get Here?

The obvious answer to the question “How did the Marine Corps get here?” is that the Marine Corps increased their footprint (became less austere) and made the load heavier (became slower because of more equipment). What specifically made the Marine Corps move away from its expeditionary roots to fight differently? There could be several reasons for this. One reason is its continued reliance on and enhancements of equipment.

a. Increased Reliance on Equipment

The last 10 years of war in Iraq and Afghanistan have seen increased enhancements and use of information technologies, command and control systems, weapon systems, and force protection measures (Marine Corps Expeditionary Energy Office, n.d.). To better illustrate this increased reliance on equipment: In the

past 10 years, the Marine Corps has seen a 250% increase in radios, a 300% increase in information technology (IT), a 200% increase in the number of vehicles, an over 75% increase in vehicle weight, and a 30% decrease in fuel efficiency (Marine Corps Expeditionary Energy Office, n.d.). These shifts in assets mean a shift in support requirements, making the Marine Corps heavier.

b. Forward Operating Bases

The nature of COIN has necessitated the need for Marines to be close to the local populace while still maintaining the correct level of force protection. Being stationary for long periods of time leads to greater stability within the forward operating bases (FOBs) and to a less austere environment by allowing quality-of-life items that would otherwise not be allowed due to the nature of offensive combat operations. Such items are generators, enhanced communications and command and control equipment, as well as tents or hardened encampments.

c. The Mission

Ultimately, irregular warfare shaped the way that the Marine Corps fought the Global War on Terror. The conflicts were not traditional in the sense of a mass-on-mass, uniformed enemy. As a result, the Marine Corps required a change in tactics, techniques, and procedures and, in doing so, became resource-intensive compared to the traditional way of waging war.

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IV. ANALYSIS

A. INTRODUCTION

The concept of self-sufficiency is dynamic and difficult to frame due to the many contexts it can be applied to. In this project, we focus on the self-sufficiency of the United States Marine Corps and its relationship with three interdependent elements: environment, time, and supply chain (see Figure 6). We chose these factors because we determined, upon thorough analysis of the literature, that they have the most significant impact on Marine Corps self-sufficiency.

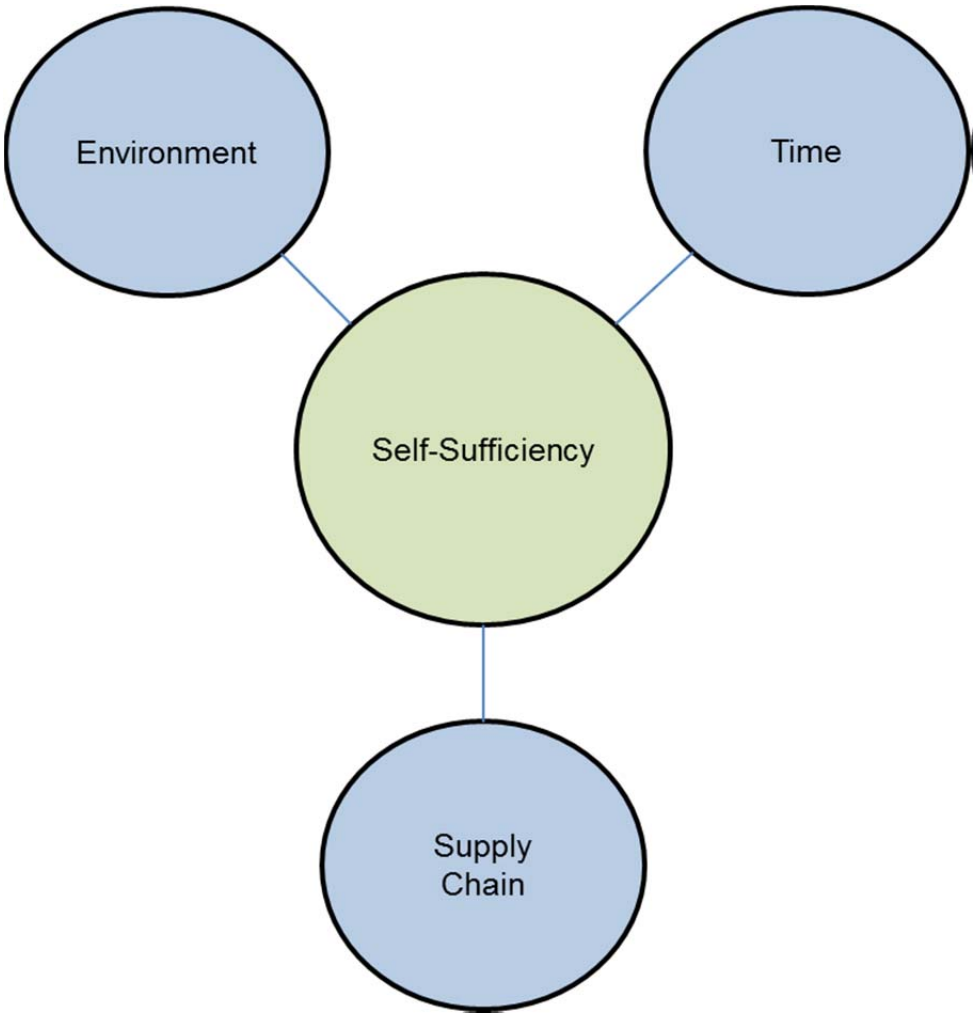

Figure 6. Relationship Among Self-Sufficiency and Its Elements

Our view of self-sufficiency, as illustrated in Figure 6, proposes that self-sufficiency is a soft core molded by three elements. As such, the limiting factor (i.e., the factor that causes the most strain on self-sufficiency) will "stretch" self-sufficiency, possibly to the point of breakage. In this chapter, we describe the

elements of environment, time, and supply chain and explain their interrelationship to shape self-sufficiency.

B. DEFINING THE ELEMENTS

1. Environment

Environment is the element of self-sufficiency that sets the stage in which Marine Corps operations are conducted. There are many different variables that an environment may consist of; these variables may include the physical, cultural, political, and economic factors that change given a specific scenario. In its simplest form, the environment is the who, what, when, where, and why of a given situation. For example,

- Who: an individual Marine, fire team, squad, company, battalion, etc.
- What: the mission of the "who" and what we are trying to accomplish
- When: the time of year (e.g., summer, winter) and social constructs (e.g., TET OFFENSIVE, EID)
- Where: country, regional location, and climate (e.g., arid, tropical, mountain, desert)
- Why: the purpose (end state) of military operations

We further view the environment as a combination of the internal and external influences that can impact the ability of a unit to be self-sufficient. We have denoted these influences as environmental factors and describe them as follows:

- Mission: There are many different types of missions that can be conducted. These missions include not only offensive and defensive operations but also any type of mission that can be conducted across the range of military operations. The mission affects the environment by providing conditions for a unit to operate within.
- Location: The location is a physical factor of the environment that delineates where a unit is operating. It encompasses physical boundaries and distances within an area of operations. It is also the basis for other environmental factors such as terrain and weather within a given region.
- Enemy activity: The level of enemy activity is an external factor of a given environment that impacts operations. We view this as operating within a permissive or non-permissive environment. In a permissive environment, there is a very low or nonexistent threat of enemy

activity. In a non-permissive environment, there is a very high threat of enemy activity.

- Terrain: The terrain within a specified area of operations is another physical factor that impacts the environment. This factor depends on the location.
- Weather: The weather within a region is a physical factor of the environment. This is an external factor that cannot be controlled and can only be planned for given current meteorological data.
- Available infrastructure: The available infrastructure within a given region is another external factor contributing to the overall environment. We consider important infrastructure to be related to transportation, energy, water, fuel, and buildings (e.g., roads, ports, airfields, railways, power grids, water purification plants).
- Available natural resources: The available natural resources within a region are another external factor within an environment related to self-sufficiency. These are resources include water, timber, sunlight, minerals, and wind.

Although we can influence the environment or situation somewhat by carefully planning military operations, the environment (or situation) is most often a given scenario—a state of nature—around which we must plan. Therefore, most of our focus and efforts to increase or optimize self-sufficiency should be on the factors of time or supply chain.

2. Time

In our model, the element of time is a function of three subcomponents: time as a function of mission duration (t_{MD}), the time needed to be self-sufficient (t_{SS}), and the timing factors of the supporting supply chain (t_{SC}). Time can also be stated as follows: Time = $f(t_{MD}, t_{SS}, t_{SC})$.

Time as a function of mission duration (t_{MD}) is derived from its relationship with the environment element. It is a byproduct of the operational environment, denoting the duration of the given/current mission. Simply put, it is how long a unit will operate in a certain environment.

Time as a function of self-sufficiency (t_{SS}) is how long a unit can sustain operations without external support.

Time as a function of supply chain (t_{SC}) denotes the supply chain fundamentals related to time: lead time, inventory/DOS, and capacity. Lead time is the amount of time elapsed from the time a requirement is generated to the time it is

received by the supported unit. Inventory and DOS are the amount of supplies carried by the supported unit. Capacity is a physical limitation to the amount of inventory or DOS that the supported unit is able to carry.

Given a certain environment (e.g., OPTEMPO and mission) and supporting supply chain, Marine units (regardless of size) can only operate for a finite period of time before the logistics chain that supports them will have to provide replenishment to continue operations. For example, a Marine unit conducting operations for one day will experience a higher level of self-sufficiency than the same unit conducting operations over a one-month period.

3. Supply Chain

A formal definition of *supply chain* is "the material and informational interchanges in the logistical process stretching from acquisition of raw materials to delivery of finished products to the end user. All vendors, service providers and customers are links in the supply chain" (Council of Supply Chain Management Professionals, 2013). Supply chains are a vital aspect in both commercial and military operations. In a commercial supply chain, efficiency is what allows control over cost and provides value to the customer. In the military supply chain, efficiency assists in controlling the monetary cost but more significant is reducing the human cost of casualties and accomplishing the mission.

There are three attributes associated with military supply chains that affect self-sufficiency: responsiveness, flexibility, and sustainability. In military logistics, specifically tactical logistics, the military supply chain is responsive in nature. The supply chain must operate rapidly and react to an ever-changing operating environment to meet the demands of the units being supported. How efficiently a supply chain does this is a measure of its responsiveness, or "getting the right goods to the right place at the right time" (USMC, 1999, p. 1-6).

The military supply chain must also be flexible. The flexibility of a supply chain is its "ability to adapt logistics structure and procedures to changing situations, missions, and concepts of operation" (USMC, 1999, p. 1-6). The environment that the military operates in is not static, and neither is the supply chain that supports it. As the mission or objective changes, the supply chain must adapt in order to meet new demands.

Another attribute of a military supply chain is sustainability. "Sustainability is the ability to maintain logistics support to all users throughout the area of operations for the duration of the operation" (USMC, 1999, p. 1-6). The concept of distributed operations dictates that the military supply chain must provide sustainable support to multiple locations across a growing battlespace.

C. INTERRELATIONSHIPS OF ELEMENTS

In this section, we discuss the interrelationships that exist among the three elements of self-sufficiency (see Figure 7). We evaluate first the interaction between the environment and the supply chain, then the interaction between time and the supply chain, followed by the interaction between the environment and time.

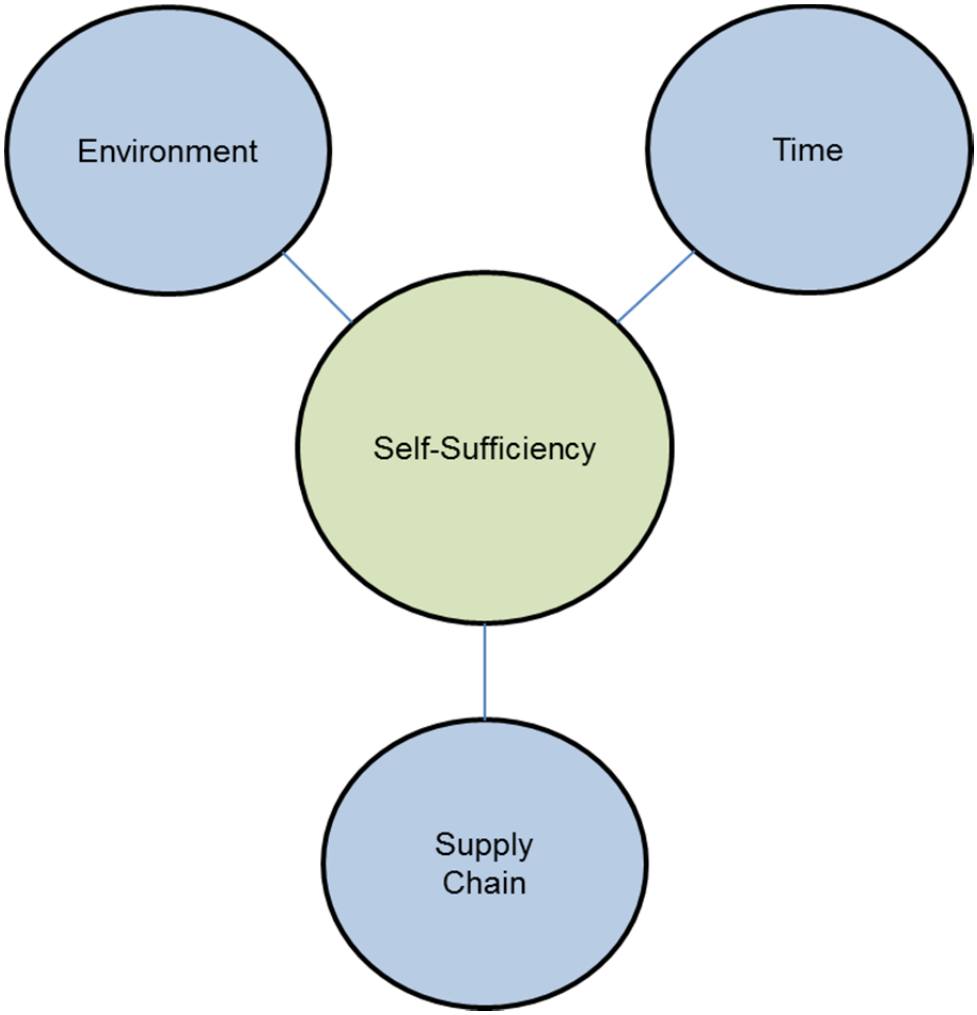

Figure 7. Interrelationships Among the Elements

1. Environment and Supply Chain

In military operations, the necessary supplies are determined by the type of mission being conducted and the environment that the mission is being conducted in. These supplies can be any of the 10 predetermined classes of supply, but the quantity and rate in which they are needed are subject to uncertainty. This uncertainty exists because of the complex and often changing environment that military operations are conducted in. As previously mentioned, the factors affecting the environment are

- mission,
- location,
- enemy activity,
- terrain,
- weather,
- available infrastructure, and
- available natural resources.

The first contributing factor affecting the supply chain environment is the type of mission being conducted. The mission type can be one of any across the ROMO, from humanitarian assistance to combat operations. Out of the 10 predetermined classes of supply, there are certain supplies that will always be needed: water and food (Class I), fuel (Class III), and ammunition (Class V). The quantity needed of each item is dependent upon the scale of the operation and the time period in which the mission is being conducted.

The second factor impacting the supply chain environment is the location in which the mission is being conducted. This is the physical location where forces are operating and the forces' proximity to a logistics supporting element. Current combat operations have employed the distributed operations concept where multiple units are spread across a geographical region in order to leverage their combat power against the enemy. This concept adds complexity to the supply chain that supports it because instead of supporting one location, the supply chain must support multiple locations at once. Furthermore, the distances between each supported unit can vary quite significantly, adding even more complexity.

The third factor affecting the supply chain environment is the level of enemy activity within the operating area. Regardless of what force protection measures we take, the enemy always has a choice. Even if there are only a few units that require support, the level of enemy activity makes supporting those units much more difficult. The military's supply convoys are a known target for enemy activity and are vulnerable to enemy threats.

The fourth factor affecting the supply chain environment is how the terrain affects the supply distribution network. The type of terrain affects the mode of transportation required to resupply a unit. In a mountainous region with a poor road system, ground transportation may be severely limited. This type of scenario will force the distribution network to utilize alternative transportation methods (i.e., air transportation). If air transportation is not available, the amount of lead time required

to provide support will increase. With a longer lead time, the supported unit is forced to carry more on-hand supplies or go without certain items.

The fifth factor affecting the supply chain environment is the weather or climate in which the supply chain is operating. Weather can severely limit the ability of the supply chain by limiting its mobility, access to distribution nodes, and responsiveness to demand. An example of this can be seen by a sandstorm covering a specific area within the operating environment. Due to poor visibility, logistical transportation is unable to maneuver by ground or air. This limits the access to these specific distribution nodes and may not allow for responsive supply for demanded items.

Weather can also have an effect on the demand for supplies. In winter, demand will include items that increase self-sufficiency during colder temperatures and shorter days, while demands during summer will include items necessary for warmer temperatures and longer days. Relating to the location and terrain factors, depending on where in the world the operations are taking place, the climate of that area must be taken into account when trying to increase the self-sufficiency of a unit.

The sixth factor affecting the supply chain environment is the available infrastructure in the area of operations. The available infrastructure affects the distribution network of a supply chain and the amount of military resources needed to conduct a mission. The distribution network is affected by the quantity and quality of the infrastructure available for transportation, such as roads, seaports, rail systems, and airfields. A region with poor transportation infrastructure diminishes the military supply chain's ability to import needed supplies from outside the region and distribute them across the last tactical mile to the operating forces.

Other forms of existing and to-be-constructed infrastructure that impact the supply chain environment are the facilities available to the operating forces. Important facilities to be concerned with in the planning process are the available power grid, water purification plants, and oil refineries. Additionally, buildings that can be used for multiple purposes, such as medical treatment, dinning, storage, and maintenance of equipment, are important as well.

Without quality transportation and facilities infrastructure, the military supply chain must adapt so that it can meet mission requirements. This becomes a logistical constraint that adds complications to the supply chain and can result in a delay of support to units in need. To overcome this constraint, the military must rely upon its own organic capabilities, such as bridge building equipment, combat engineers, generators, helicopters, and deployable shelters, to name a few.

The seventh and final factor affecting the supply chain environment is the available natural resources within a region. When discussing the military's uses of

natural resources, the availability of fresh water within a region is a common consideration, but not the only one. Other natural resources that can be used as alternative energy sources such as solar and wind power are becoming important as well.

Current initiatives, such as the Marine Corps Expeditionary Energy Office and the Experimental Forward Operating Base (EXFOB), are analyzing ways that the Marine Corps can utilize alternative energy sources while stationed at home and abroad. These initiatives are developing new technologies that utilize alternative energy to support Marines around the world. These efforts will decrease the strain on the supply chain by reducing the demand for energy- and water-related logistics.

2. Supply Chain and Time

The interrelationship between a military supply chain and time (t_{SC}) is best explained by using the specific supply chain fundamentals of inventory, lead time, safety stock, and capacity. These fundamentals can be applied to both the logistics support element and the unit it is supporting. For the purpose of this analysis, we apply these fundamentals to a supported operating unit.

The concept of inventory applied to an operating unit is also known as days of supply (DOS). The amount of inventory that an operating unit will carry is determined by the following variables:

- mission duration,
- lead time for resupply, and
- (carrying) capacity.

The mission duration is one variable associated with the amount of inventory that a unit will carry. A unit conducting a shorter mission, such as a 12-hour patrol, will require much less inventory than a unit conducting a longer mission, such as for multiple days. Regardless of the length of the mission, it is obvious that time plays an important role in determining the amount of inventory that a unit will carry.

Lead time is the amount of time elapsed from the time a requirement is generated to the time the requirement is received. In the case of an operating unit, lead time is the amount of time that it takes to be resupplied from a supporting element. Assuming that all required supplies are in stock at the supporting base, the amount of lead time is determined by the distance from a supporting base and the mode of transportation used for the resupply.

The distance between an operating unit and its support base is subject to variability. Variability exists because operations are not static unless a unit is in a prolonged defense. An offensive unit is constantly moving towards its objective and,

in many cases, is increasing the distance away from its supporting base. As this distance increases, the lead time for resupply increases as well.

The mode of transportation utilized to resupply a unit and its reliability is subject to variability as well. The type of transportation used for resupply is subject to the capabilities and resources made available to the supply chain. The transportation resources usually made available are in the form of a ground or aviation asset. However, both forms of transportation are subject to reliability issues, such as mechanical failure, weather, or lack of available infrastructure such as roads and airfields.

To protect against variability in lead time, the concept of safety stock can be applied. Safety stock is a quantity of extra stock carried in inventory that is meant for protection against variability or uncertainty. Although it is highly unlikely that the term *safety stock* has ever been uttered by a unit leader, unit leaders will prescribe a certain level of extra inventory to be carried for unforeseen circumstances. These unforeseen circumstances are the previously mentioned variability or uncertainty in the supply chain.

The last variable in the interrelationship between the supply chain and time is carrying capacity. This is a physical limitation to the amount of inventory that can be stored. In our scenario, carrying capacity is limited to the amount of supplies that can be physically carried by a Marine or a vehicle. Capacity, in this case, is a balancing act between what can be carried and conducting the mission. Because one of the tenets of maneuver warfare is speed and tempo, it would be counterintuitive to weigh down an operating force with excess supplies.

The interrelationship between the military supply chain and time bears some similarities to its commercial counterpart. Both supply chains rely on time as a measure of responsiveness to the demands of their customers and inventory for planning purposes. The key difference between the two supply chains is the extreme sense of urgency required in the military supply chain that is absent in the commercial supply chain. This urgency is due to the consequences of not meeting a demand on time. In the military, not meeting demand can result in mission degradation or loss of life. In the commercial world, not meeting demand results in a lost sale or lost profit. Not meeting demands is considered unacceptable in both supply chains, but the consequences of failure for the military supply chain are much direr.

3. Time and Environment

Environment drives the relationship between environment and time, with time (t_{MD}) being the duration that a unit operates in a given environment. Based on the many different variables within an environment, it takes a certain amount of time to

complete a mission. The amount of time it takes to accomplish a mission is subject to variability. This variability exists because of the previously mentioned factors that compose an environment, such as

- mission,
- location,
- enemy activity,
- terrain,
- weather,
- available infrastructure, and
- available natural resources.

The severity of each of these factors adds to the complexity of a mission. This complexity can then extend the amount of time required to accomplish the mission. An example of this can be seen by comparing operations in a permissive and non-permissive environment. All else equal, a military operation in a permissive environment has less complexity than that in a non-permissive environment. This is because the level of enemy activity in a permissive environment is very low compared to a non-permissive environment. The reduced complexity of the permissive environment allows for the unimpeded completion of the mission, and thus a lower t_{MD}.

D. EFFECT OF EACH ELEMENT ON SELF-SUFFICIENCY

We have now defined each element of self-sufficiency and discussed the interrelationships among the elements. In this section, we discuss how self-sufficiency can be viewed from the perspective of each element.

1. Environment

The environment in which Marine units conduct military operations can shape the units' self-sufficiency in many ways. Given a certain supply chain with specific capabilities and a time frame within which Marine units desire to be self-sufficient, the level of self-sufficiency is influenced largely by the environment in which the units operate. For example, a squad-sized unit conducting humanitarian operations in Djibouti will require a much different level of self-sufficiency than a company-sized unit conducting clearing operations in a highly kinetic, mountainous region of eastern Afghanistan.

2. Time

From the perspective of time, the Marine Corps improves self-sufficiency by outfitting and resourcing a Marine unit to enable it to remain mission-effective for an increased period of time without the need of external assistance from the supporting logistics chain. It is incumbent upon leadership to properly prioritize the necessary supplies to increase the element of time (and ultimately self-sufficiency) by optimizing the value of those necessary items, given mission, space, and weight constraints. Also worth noting is the positive correlation between the duration of operations and the possibility of emergent circumstances that could hinder a Marine unit's level of self-sufficiency.

3. Supply Chain

Another element related to the self-sufficiency of a unit is its reliance on the supply chain that supports it. The more self-sufficient an organization becomes, the less burden is placed on its supply chain. This increased self-sufficiency allows the unit to operate with less complexity and fewer logistical constraints. Although it is highly unlikely that any organization can ever be completely self-sufficient, units can become more self-sufficient.

The concept of self-sufficiency can be applied to the military supply chain by discussing supply chains in the context of responsiveness, flexibility, and sustainability, as mentioned previously. At the tactical level, the military supply chain is a response supply chain. It must be able to rapidly react to the demands generated by the force that it is supporting. How quickly it reacts is a measure of responsiveness. Conversely, if the operating force is more self-sufficient, the supply chain would not need to be as responsive. This does not alleviate the supply chain of its responsibility to rapidly react to demand. It simply means that the number of responses required will decrease because the concept of self-sufficiency reduces the collective demand on the supply chain.

An example of this would be a Marine FOB using solar panels to augment its energy requirements. The solar panels reduce the required output of the diesel generators. When the amount of power required from the generators is reduced, the amount of fuel required to run the generators is reduced as well. This in turn reduces the amount of resupply convoys needed to provide fuel to the FOB.

The flexibility of a supply chain can also be improved by applying self-sufficiency concepts. A flexible supply chain can adapt to changing situations within the environment. The customer in the military supply chain is the unit being supported, and as the customer, it is part of the supply chain. By increasing the self-sufficiency of the supported unit, the unit's flexibility is increased along with the flexibility of the supporting supply chain. The improved flexibility allows both

supported and supporting units to better adapt to the changing environment in which they operate.

Sustainability is another characteristic of a supply chain that can benefit from self-sufficiency concepts. Sustainability in a military supply chain is the ability to maintain logistics support for the duration of the mission. The more self-sufficient a unit is, the longer the unit can sustain operations and require less logistical support.

The supply chain is the element over which we have the most control to influence self-sufficiency. The supply chain's composition, capabilities, and relationship with the supported unit(s) are all decisions that are made by some form of leadership. Although the supply chain is adapted based on the environment, its ability to support and sustain Marine operations increases self-sufficiency by decreasing the unit's need to be totally self-reliant. An effective supply chain allows for an increase in duration and intensity of operations.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Our focus during this project was to first define *self-sufficiency* as it relates to the Marine Corps. In order to define *self-sufficiency*, for our purposes, we stayed consistent with the Expeditionary Energy Office's initiatives for creating a more self-sufficient force. In our efforts to define *self-sufficiency*, we first defined the elements of self-sufficiency—time, environment, and supply chain—and analyzed how these elements interrelate and help shape self-sufficiency.

Our motivation for this project was guided by the current strategic initiatives to decrease the Marine Corps' reliance on nonrenewable energy and water sources. Over the past decade at war, the Marine Corps has grown increasingly reliant on fossil fuel and water (i.e., liquid logistics). The Marine Corps' reliance has increased the need for resupply convoys, which have become a critical vulnerability in which there is one fatality for every 50 convoys on average.

We completed this project by conducting an extensive review and analysis of applicable military, academic, and commercial literature. We reviewed the applicable sources to develop a well-rounded concept of self-sufficiency—as it relates to the Marine Corps—and its primary elements. This approach ensured a literature-based context for future discussions and projects related to and based on Marine Corps self-sufficiency.

Our initial understanding of the term *self-sufficiency* was that people or organizations were considered to be self-sufficient if they did not require external support to sustain life or operations. After analyzing the applicable literature, we have determined that this understanding cannot be realistically applied in its entirety to the Marine Corps. Marine Corps operations are often complex, requiring support from many different activities. It would not be feasible or efficient for a Marine Corps unit to attempt to be completely self-sufficient for an infinite period of time.

Although the Marine Corps may never be completely self-sufficient, it can increase its level of self-sufficiency. A unit's level of self-sufficiency is primarily affected by the dynamic relationships among three principal elements: environment, time, and supply chain. Each of these elements interacts with each other to either increase or decrease the self-sufficient capability of a unit. When a unit's level of self-sufficiency is increased, it becomes less reliant on the supply chain that supports it and more focused on accomplishing its mission. Therefore, we have defined *self-sufficiency*, as it relates to the Marine Corps, as a capability that depends on the three primary elements of environment, time, and supply chain.

B. RECOMMENDATIONS

Our project breaks down self-sufficiency into three primary elements—environment, time, and supply chain—to allow for more focused research on how to increase or optimize self-sufficiency of Marine Corps units. Our recommendations for future research projects are as follows:

1. The guiding principle for this project was the need for the Marine Corps to become more self-sufficient. Our recommendation for future research is to establish scalable and appropriate metrics to measure a unit's self-sufficient capability.
2. The military supply chain has grown increasingly reliant on its ability to contract goods and services to provide support for the operating forces. Another recommendation for future research is to study the relationship between contracting goods and services and their ability to enhance a unit's self-sufficient capability.

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