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UNITED STATES MARINE CORPS COST REDUCTION AND THE JOINT BATTLE COMMAND PLATFORM

by

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September 2013

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The Department of Defense and the United States Marine Corps are under increased pressure to reduce costs and expenditures in response to the austere financial environment. Marine Corps information technology (IT) programs are in jeopardy due to budget shortfalls, which may result in reduced military capability. The purpose of this study is to test the theory of vicious business cycles, which relates cost reduction to return on investment for the Joint Battle Command Platform. The Joint Battle Command Platform is an Acquisition Category II program of record designed to meet joint requirements for a common C2/SA system between the Army and Marine Corps. In an attempt to achieve cost savings, the JBC-P has undergone several cost reduction initiatives. Using several value metrics to measure the impact of cost reductions on the capability provided by the program, this study determines that cost reductions do reduce the value of the military capability provided by the program. These reductions could be an indication of a vicious cycle. Identifying the occurrence of vicious business cycles in IT programs will allow decision makers to more effectively cut costs without reducing military capability.

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UNITED STATES MARINE CORPS COST REDUCTION AND THE JOINT BATTLE COMMAND PLATFORM

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ABSTRACT

The Department of Defense and the United States Marine Corps are under increased pressure to reduce costs and expenditures in response to the austere financial environment. Marine Corps information technology (IT) programs are in jeopardy due to budget shortfalls, which may result in reduced military capability. The purpose of this study is to test the theory of vicious business cycles, which relates cost reduction to return on investment for the Joint Battle Command Platform. The Joint Battle Command Platform is an Acquisition Category II program of record designed to meet joint requirements for a common C2/SA system between the Army and Marine Corps. In an attempt to achieve cost savings, the JBC-P has undergone several cost reduction initiatives. Using several value metrics to measure the impact of cost reductions on the capability provided by the program, this study determines that cost reductions do reduce the value of the military capability provided by the program. These reductions could be an indication of a vicious cycle. Identifying the occurrence of vicious business cycles in IT programs will allow decision makers to more effectively cut costs without reducing military capability.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAO	Approved Acquisition Objective
ACAT	Acquisitions Category
ACE	Air Combat Element
AO	Area of Operations
BCT	Brigade Combat Team
BFT	Blue Force Tracker
BOM	Bill of Materials
C2	Command and Control
CDD	Capability Development Document
CD&I	Combat Development and Integration
CE	Command Element
CES	Cost Element Structure
CJCS	Chairman of the Joint Chiefs of Staff
COE	Concept of Employment
COP	Common Operational Picture
COTS	Commercial off the Shelf
CP	Command Post
CPIC	Capital Planning Investment Control
DACT	Data Automated Communication Terminal
DAGR	Defense Advanced Global Positioning System Receiver
DC	Deputy Commandant
DCR	DOTMLPF Change Recommendation
D-DACT	Dismounted Data Automated Communication Terminal
DoD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy
EPLRS	Enhanced Position Location Reporting System

FBCB2-BFT	Force XXI Battle Command Brigade and Below Blue Force Tracker
FCB	Functional Capability Boards
FOC	Full Operating Capability
FoS	Family of Systems
FST	Field Service Technician
FY	Fiscal Year
GAO	Government Accountability Office
GCE	Ground Combat Element
GOTS	Government off the Shelf
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HQMC	Headquarters Marine Corps
IA	Information Assurance
IOC	Initial Operational Capability
IT	Information Technology
ITSG	Information Technology Steering Group
JBC-P	Joint Battle Command-Platform
JBFSA	Joint Blue Force Situational Awareness
JCIDS	Joint Capabilities Integration and Development System
JCR	Joint Capability Release
JROC	Joint Requirements Oversight Council
KPP	Key Performance Parameters
KVA	Knowledge Value Added
LCCE	Life Cycle Cost Estimate
LCE	Logistics Combat Element
M-DACT	Mounted Data Automated Communication Terminal
MAGTF	Marine Air-Ground Task Force
MARCORSYSCOM	Marine Corps Systems Command
MCIEN	Marine Corps Information Enterprise
MCITE	Marine Corps Information Technology Environment

METT-TC	Mission, Enemy, Terrain, Troops, Time and Civilians
MTX	Miniature Transmitter
NSA	National Security Agency
OPFAC	Operating Facilities
PIED	Programmable In-Line Encryption Device
PLI	Position/Location Information
PM	Program Manager
POR	Program of Record
ROI	Return on Investment
SA	Situational Awareness
SoS	System of Systems
TOC	Tactical Operations Center
USMC	United States Marine Corps
VCJCS	Vice Chairman of the Joint Chiefs of Staff
WBS	Work Breakdown Structure

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EXECUTIVE SUMMARY

The federal budget and military expenditures have received considerable attention in recent years due to increased national debt and an unfavorable economic climate. As a result, mandatory budget reductions are being made to many defense programs to include those involving information technology (IT) maintenance and acquisition. While budget reduction efforts are increasing, the global demand for IT resources and the threats of cyber-attacks to the national and military infrastructure are also increasing (Government Accountability Office, 2011). The result is an increased requirement for greater IT capability, particularly across the Department of Defense. Therefore, the current challenge is to reduce costs in order to meet budget restrictions while simultaneously continuing to maintain a robust military IT capability (GAO, 2011). However, reducing costs without proper analysis has the potential to incur what the private sector terms a business "death spiral" or vicious cycle (Rust, Moorman, & Dickson, 2002). The business vicious cycle is a negative feedback loop, where cost-cutting measures may put higher burdens on existing programs and personnel, reducing the quality of the current systems and number of qualified personnel leading to further cost cutting due to the perceived ineffectiveness (Rust, Moorman, & Dickson, 2002).

The problem is that support for Marine Corps information technology (IT) programs are in jeopardy due to budget shortfalls, which may result in reduced military capability. The theory of vicious business cycles, relates cost reduction to return on investment as a self-reinforcing positive feedback loop (Masuch, 1985). Identifying the occurrence of vicious business cycles in IT programs will allow decision makers to more effectively cut costs without reducing military capability. This is important because as the Marine Corps faces increased budget reductions, and systematically reducing costs in an effective manor from within the Department of Defense and the Marine Corps is becoming increasingly important.

The Joint Battle Command Platform is an Acquisition Category II program of record designed to meet joint requirements for a common C2/SA system between the Army and Marine Corps. In an attempt to achieve cost savings, the JBC-P has undergone

several cost reduction initiatives. This study uses six value metrics to represent the military capability provided by the program. These metrics include the number of systems (AAO), number of technical support for the systems, refresh rates, the expected life cycle, the PLI reception rate standard, and the system technology type. These metrics are compared over time as several implementations of cost reduction initiatives were implemented. Using the six value metrics to represent military value or capability, this study determines that cost reductions do reduce the value of the military capability provided by the program over time. Over the four fiscal years covered in this study, the life cycle cost was increasingly reduced with each cost reduction iteration. These reductions could be an indication of a vicious cycle. However, there is not enough evidence to definitely determine that a vicious cycle is occurring. Cost reductions are having a negative effect on the ability of the program to satisfy the Joint Capability Areas (JCAs) that it was designed to achieve. Further study is required to determine if similar reductions are occurring in other programs in the Marine Corps C2 portfolio. Nevertheless, identifying the occurrence of vicious business cycles in this program, as well as other IT programs, will allow decision makers to more closely manage cost reductions to avoid unnecessary loss in military capability.

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I. INTRODUCTION

The federal budget and military expenditures have received considerable attention in recent years due to increased national debt and an unfavorable economic climate. As a result, mandatory budget reductions are being made to many defense programs to include those involving information technology (IT) maintenance and acquisition. While budget reduction efforts are increasing, the demand for IT resources across the globe and the threats of cyber-attacks to the national and military infrastructure are also increasing (Government Accountability Office, 2011). The result is an increased requirement for greater IT capability, particularly across the Department of Defense. Therefore, the current challenge is to reduce costs in order to meet budget restrictions while simultaneously continuing to maintain a robust military IT capability (GAO, 2011). However, reducing costs without proper analysis has the potential to incur what the private sector terms a business "death spiral" or vicious cycle (Rust, Moorman, & Dickson, 2002). The business vicious cycle is a negative feedback loop where cost cutting measures may put higher burdens on existing programs and personnel, reducing the quality of the current systems and number of qualified personnel leading to further cost cutting due to the perceived ineffectiveness (Rust, Moorman, & Dickson, 2002).

The commercial sector and private industry both use return on investment (ROI) as a tool for measuring a program's value (Bingham & Goudreau, 2004). In the private sector, ROI is calculated using a dollar value revenue-based approach (Bingham & Goudreau, 2004). Determining ROI in public sector, and specifically the Department of Defense (DoD), is more problematic because there is not a monetary equivalent for revenue (Bingham & Goudreau, 2004). Therefore, ROI in the DoD must be measured using a different approach. Any method for analyzing the ROI of program investments can also be used to measure the resulting value from cost cutting of IT programs in the public and private sector. This is potentially beneficial to the Department of Defense and the United States Marine Corps because a thorough understanding of the implications of cost reduction measures in IT will allow decision makers to better leverage the capabilities if IT systems while simultaneously minimizing associated costs.

The Department of Defense and the United States Marine Corps are under increased pressure to reduce costs and expenditures in response to the austere financial environment. The problem is that support for Marine Corps information technology (IT) programs are in jeopardy due to budget shortfalls, which may result in reduced military capability. The purpose of this study is to test the theory of vicious business cycles, which relates cost reduction to return on investment in IT in the United States Marine Corps. Identifying the occurrence of vicious business cycles in IT programs will allow decision makers to more effectively cut costs without reducing military capability. This is important because as the Marine Corps faces increased budget reductions, and therefore systematically reducing costs in an effective manor from within the Department of Defense and the Marine Corps is becoming increasingly important.

This will be a case study of a Marine Corps IT program of record (POR) that is undergoing cost reductions. The research methods primarily involve secondary research focused on the case of Marine Corps application of cost reduction in IT. Secondary research will also include contemporary business case vignettes to understand similar industry cost reductions and the consequences of those decisions as a way to compare private sector cost cutting methods to Marine Corps methods. Additionally, research will be conducted on ROI valuation within the Marine Corps in the budget process as a way to understand budget decision-making. Finally, research obtained from reviewing and studying ROI valuation and cost cutting in the private sector will be compared to Marine Corps methods for the purpose of improving effective cost reduction measures.

The focus of this research will be to review cost cutting with the Joint Battle Command Platform (JBC-P) Family of Systems programs in the Marine Corps. Additionally, a qualitative descriptive approach will be used which will analyze the impact of cost cutting measures to the ROI of the investment in the JBC-P program. The independent variable will be cost reductions and the dependent variable will be ROI. The ROI calculations for the studies will be compared to the baseline military capability provided by the program before the reductions were implemented. The potential benefits that may result from this thesis study include a better understanding of how cost reductions in the DoD and the Marine Corps will impact the return on investment in

Information Technology programs. As the Marine Corps moves further toward implementation of sequestration and other budget reduction measures, Marine Corps leadership and financial professionals could benefit from a better understanding of the impact that cost reduction measures can have on the organization and their investments. As the Marine Corps moves further toward a more robust IT and cyber capability, Marine Corps decision makers could benefit from a better understanding of how to generate the largest return in value while reducing costs and apply those principles to recognize and manage risk in the Marine Corps IT budget process.

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II. BACKGROUND

This chapter provides a brief overview of existing economic theories on return on investment (ROI), and vicious cycle theory. This chapter will also provide a background on the Marine Corps IT investment vision and strategy. Last, this chapter will cover Marine Corps involvement with Blue Force Tracking and Situational Awareness technologies including the Joint Battle Command Platform Family of Systems.

A. PROBLEM STATEMENT

The Department of Defense and the United States Marine Corps are under increased pressure to reduce costs and expenditures in response to the austere financial environment. The problem is that support for Marine Corps information technology (IT) programs are in jeopardy due to budget shortfalls, which may result in reduced military capability.

B. PURPOSE STATEMENT

The purpose of this study is to test the theory of vicious business cycles, which relates cost reduction to return on investment in IT in the United States Marine Corps. Identifying the occurrence of vicious business cycles in IT programs will allow decision makers to more effectively cut costs without reducing military capability. This is important because as the Marine Corps faces increased budget reductions, and systematically reducing costs in an effective manor from within the Department of Defense and the Marine Corps is becoming increasingly important.

C. RESEARCH QUESTIONS

1. What types of risks are created when large scale cost reductions are implemented in IT system procurement and management?

2. Do funding reductions for IT programs generate a self-perpetuating deviation-amplifying positive feedback loop with respect to ROI?

3. How can DoD leadership more accurately measure ROI to recognize and manage risks with regards to reducing funding for IT programs?

4. How does ROI calculation using a qualitative analysis compare with the current DoD ROI calculation in defense budget analysis?

5. How can the DoD more effectively manage budget reductions so that the impact on operational effectiveness is minimized?

D. BACKGROUND

In response to mandatory budget reductions, the DoD has been forced to initiate significant cost cutting measures (Sharp, 2012). Cost reductions in an organization have the potential to cause a death spiral or vicious cycle of downward performance (Rust, Moorman, & Dickson, 2002). The vicious cycle is a negative feedback loop where a certain behavior reinforces itself and produces detrimental results (Rust, Moorman, & Dickson, 2002). In the private sector, the implementation of cost reduction measures may initiate firings and loss of benefits, which in turn would result in a reduction in customer service, customer loyalty, and sales which would lead to further cost reduction efforts (Rust, Moorman, & Dickson, 2002). Cost cutting can also have major implications in the public sector, particularly the DoD (Parrish, 2012). Efforts to reduce costs in defense programs may put higher burdens on existing programs and personnel, reducing the quality of the current systems and the number of qualified personnel (Hillen, 1999). The information technology services provided by the DoD IT organizations are no exception.

1. Vicious Cycle Theory

In an attempt to increase productivity and control costs, many organizations find themselves in a service quality “death spiral” (Olivia & Sterman, 2010). These death spirals or vicious cycles occur when organizations attempt to control costs and increase throughput, resulting in worker burnout, corner cutting, and service quality reduction. This result than produces more cost cutting due to productivity loss and the cycle then repeats itself (Olivia & Sterman, 2010). This phenomenon usually occurs when productivity growth is perceived to be low. The organization then usually reacts to this perception by implementing cost containment initiatives to make gains in efficiency (Olivia & Sterman, 2010). However, this pressure to “do more with less” can force programs or organizations to operate with little ability to accommodate demand variability (Olivia & Sterman, 2010, p 3). These policies typically result in poor quality when demand temporarily rises. In addition, cost reduction initiatives such as these can trigger a set of self- reinforcing processes (Olivia & Sterman, 2010). These processes lead to the persistent, continual erosion of service quality, service capacity, and the customer base. This results in positive feedback loops that function as vicious cycles that may lead an organization or program into a death spiral of declining quality, customer loss, budget cuts, higher work pressure, poor morale, and higher employee attrition (Olivia & Sterman, 2010). This cycle may then continue until the organization or program is degraded to the point of ineffectiveness. However, despite the tendency naturally toward quality erosion in cost cutting, with the right mix of policies, these same positive feedback loops can reverse themselves producing what they term a “virtuous” cycle (Olivia & Sterman, 2010). Therefore, it is important to understand how to recognize vicious cycles in order to correct them.

The logic of vicious cycles, or vicious circles as Masuch (1985) refers to them, finds its theoretical basis in the concept of action loops. Action loops are built upon the theoretical notion of social systems. The basic element of social systems is individual human or unit actions (Masuch, 1985). These individual unit actions have four primary components, which include the individual actors, the actor’s purpose, the situation to be acted upon, and the specific activity itself (Masuch, 1985). The theory is based upon the concept that individual actors will act upon their purpose in a given way in a situation in a conscious manner that does not intentionally work against that original purpose. The result of this unit action is change but one action alone does not constitute a system (Masuch, 1985). Social systems comprise repeated actions that form action loops. Action loops are created when some action generates a series of other actions which ultimately re-create the original situation (Masuch, 1985). When the original situation is re-created, the loop can then repeat itself creating a network of activities that result in unique identity characteristics within that environment. This network of activities made up of action loops are then referred to as systems (Masuch, 1985).

In cybernetics, these action loops are called feedback loops. These feedback loops are described as being either positive or negative feedback loops. In addition, these feedback loops are generally described as approaching some reference point or moving away from it (Masuch, 1985). Positive feedback loops can also be described as deviation amplifying when related to a normative reference point, or value judgment, and are referred to as self-reinforcing when related to factual reference points (Masuch, 1985). Page numbers needed with directly quoted material. Subsequently, negative feedback loops are described as "deviation counteracting" when referenced to a normative, and "self-correcting" when referenced to a fact. Positive feedback loops are feedback loops that move away from some reference point and negative feedback loops are loops that move toward or remain constant with regard to some reference point (Masuch, 1985). However, the reference point depends on perspective. Likewise, determining whether or not a feedback loop is a vicious circle also depends on the point of reference.

Vicious circles are a specific type of feedback loop. These feedback loops can be described as deviation-amplifying (vicious circles), deviation-counteracting, self-reinforcing or self-correcting (Masuch, 1985). Vicious cycles are usually described as spirally processes. These processes can be deviation amplifying where a negative impact to one variable causes similar negative impacts to other variables and the cycle continues until nothing can stop the cycle (Masuch, 1985). This phenomenon then becomes a self-terminating dynamic. However, sometimes death spirals can occur for a different reason. Instead of continually contracting circles, death spirals can also occur form continually expanding circles (Masuch, 1985). These circles are fed by outside processes, and growth depends on iteratively increasing variables. Eventually the circles exhaust all available resources resulting in another type of self-terminating dynamic (Masuch, 1985). Masuch argues that deviation-amplifying feedback loops are feedback loops where a change to one variable results in the change in other variables that move the circle away from a reference point (1985). I think I sent you some APA examples in your Initial Review. When you mention a name in the sentence, you only need a date in the parenthetical citation. Subsequently, if a feedback loop isn't deviation-amplifying than it is deviation counteracting. Deviation-counteracting loops are feedback loops where a change to one variable is balanced by an opposing changing variable that counteracts the change incurred by the first variable. Deviation counteracting loops tend to move toward or maintain themselves with respect to a reference point (Masuch, 1985). Either of these feedback loops can also be termed as self-reinforcing or self-correcting if they are based on factual reference points (Masuch, 1985).

	Deviation-amplifying	**Deviation counter-acting**
Self-reinforcing feedback	**Undesired change (Crisis)**	**Desired change (Development)**
Self-correcting feedback	**Undesired permanence (Stagnation)**	**Desired permanence (Stability)**

Table 1. Typology of Feedback Loops (From Masuch, 1985)

Vicious circles may also occur in combination, with layers of vicious circles occurring within the same organization. One type of combination vicious circle is termed an explosive feedback loop (Masuch, 1985). Explosive loops combine two or more feedback loops where at least one is deviation amplifying. Organizations can have multiple layers of vicious circle feedback loops. For example, there can be a layer 1 vicious circle, a layer 2 vicious circle, and a layer 3 vicious all within the same organization. It is easy to then imagine how a change to a variable in the layer 1 vicious circle could lead to an explosive loop where that change could cause further changes to variables in layer 2 and then layer 3 (Masuch, 1985). Monitored clusters are another form of combination feedback loops. Monitored clusters combine one or more deviation amplifying feedback loops with one or more negative feedback loops. Monitored clusters have more deviation amplifying feedback loops than negative loops. However, the negative loops in a monitored cluster are not enough to completely counteract the growing vicious circle but instead put a check on the circle's expansion (Masuch, 1985).

Vicious circles are created by human actors due to an inadequate understanding of their situation. In particular, the deviation-amplifying feedback loop occurs specifically because of an inaccurate assessment of a situation (Masuch, 1985). As a result, the continued actions lead further and further away from a desired outcome. The actors are often unaware of this behavior because otherwise they would they would likely pursue a different policy (Masuch, 1985). Action loops, or feedback loops, are comprised of an individual actor, a situation to be acted upon, and the actor's purpose. The actor pursues their purpose in a rational manner, although it may be unconscious. Otherwise, the actor would be behaving in such a way as to frustrate their own purpose, which would be illogical (Masuch, 1985). There are three factors that explain why a vicious circle continues on its destructive path and remain undetected: (1) participants' cognitive disposition, (2) the complexity of the situation, and (3) the self-concealing nature of vicious circles (Masuch, 1985). Vicious circles are dangerous and destructive to organizations. However, it is possible to detect them and understanding them can provide direction for organizational improvement (Masuch, 1985).

2. USMC C2 Strategy

The USMC Concepts and Programs 2013 document outlines the vision and strategy guiding the development and acquisition of Marine Corps command and control systems (Headquarters Marine Corps, 2013). The vision for Marine Air Ground Task Force (MAGTF) Command and Control (C2) is based upon a leader-centric and network-enabled framework designed to support and enhance the decision making cycle of the warfighter. The vision is that Commanders will be able to better command and control widely dispersed units across the battlefield (HQMC, 2013). This control is desired to be extended down to the company level and below. The vision describes a Marine Corps who's systems are highly connected internally within the organization, as well with joint forces and with mission partners. This networked force will then be able to share information, collaborate, create adaptive organizations and achieve synchronization and integration below the company level (HQMC, 2013). At the core of the MAGTF C2 vision are the following principles:

- Commander/Leader Centric
- Network enabled
- Information Assurance
- Collaborative, shared situational understanding
- Performed by all echelons
- Can be performed anywhere in the operational environment

Within this MAGTF C2 vision is the Marine Corps Information Enterprise (MCIEN) strategy. The MCIEN strategy is designed to achieve the goals set out in the MAGTF C2 vision. The MCIEN is defined as, "the Marine Corps information resources, assets, services, and processes required to achieve decision and execution superiority, and to share information and knowledge across the Marine Corps and with mission partners" (HQMC, 2013). The vision of the MCIEN is to develop a knowledge-based force that is seamlessly connected to essential enterprise capabilities across the full spectrum of operational environments. The purpose of this vision is to facilitate enhanced decision making, achievement of knowledge superiority, and to gain the tactical, operational, and strategic advantage (HQMC, 2013). The MCIEN has also outlined a strategy to support the achievement of this vision statement.

The MCIEN strategy is designed to achieve the MCIEN vision through the development of improved communications and services that are both seamlessly connected, mobile and secure (HQMC, 2013). The MCIEN strategy is aimed at the development of technological systems that enable collaboration, coordinated actions, and instant, or near real-time, access to mission-critical data, information, and knowledge (HQMC, 2013). Subsequently, the Marine Corps Information Technology Environment (MCITE) will focus on the development of systems that more effectively deliver, display, and manage data, information, and knowledge across the Marine Corps and DoD enterprise (HQMC, 2013). Marine Corps IT investments will be developed as systems that enhance the reach of command and control on the battlefield while increasing organizational and tactical agility. In addition, IT investments will also focus on professional training and educational systems for the organization to educate military members and civilian employees on how to leverage these technological advantages

(HQMC, 2013). Last, the MCIEN strategy is focused on the development of IA practices and technology to protect and defend data, information and knowledge while maintaining the technological advantage over adversaries.

3. Joint Requirements Oversight Council

The determination of the joint force requirements that drive the development of IT systems that support the Marine Corps C2 strategy is made by the Joint Requirements Oversight Council (JROC). The JROC is the highest-level board and process owner of the Joint Capabilities Integration and Development System (JCIDS) (Chairman of the Joint Chiefs of Staff, 2012). The key and statutory responsibility of the JROC is to validate joint warfighting requirements (Fast, 2013). The JROC reports to the Secretary of Defense regarding the identification, assessment and prioritization of joint military requirements (Fast, 2013). The JROC is a staffing organization designed to ensure that the needs of the services and component commanders meet the needs of the joint force. The JROC's direct area of interest encompasses ACAT I/IA programs & Joint Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy (DOTMLPF-P) Change Requests (DCR) (Fast, 2013). The responsibilities of the JROC include advising the Secretary of Defense on the prioritization of requirements identified by the Combatant Commands (CJCS, 2012). In addition, the JROC also advises the Secretary of Defense on how well the program recommendations and budget proposals of the Services, Combatant Commands, and other components of the DoD align with the priorities established in strategic plans and with the Combatant Command priorities (CJCS, 2012). In summary, the JROC validates the requirements for joint acquisition programs and ensures they meet strategic objectives.

The JROC board permanently consists of a chairman and four council members from the Army, Navy, Air Force, and Marine Corps, respectively (Fast, 2013). Commas always come before using the use of "respectively.: The Vice Chairman of the Joint Chiefs of Staff (VCJCS) is the chairman of the council, and council members include the Vice Chief of Staff for the Army, the Vice Chief of Naval Operations, Vice Chief of Staff for the Air Force, and the Assistant Commandant of the Marine Corps. The Combatant

Commands must be consulted and attend as invited by VCJCS. Currently there is a standing invitation for all the Combatant Commands to attend all JROC sessions (Fast, 2013). The JROC council uses Functional Capability Boards (FCBs) to provide the analytical foundation for JROC recommendations and brief the JROC on validation recommendations. The JROC then advises the Chairman of the Joint Chiefs of Staff on the validation determination made by the board (Fast, 2013).

4. USMC C2 Portfolio

The FY12 MAGTF C2 Roadmap outlined a C2 portfolio that was designed to provide a strategy for the development of MAGTF C2 systems for the Marine Corps out to FY 2020. These same concepts have been carried in to the current FY13 MAGTF C2 Roadmap (Headquarters Marine Corps Combat Development & Integration, 2012). In addition, the new FY13 Roadmap incorporates new improvements to the previous year's strategy that are to be achieved through FY 2021. The primary themes are aimed at reducing redundant systems and eliminating inefficiencies in order to streamline MAGTF C2 (HQMC CD&I, 2012). An important part of the development strategy is to continuously monitor and adjust development activities as the needs and priorities of the Marine Corps as well as new more effective solutions are identified (HQMC CD&I, 2012). The MAGTF FY13 C2 Roadmap divides the current C2 portfolio into three primary categories: Core MAGTF C2 Systems, Critical Associated MAGTF C2 Systems, and Associated MAGTF C2 Systems. There are currently 33 Core C2 Systems, 16 Critical Associated MAGTF C2 Systems, and 77 Associated MAGTF Systems within the portfolio (see Appendix A). The entire portfolio is viewed as the MAGTF C2 System of Systems (SoS). Several of these systems are considered to be Family of Systems (HQMC CD&I, 2012). The core MAGTF C2 FoSs in the C2 portfolio consist of the following list:

- JBC-P
- OPFAC & Networking
- Aviation C2
- Tactical Communications & Networking
- COP Tools
- Transmission Systems

- Switching & Multiplexing
- Systems Engineering and Integration
- Miscellaneous

The relationship between the FoS and SoS is depicted in represented in Figure 1. All of these programs are developed with several characteristics in common as outlined by the MAGFF C2 Roadmap. These characteristics describe systems that are modular, scalable, interoperable, shared, agile, secure, and survivable (HQMC CD&I, 2012). The capabilities provided by the individual programs are evaluated based on these characteristics.

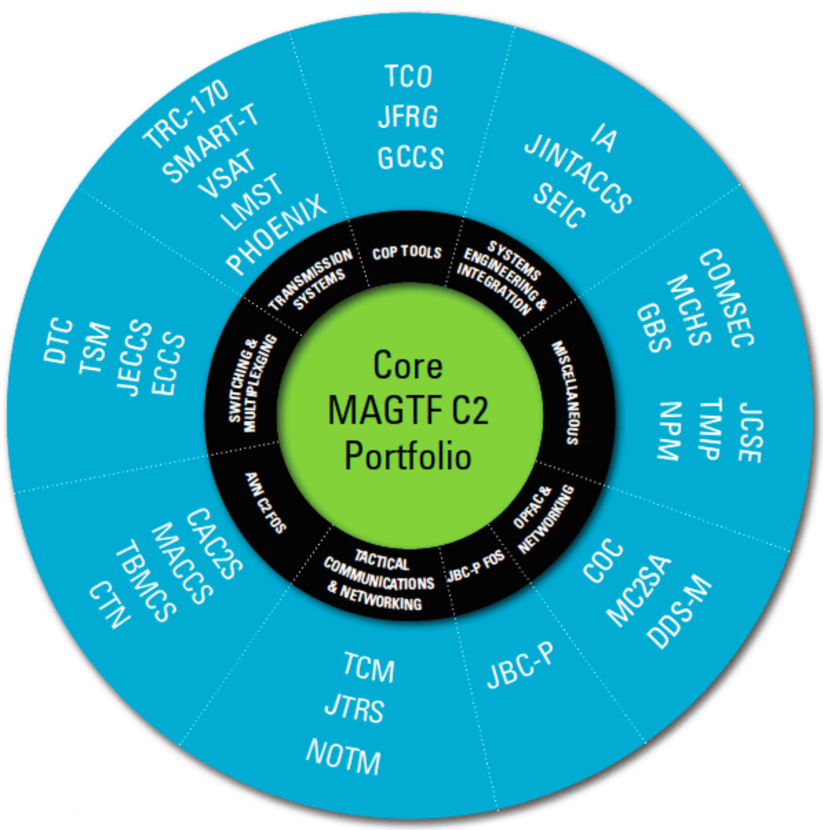

Figure 1. Core USMC MAGTF C2 Portfolio (From HQMC CD&I, 2012)

5. Budget Pressures

In 2011, Congress passed the Budget Control Act and put in place the mechanism for automatic budget cuts across the U.S. government. On January 2, 2013, the Budget

Control Act came into effect and an automatic sequestration of funds was initiated. Originally, a budget cap of $546 billion was imposed on the Department of Defense over ten years (Harrison, 2012). However, the Congressional Joint Select Committee on Deficit Reduction failed to achieve any of the budget reductions that it was charged to find and an additional $54.7 billion was imposed on the defense's budget cap (Harrison, 2012). This reduced the new budget cap, along with other constraints to $487 billion over the next ten years. The Budget Control Act also specified that these cuts would be applied as a uniform percentage across the DoD. Of all of the services, the Navy and Marine Corps had the smallest budget reduction at 4.3% (Harrison, 2012). However, this percentage increases slightly over the next ten fiscal years. In FY13 the Marine Corps budget was reduced by $1.2 billion with the potential that further uncertain reductions may continue into the future (Harrison, 2012). These budgetary pressures have put significant strain on the ability of the Marine Corps and the Marine Corps to fund the MAGTF C2 portfolio.

The current austere financial environment is shaping how the Marine Corps manages the MAGTF C2 portfolio. The goal is to meet capabilities requirements while achieving greater efficiency, developing new ways of reducing sustainment costs, and conducting selective modernization (HQMC CD&I, 2012). Furthermore, in response to financial pressures, the portfolio is analyzed against several considerations. These considerations include the following categories: amphibious/expeditionary operations, sustainment strategy, determination of necessity, and modernization (HQMC CD&I, 2012). As the Marine Corps reorients from the Middle East areas of operation to the Pacific, there is an increased focus on conducting shipboard and ship to shore operations. MAGTF C2 systems will need to be developed that meet these operational needs, or their value to the organization may be reassessed (HQMC CD&I, 2012). In addition, The MAGTF C2 Roadmap describes that programs will be evaluated based on their sustainability. Constant sustainment and declining funds increases the risk to the program and resources. Therefore, it necessitates the need to develop systems with low sustainability costs (HQMC CD&I, 2012). The third consideration when evaluating programs in the MAGTF C2 portfolio is the need to determine whether capabilities are required capabilities or simply desired capabilities. Expending limited resources to develop capabilities that are non-essential may take resources away from programs and capabilities that are determined to be critical to meeting organizational requirements (HQMC CD&I, 2012). The last consideration made in evaluating the Marine Corps C2 portfolio is the need for modernization. The Marine Corps needs to ensure that its systems stay modern or it risks losing critical capabilities due to obsolescence. Therefore, the Marine Corps is evaluating the C2 portfolio according to a risk-reward assessment based on the following criteria (HQMC CD&I, 2012, p 24):

- Whether the program must continue on its current schedule or risk a loss of critical capability
- The program can be delayed and the impact managed or mitigated
- Reducing the capacity of the capability is warranted
- Whether the system cannot be reasonably justified due to the current financial environment

These considerations are shaping the current efforts at budget reduction with regard to the MAGTF C2 portfolio.

6. Return on Investment

The increasing global threat of cyberattacks has highlighted the importance of information technology and "cyber" capabilities within the Department of Defense (GAO, 2011). Within the current economic and political environment, measuring the return on information technology investments is critical for examining cost efficiency (Pavlou, Housel, Rodgers, & Jansen, 2005). In addition, the ability to be able to measure the cost and the revenue due to IT, at a specified point in time, would make it possible to establish an independent return ratio for productive assets such as IT (Pavlou et al., 2005). However, the Marine Corps, and the Department of Defense in general, have difficulty in determining the market price of defense outputs that reflect society's valuation of those outputs (Hartley, 2011). There is no market price for the value of a tank or submarine force as there would be for private sector goods such as cars. Without realistic market prices, it is difficult to determine the revenue of what is produced within the Department of Defense (Hartley, 2011). As a result, a value determination must be made that captures what the output of defense investments are really worth to the organization and society (Hartley, 2011).

The concept of Return on Investment (ROI) has been critical in determining the valuation and effectiveness of investments made in organizational management (Bingham & Goudreau, 2004). In recent years, the federal budget, including the defense budget, has received an increasing amount of attention (Sharp, 2012). Due to the Budget Control Act passed by Congress and the President in August of 2011, the Department of Defense in facing a reduction in federal funding of $487 billion over ten years (Sharp, 2012). As a result, the importance of valuing ROI in Department of Defense programs has become even more important in ensuring that funding is being allocated for the most effective and valuable programs (Bingham & Goudreau, 2004). Evaluating ROI for defense requires a different approach than evaluating ROI for the private sector. Traditionally, ROI is a monetary percentage where the percentage ROI is equal to the ratio of earnings over the investment (Bourazanis & Gusnadi, 2005).

$$Percentage\ ROI = \frac{Earnings}{Investment}$$

However, the "earnings" produced by defense investments are not readily valued in terms of profits and revenues. Instead, other sources of hard data must be used to determine the value of earnings. The value of any government output can be measured using the four major categories of hard data: output, quality, cost, and time (Bourazanis & Gusnadi, 2005). Therefore, the ROI ratio can be described not using only monetary values but also through these four terms. Cost remains in monetary terms, and is included in both the investment and earnings portions of the ROI equation (Bourazanis & Gusnadi, 2005). However, output, quality and time can also provide a substitute for revenue to describe the numerator. In order to increase the ROI for the Department of Defense investment, the desired goal would then be to save time, improve quality, and increase productivity (Bourazanis & Gusnadi, 2005).

Currently, the Marine Corps leadership does not have a systematic process to link IT investments with its two primary ROI processes, Capital Planning Investment Control (CPIC) and Information Technology Steering Group (ITSG) (Shives, 2012). In addition, the

Marine Corps does not calculate an ROI percentage but rather conducts cost based analysis. This cost-based analysis is generated in the form of the Life Cycle Cost Estimate (LCCE). A LCCE is generated at each Milestone Decision of a program in the defense acquisition process (Marine Corps Systems Command, 1998). The LCCE contains the methodologies, assumptions, definition of terms, cost drivers, factors, cost estimating worksheets and a cost model structure for a particular program. This information is used to provide a method for evaluating program alternatives (Marine Corps Systems Command, 1998). However, in the foreseeable future, investment, procurement, and life-cycle maintenance spending is likely to be reduced. Therefore, a disciplined and comprehensive approach for reviewing IT investments is essential for the DoD and the Marine Corps to operate in a constrained budget environment (Shives, 2012).

7. Stakeholders

There are multiple stakeholders involved in the investment of IT programs in the DoD. Typically, there are more stakeholders that are interested in a government entity investment than there would be in a private sector venture (Bourazanis & Gusnadi, 2005). In the private sector, primarily the organization is the interested stakeholder in the ROI of an investment decision (Bourazanis & Gusnadi, 2005). The groups most interested in the ROI of a government investment initiative would include the program participants, the immediate manager of the participants who support the program, the sponsor who initiates or approves the program, top administrators who manage the agency, the lawmakers who create laws and regulations concerning the accountability of programs, and taxpayers who are concerned about the use of tax dollars (Bourazanis & Gusnadi, 2005). Therefore, for Marine Corps IT investment decisions the following stakeholders would be interested in the outcome: the warfighter who will benefit from the investment, the defense industry, the program management, the Department of Defense leadership, the legislative branch of government, the executive branch of government, and the taxpayers (Fast, 2013). All of these stakeholders are impacted by investments in defense program acquisition and development (Fast, 2013).

8. Joint Battle Command Platform

The Joint Battle Command Platform (JBC-P) is an Army led joint digital battle command information Family of Systems (FoS) program designed to provide integrated, on-the-move, timely and relevant command and control (C2) and situational awareness (SA) to tactical combat, combat support commanders, leaders, and key C2 nodes. (HQMC CD&I, 2012). The program is an Acquisition Category II (ACAT II) program designed to meet requirements established by the Joint Requirement Oversight Council (JROC) as a joint interest program supporting Tier 1 Joint Capability Areas of Joint C2, Joint Battlespace Awareness, and Joint Net-Centric Operations (Marine Corps Systems Command, 2012b). Specifically, it is designed to satisfy a JROC approved Capabilities Development Document (CDD) (HQMC CD&I, 2012). The United States Marine Corps (USMC) is participating in the JBC-P program under the authority of the Marine Corps Systems Command (MARCORSYSCOM) (MCSC, 2012b). The JBC-P is a Family of Systems that represents the next evolution of the Blue Force Tracker Family of Systems (HQMC CD&I, 2012).

Figure 2. BFT TOC Kit and HMMWV Mounted Variants (From Alexander, 2013)

The JBC-P FoS program is an incremental development with two increments. The JBC-P FoS is defined as a weapon system program with a product line made up of systems and products associated with the BFT FoS (Increment I) and JBC-P (Increment II) (MCSC, 2012b). The JBC-P FoS encompasses both Increment I and Increment II. Increment I consists of JCR software, BFT mounted systems, Tactical Operations Center (TOC) Kits, the improved BFT-2 transceiver, and the KGV-72 National Security Agency (NSA) Type 1 Programmable In-Line Encryption Device (PIED) (MCSC, 2012b). Increment II is the JBC-P product that consists of JBC-P software, which will run on the hardware delivered under Increment I. Increment II also consist of a dismounted handheld computing platform (MCSC, 2012b). In addition, the JBC-P FoS will consist of three primary system types: vehicle-mounted systems, dismounted systems, and Tactical Operations Center (TOC) kits.

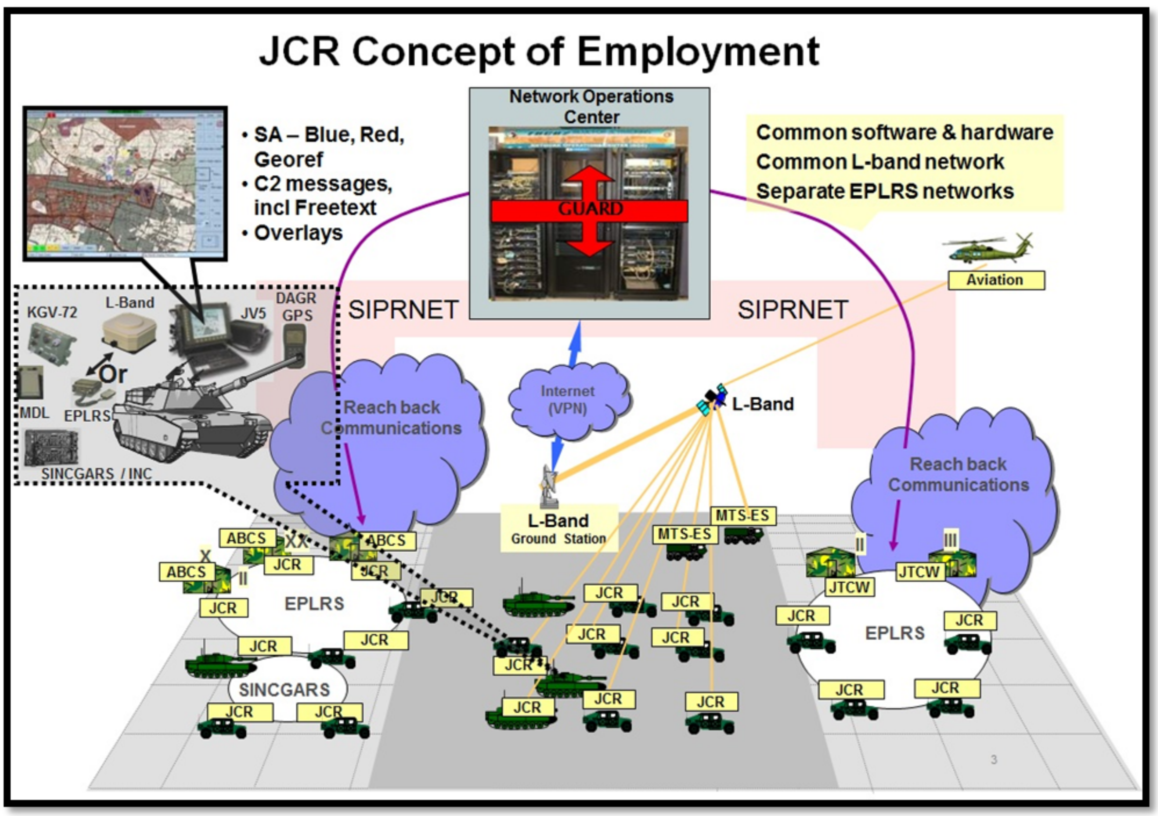

Figure 3. JCR Concept of Employment (COE) (From Alexander, 2013)

The JBC-P is designed to achieve technical interoperability both vertically and horizontally across joint warfighting components in all operating environments

(Alexander, 2013). JBC-P capabilities are also designed to increase the accuracy and density of position location information (PLI) and the situational awareness (SA) picture to further reduce and manage fratricide risk (Alexander, 2013). In addition, increases in the accuracy of graphical overlays and the increased efficiency of orders transmission will provide commanders with improved friendly, hostile, neutral, unknown, and non-combatant SA (Space and Naval Warfare Systems Center, 2011). The improvements to the previous BFT FBCB2 system for the JBC-P will address JROC convergence directives and increase interoperability between services (Alexander, 2013). The concept of employment of the JBC-P FoS is that it will be the primary generator of PLI for ground forces in the MAGTF. In addition, it is designed to be the primary digital command and control situational awareness (C2/SA) system for Marine battalions and below. It will also serve as a redundant C2/SA capability for the battalion and above (MCSC, 2012b). Therefore, the JBC–P FoS is designed to provide C2/SA capabilities at the platform level across the Army and Marine Corps to enable joint warfighters to gain and maintain the tactical and operational initiative under all mission, enemy, terrain, troops, time and civilians (METT-TC) conditions (MCSC, 2012a).

E. IMPLEMENTATION

1. Development and Conversion Strategies

Because the JBC-P FoS has largely already been developed and partially implemented, we will assess the effectiveness of the program's development thus far, instead of proposing a separate development strategy. Initial feedback of the system has been largely positive as warfighter interviews consistently assess the capabilities as greater than previous systems in the areas of situational awareness and interoperability (Alexander, 2013). Additionally, the development took a decidedly incremental approach to not only fielding, but also development. This gave the program the flexibility to make incremental changes to different platforms as the system was designed, rather than large after-the-fact modifications to the contract. This incremental approach has been particularly beneficial to the software development as each additional refinement creates new capabilities without sacrificing the core competencies of the system (Alexander, 2013). However, much of the strategy was a top-down directed development program, with few indications of extensive field interviews in the early phases to assess the needs of the warfighter. Additionally, some believe that the because the U.S. Army has led the program management, many of the requested Marine Corps capabilities have been given a lower priority on the system, reducing the effectiveness for the Marines, while preserving system effectiveness according to U.S. Army specifications (Alexander, 2013).

As we mentioned previously, in addition to development, the DoD has favored an incremental conversion strategy over the ill-fated flash cutover discussed in the FBI case study on the Trilogy system. This offers the DoD a number of advantages not possible with the flash cutover approach. First, incremental changes are more easily implemented if the conversion only occurs in a limited population of the ultimate deployment environment (Ambler, 2001). This advantage, while intuitive, is worth mentioning because of the dangerous environments in which these systems may operate. Should a critical system vulnerability or potential software exploit present itself in the first 6 months of deployment, installing the required patch is much more manageable with an initially limited distribution of systems (Ambler, 2001). A second advantage is the scalability of the required training associated with the system. Regardless of design quality, training requirements will always need to be addressed when deploying a new system. The JBC-P is no different and the incremental roll out strategy allows trainers to successfully provide adequate training to the target population. The final benefit to the phased approach are the real options afforded to the program managers. If the system effectiveness is far below acceptable thresholds scrapping the program is much less costly if the program has been only partially implemented (Fink, 1998).

Unfortunately, there a several risks to this phased adoption strategy. Most can be classified as temporary inefficiencies, including increased maintenance requirements, losses in economies of scale, and limited unit interoperability. Maintenance increases at higher echelons are expected as the requirement to support both systems will place a temporarily increased burden on support personnel. Furthermore, losses to economies of scale will be evident in rising replacement part costs and average repair time for inoperable systems. Finally, the phased adoption strategy may affect unit interoperability as different units are equipped differently during the transition. The JBC-P is designed to mitigate, or at least reduce, this problem through backwards compatibility with the current BFT systems. Again, while these risks and inefficiencies can be, and have been, reduced, they cannot be eliminated and should be addressed in any phased adoption strategy, including the JBC-P.

The capability to identify position location information is a capability that contributes to situational awareness. More specifically, identifying position information satisfies the situational awareness requirements to maintain the ability to gain knowledge regarding the status of friendly forces, enemy forces, other threats, neutral or civilian local population, and information regarding the area of operations (AO). The minimum acceptable performance of the receipt of position location information (PLI) is outlined in the Capabilities Development Document (CDD) for the JBC-P as the Key performance Parameters (KPP). The KPPs outline threshold and performance values for performance of the reception rate of PLI. The Objective values are the desired performance values and the threshold values are the minimum acceptable performance values (Acquisition Slide 3–01). The PM uses the difference between the objective and threshold values as "trade space" to manage his program. He uses the trade space to meet the desired capability of the program while also managing schedule and cost, making trade-offs where necessary but within the trade space (Acquisition Slide 3–01). Key Performance Parameter (KPP) 2 for the JBC-P specifies that the system must achieve a threshold of 75% and an objective of 95% (T/O) joint PLI in the immediate battle space and threshold of 65% and objective of 85% (T/O) in the extended battle space (MCSC, 2012b). More clearly, the system must receive a minimum of 75% of the PLI in a battle space with a target of receiving 95% of the PLI in the immediate battle space. In addition, the system must be able to receive a minimum of 65% of the PLI in the extended battle space with the target received PLI to be 85% (MCSC, 2012b).

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III. DATA COLLECTION

This chapter will outline a method for measuring return on investment for the JBC-P program. This section will analyze the change in funding over time for the JBC-P. Additionally, it will present data regarding the program's capabilities with relationship to cost.

1. Assumptions

This study includes several assumptions that were made in our strategic assessment of the JBC-P program. Our first assumption regards the amount of maintenance required for the JBC-P FoS. We assume that there is at minimum a small positive correlated between the amount of maintenance required and the effectiveness of the overall system. If maintenance levels are adequately funded to a minimum threshold than the overall system effectiveness will remain stable. In addition, we assume that after the threshold of effective maintenance is achieved, no further value is added by the addition of more support personnel. Our second assumption regards the access to information sources for the system. That there are adequate controls for "information overload," and an increase in the quantitative sensor count will loosely correlate with an increase in the overall information available to the system. Third, we assume that the large portion of the of the evaluation criteria presented within the categories of 'system availability' and 'system effectiveness' are mostly from an acquisition perspective and, to a lesser degree, the operational level of C2.

We have also made several assumptions regarding the timeline analyzed in this study. The primary documents used to analyze the cost reduction initiatives do not specify the exact date that the initiatives were implemented. However, we were able to group the implementations of the cost reduction initiatives into the time periods from before and after the publication of the 2012 LCCE. Therefore, we assume that the first three cost reductions initiatives were implemented in FY11 while the rest of the identified initiatives implemented after the publication of the 2012 LCCE occurred in FY12. These assumptions have guided our analysis of the JBC-P FoS.

2. Strategic Goals

A metric for value is required to understand the productivity output of the JBC-P FoS. The JBC-P program does not produce monetary revenue so value determination has to come from a capability, or a series of capability oriented metrics. Formally, the primary capabilities specified by USMC C4 that the JBC-P FoS is designed to satisfy include (HQMC CD&I, 2012):

1. Exercise Command Leadership
2. Enable Global & Regional Collaboration
3. Achieve Situational Awareness (SA)
4. Communicate Commander's Intent & Guidance
5. Plan Collaboratively
6. Monitor & Assess Execution Effectiveness
7. Collaborate

In addition, four lesser enabling capabilities are also specified to be provided by the JBC-P FoS and these include (HQMC CD&I, 2012):

1. Synchronize Execution Across All Domains
2. Leverage Mission Partners
3. Establish Organizational Relationships
4. Process Information

Many of the capability areas specified by USMC C4 are general and overlap each other. For this study, we will analyze capabilities the JBC-P FoS is designed to meet based on those capabilities listed by the Joint Capability Areas (JCAs) (see Appendix B). According to the MAGTF C2 Roadmap, the JBC-P FoS is designed to meet JCA 5.1 and 5.2. JCA 5.1 is specified as the capability to "collect information" and JCA 5.2 is defined as the capability to "achieve situational awareness" (HQMC CD&I, 2012). The definitions of these JCA capability areas will guide our selection of operationally defined metrics for JBC-P FoS output.

3. JCA 5.1: Collect Information

The MAGTF C2 Roadmap defines the JCA 5.2 "collect information" capability area as the ability to collect the data necessary to effectively and efficiently support command and control (HQMC CD&I, 2012). More specifically, the MAGTF C2 Roadmap further defines the requirements for achieving this capability area:

> This includes the ability to observe compliance with guidance, to monitor events and effects of decisions, to gather friendly force locations and status, and to access or obtain combat information, Identity Operations (IdOps) information and data, civil information, sensor data, and finished intelligence products. (HQMC CD&I, 2012, p 35-36)

4. JCA 5.2: Achieve Situational Awareness

JCA 5.2 "achieve situational awareness" is defined in the MAGTF C2 Roadmap as the capability to maintain understanding of a situation (HQMC CD&I, 2012). This capability spans across both physical and cyber domains, as well as the electromagnetic spectrum. This capability also requires the ability to gain knowledge regarding the status of friendly forces, enemy forces, other threats, neutral or civilian local population, and information regarding the area of operations (AO) (HQMC CD&I, 2012). Maintaining this knowledge is based on the timely receipt of information that is collected from multiple nodes throughout the operating environment (HQMC CD&I, 2012). In addition, maintaining this knowledge is also dependent on the ability to effectively process and manage this information (HQMC CD&I, 2012). Achieving situational awareness includes the ability to create a common operational picture (COP) that provides a presentation of current information and an ability to forecast information. The common operational picture is created from the integration of processed information from sensors, analysts and data processors. The information is then displayed through an analysis and assessment of that information (HQMC CD&I, 2012).

Achieving joint situational awareness is the primary capability that the JBC-P FoS is designed to provide. Situational awareness is an important military capability that enables planning, directing, and synchronizing all operations and other activities conducted in a specific AO for the local regional Combatant Commander (HQMC CD&I, 2012). These activities can include logistics operations, cyberspace operations, air traffic control, electronic warfare, kinetic and non-kinetic targeting, fire support coordination, public affairs operations, and information operations. It also includes the ability to coordinate with higher, adjacent, and other units in the operating environment (HQMC

CD&I, 2012). This requirement for achieving situational awareness for the ground combat element (GCE), air combat element (ACE), logistics combat element (LCE), and the command element (CE) of the Marine Corps extend from the highest levels down to the squad level or service equivalent (HQMC CD&I, 2012).

5. Defining the Variables

This section will propose metrics for the evaluation of the strategic goals mentioned in the earlier section. We will accomplish this by evaluating a single program within the larger strategy as a vignette which can be applied to other programs and the Marine Corps C2 strategy as a whole. The scope of this paper will not include metrics for all programs within the larger strategy, but the metrics presented here, and the logic supporting them, can be applied as a template for similar programs within the larger C2 portfolio. For our analytical approach, we will use the hierarchical multi-level representation of a System-of-Systems (SoS) capability as the framework. We will tailor this framework for our analysis of the JBC-P (Han, Fang, and DeLaurentis, 2012). This framework provides a method for logically connecting the capability metrics with the defined JCAs.

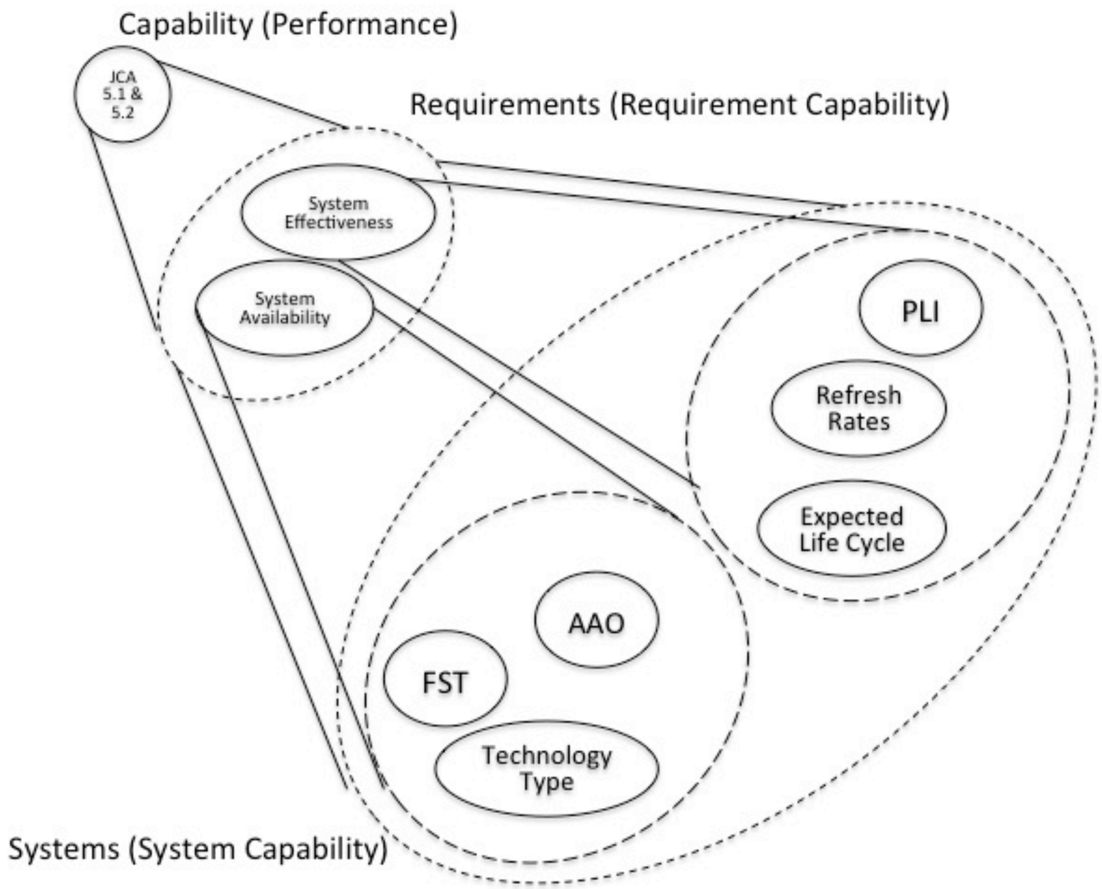

Figure 4. Hierarchical multi-level representation of the JBC-P FoS capability areas and metrics (After Han et al., 2012)

As is evident in the definitions of the joint capability areas, many of the requirements for JCA 5.1 are similar to the requirements put forth in JCA 5.2. The JBC-P FoS is designed to meet the requirements for both these joint capability areas. Therefore, the operationally defined variables that will be used as metrics for this study will be defined using the definitions for the requirements for both JCA 5.1 and 5.2. To satisfy JCA 5.1 "collect information" and JCA 5.2 "achieve situational awareness," the definitions for these capability areas require that the system have the ability to present current information and forecast information, integrate information from a variety of inputs, gain knowledge of the status of all units in an AO, and have the ability to effectively process and manage this information (HQMC CD&I, 2012). The requirements to integrate information from a variety of inputs and gain knowledge of the status of all units in an AO will be categorized as system availability. The requirements to present current information and forecast information, and effectively process and manage this information will be categorized as system effectiveness.

The JBC-P FoS is designed to achieve both of our defined categories of system availability and system effectiveness. However, operational definitions for these categories had to be determined to be able to generate accurate metrics for the output of the JBC-P FoS. For the purposes of this study, six primary measurable metrics have been determined that will provide some insight in the ability for the JBC-P FoS to meet the requirements outlined in the JCA 5.2 and 5.1. According to the JBC-P FoS LCCE, the most critical capability that the JBC-P system provides is the ability to achieve situational awareness (MCSC, 2012b).

6. System Availability

For this study, system availability will be operationally defined as the number of fielded JBC-P Systems, the number of technical support personnel to maintain the systems, and the composition of each type of platform the system is installed (MCSC, 2012b). The first operationally defined metric for system availability is the number of fielded systems both current and planned. The number of systems planned to be fielded are specified in the Approved Acquisition Objective. The JBC-P program Approved Acquisition Objectives (AAOs) allow for the following number of systems: 13,542 mounted systems, 6,920 dismounted systems, and 1,371 TOC/Command Post (CP) kits. The total number of systems planned to be fielded on all platforms is 21,833 systems (MCSC, 2012b). In addition, the platforms the system will be hosted on will also be used as a metric for system availability. Currently, the platforms are divided into three categories: mounted systems, dismounted systems, and TOC/Command Post kits (MCSC, 2012b). These platforms are related to system availability because an increased variety of platform types ensure that the system can be fielded to a variety of unit types throughout the battlefield, increasing system availability to the warfighter. In addition to the number and types of the systems, the last operationally defined metric for system availability is the number of support personnel provided by the program management for system support (MCSC, 2012b). The amount of support personnel available to maintain fielded systems is related to system availability because the ability to operate and maintain currently fielded system impacts the ability of the warfighter to use the capability provided by the system and therefore its availability to him.

It is important to note that, at least in part, these metrics for system availability were selected due to their widespread availability as well as their implied correlation to the topic at hand. Other metrics may in fact also reflect system availability and should be measured moving forward. These could include such metrics as, average system downtime over a fixed interval, average required time to restore system services and average system life cycle per deployed system.

7. System Effectiveness

The category defined as system effectiveness will be operationally defined as the reception rate of position location information (PLI), the rate at which the fielded systems are refreshed with new ones, and the expected life of the program. The reception rate of position location information is the percentage of received locational signals throughout a specified AO (MCSC, 2012b). An increased percentage of received location information in a given AO correlates to greater effectiveness of the system to provide an accurate common operating picture of units within an AO. In addition, the rate at which the fielded systems are refreshed indicate how current the technology of the system is and how effectively it will operate. Similarly, the expected life cycle of the program, writ large, or the length of time the system will be operationally fielded, provides an indication for how current the system will be with technological advances and peer technology. Therefore, PLI reception rates, system refresh rates, and the expected life cycle of the JBC-P FoS are all metrics for system effectiveness.

Metric	Capability Category
Number of Systems	System availability
Technical support for systems	System availability
Refresh rates	System effectiveness
Expected life cycle	System effectiveness
PLI reception rate	System effectiveness
System technology by type	System availability

Table 2. The metrics and their associated capability categories

B. METHOD OF ANALYSIS

This study will be qualitative description of the military capability provided by the JBC-P. This description will used to represent the value created by the program in order to describe the return on the investment in the program. The data will be categorized and analyzed through the lens of the ROI equation. However, instead a monetary value for numerator value of "earnings" in the ROI equation, we will use our categories output, quality, and time to represent the numerator. The denominator will continue to be valued according to cost.

$$ROI\ description = \frac{Output, Quality\ and\ Time}{Cost}$$

The metrics chosen for this study will reflect the four categories of hard data of output, quality, cost, and time. Our analysis will not be able to determine a single number value for ROI but rather a descriptive understanding about how the numerator changes will respect to changes in cost.

C. COST COMPARISON

1. JBC-P PROJECTED BASELINE FUNDING

The JBC-P program is an upgrade to the Force XXI Battle Command Brigade & Below (FBCB2) technology. Initial funding for the JBC-P program began in September

2010 (IT investment dashboard). The JBC-P FoS program has since undergone a series of significant budget reductions. The initial Marine Corps baseline investment in the program in FY2010 was $2,159,000. The "will cost" baseline cost for program, or the expected cost without cost reductions, initially was planned through 2017 and is reflected in the following chart.

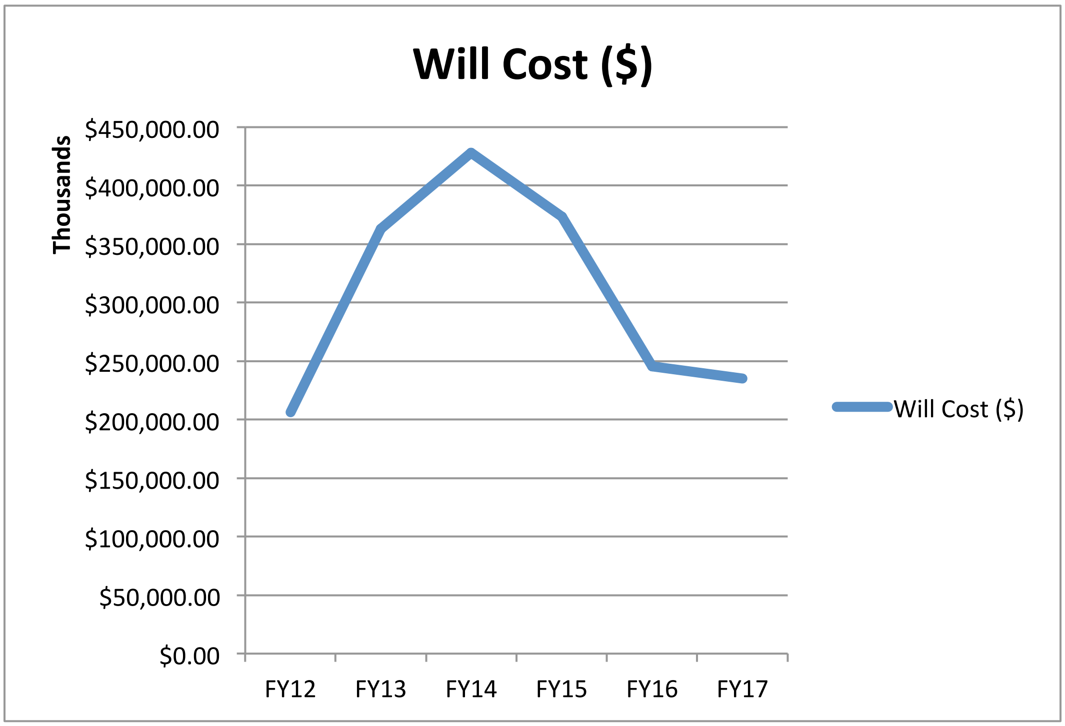

Figure 5. Baseline Will Cost Estimate of the JBC-P (After MCSC, 2012b)

Beginning in October of 2011, a "should cost" analysis of the JBC-P FoS was conducted to determine what program areas could be subject to cost reduction initiatives (MCSC, 2012b). Seven areas were identified and three were initially implemented (MCSC, 2012b). The three program initiatives included the realignment and reduction of Field Support Technician (FST), revision of the technology refresh schedules, and through purchasing a commercial off the shelf (COTS) handheld product versus the originally planned ruggedized solution (MCSC, 2012b). With the incorporation of these cost reduction initiatives, the baseline funding for the program was reduced and is reflected in Figure 6.

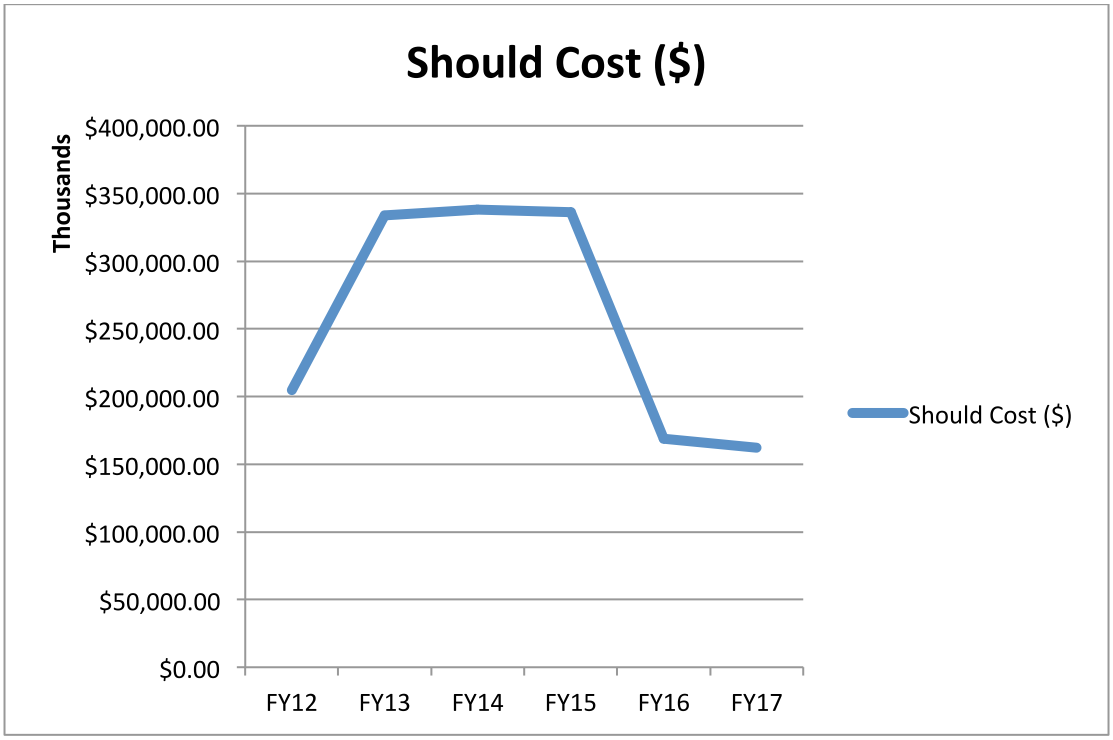

Figure 6. Baseline Should Cost Estimate of the JBC-P after the implementation of cost reduction initiatives (After MCSC, 2012b)

2. LIFE CYCLE COST ESTIMATES

In addition to the planned baseline funding through FY17, changes to the total LCCE have also been made due to budgetary pressures. The total LCCE in FY11 was $4,607,604,000. Meanwhile, the LCCE for FY12 was reduced to $4,163,764,430 through cost reduction initiatives. This difference represents a 9.6% decrease in the LCCE. Furthermore, between the FY12 LCCE and the FY13 LCCE, the JBC-P FoS program saw significant additional reductions in the expected life cycle cost. The total LCCE for FY12 was $4,163,764,430, in FY13 the LCCE was reduced to $1,661,449,101. The difference in these LCCE represents a 60% decrease from the FY12 estimate. The change in the total LCCE is represented in Figure 7.

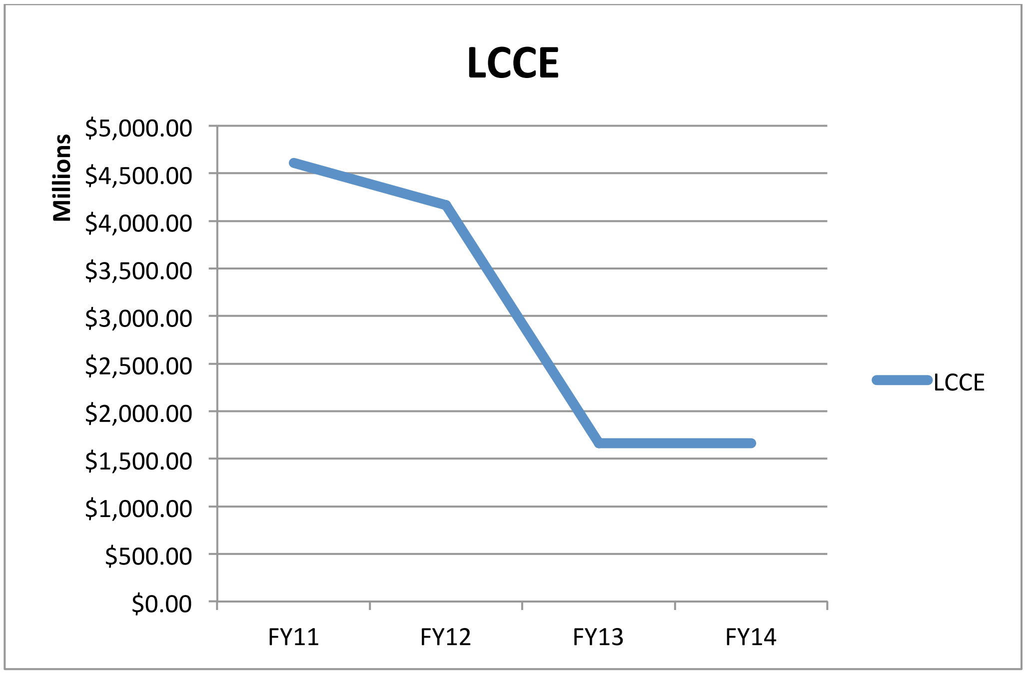

Figure 7. Life Cycle Cost Estimate over time (After MCSC, 2012b)

The total LCCE reduction from FY11 to FY12 was the result of the implementation of three cost reduction initiatives. The cost reduction initiative areas covered in this LCCE change include Field Support Technician (FST) realignment/reduction, revision of the technology refresh schedules, and through the purchase of a COTS handheld product versus the originally planned government designed ruggedized solution. The total LCCE reduction from FY12 to FY13 was the result of programmatic changes designed to achieve more cost savings (MCSC, 2012b). According to the Marine Corps Systems Command, the drivers for these cost reductions include the following:

- Changes to the dismounted (Handheld) system pricing
- The removal of the Beacon system from the JBC-P model
- The removal of analogous systems such as DDACT (replaced by Nett Warrior) & the Beacon MTX, updated Bills of Material (BOMs)
- Changing the IOC to FY14
- Changing the FOC to FY16
- Reduction in the Authorized Acquisition Objective (AAO)

- Accounting for systems and components already procured
- Changes to the subsume date FY14 based on Funding Line
- WBS/CES Changes
- Updated Sunk Costs
- Updates to the Fielding Schedule
- Updated Testing Costs

As already defined, the metrics that will be analyzed in this study include the changes to the number of systems, number of technical support for the systems, refresh rates, the expected life cycle, the PLI reception rate standard, and the system technology type as the measures for representing capability. In the following section the changes to these values will be analyzed as a result of these cost reductions.

D. VALUE COMPARISON

1. System Quantity

The first metric to be evaluated with respect to the change in cost is the change in the number of systems that are scheduled to be delivered by the program. As mentioned earlier in this study, the number of systems authorized to be fielded is known as the Authorized Acquisition Objective (AAO). As a result of the first LCCE reduction in FY11, the AAO for the mounted systems, dismounted systems, and the TOC kits stayed the same at 13,542 mounted systems, 6,920 dismounted systems, and 1,371 TOC kits (MCSC, 2012b). However, from FY12 to FY13, the AAO for the dismounted systems and TOC kits was reduced as a result of cost reductions. This resulted in the number of mounted system remaining 13,542, but a large change in the dismounted AAO from 6,920 to 1,354, and a smaller change in the AAO of the TOC kits from 1,371 to 1,166 (MCSC, 2012b). Therefore, the major changes in the AAO due to the cost reduction initiatives were made to the number of dismounted systems. These changes are summarized in Table 3.

Fiscal Year	**FY11**	**FY12**	**FY13**	**FY14**
Mounted	13542	13542	13542	13542
Dismounted	6920	6920	1354	1354
TOC	1371	1371	1166	1166
Baseline LCCE	$460,760,4000	$416,376,4430	$166,144,9107	$166,144,9107

Table 3. Change in AAO and cost with relationship to time (After MCSC, 2012b)

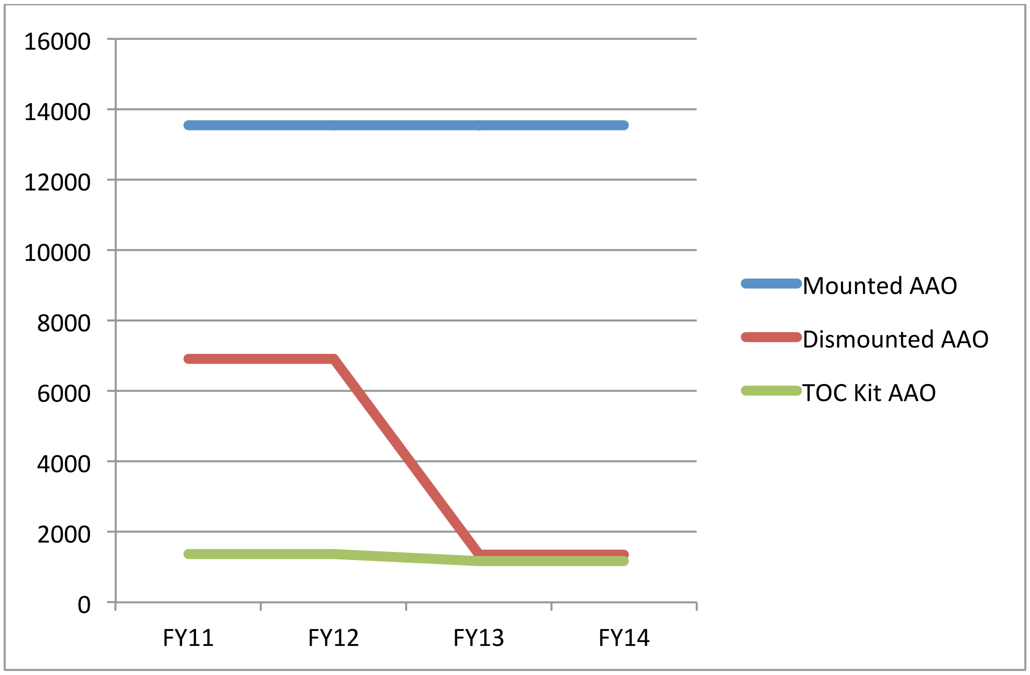

Figure 8. Change in AAO over time (After MCSC, 2012b)

2. Field Support Technicians

In addition to changes in the AAO, the cost reduction measures changed the number of support personnel available for the JBC-P system. Initial cost reduction measures in FY11 did not reduce the number of available Field Support Technicians (FSTs), which originally planned for 18 contractor provided FSTs (MCSC, 2012b). However, subsequent cost reduction initiatives included the reduction of contractor FSTs from 18 contractors to 8 personnel (MCSC, 2012b). These eight personnel would include 4 contractors and 4 government employees (MCSC, 2012b). This cost reduction initiative therefore included the replacement of contractor support personnel with government employee support personnel (MCSC, 2012b). In addition, the number of FSTs was further reduced through another round of cost reduction initiatives from 8 contractors and government FSTs to 4 government FSTs (MCSC, 2012b). In summary, after all of the cost reductions have occurred, the number of FST will change from 18 contractor provided FSTs to 4 government provided FSTs (MCSC, 2012b). Table 4 summarizes the changes in FST support with respect to the changes in the baselines LCCE.

Fiscal Year	**FY11**	**FY12**	**FY13**	**FY14**
FST	18	18	8	4
Baseline LCCE	4607604000	4163764430	1661449107	1661449107

Table 4. Change in FST support and cost with respect to time (After MCSC, 2012b)

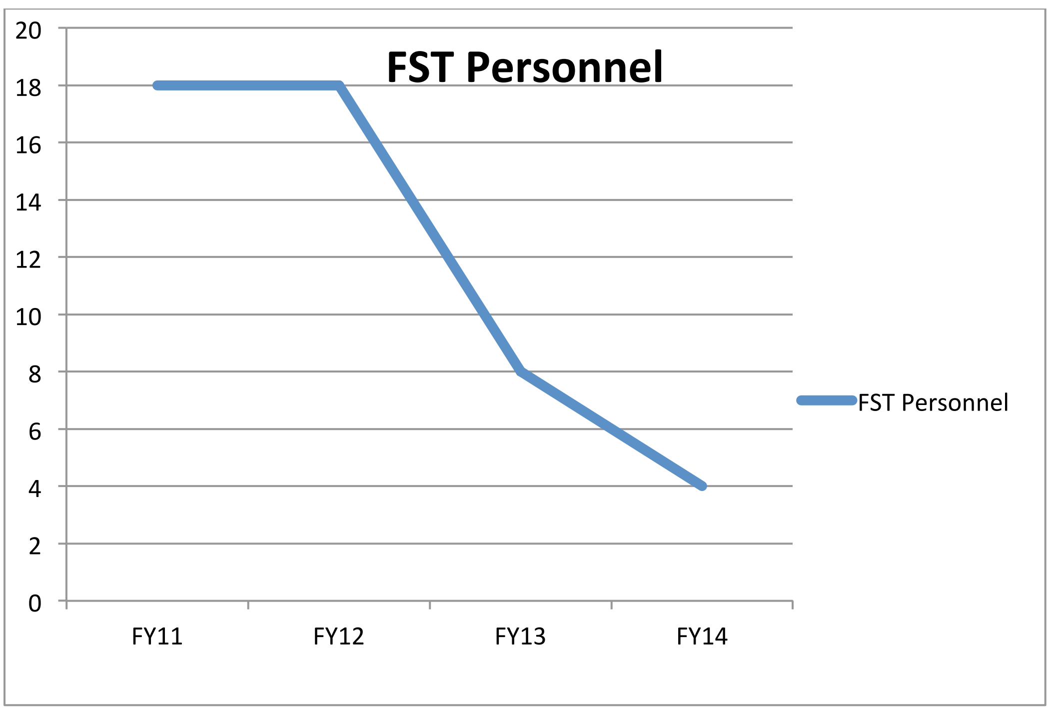

Figure 9. Change in FST support personnel over time (After MCSC, 2012b)

3. Refresh Rates

The technology refresh schedules were also revised as a result of the changes to the baseline LCCE. Originally, all of the JBC-P system types (mounted, dismounted, and TOC kits) were to be refreshed every 3 years (MCSC, 2012b). As a result of the cost reduction initiatives implemented in FY12, the technology refresh schedules for the different system types were altered (MCSC, 2012b). The new schedule has the dismounted systems refreshed every 2 years, the mounted systems every 5 years, and the TOC systems every 3 years (MCSC, 2012b). The contract implications for this change are that fewer systems in total will be purchased throughout the life cycle for the program (MCSC, 2012b).

4. Expected Life Cycle

The expected life cycle of the JBC-P program as extended as a result of the implementation of the cost reduction initiatives. Originally, the JBC-P program had the expected life cycle of 10 years from FOC (MCSC, 2012b). As a result of the cost reduction initiatives, the life cycle of the program was extended to twice that length to FOC plus 20 years. That would indicate that the program is now expected to last through FY36 (MCSC, 2012b).

5. PLI Reception Rate Standard

Another change in the program development, not incurred as a result of cost reduction initiatives, but still impacting capability was the change in the minimum C2/SA standard. Originally, for Increment 1 of JCR, the KPP of the system as specified in the DACT ORD was that the system must have C2/SA of 100% of the PLI. The Deputy Commandant, Combat Development and Integration (DC, CD&I) changed this parameter for Increment II as Key Performance Parameter (KPP) 2, which specifies that the system must receive a minimum threshold of 75% of the PLI in a battle space with a objective of receiving 95% of the PLI in the immediate battle space. In addition, the system must be able to receive a minimum threshold of 65% of the PLI in the extended battle space with the objective received PLI to be 85% (HQMC CD&I, 2012).

6. System Technology Type

Another metric to be evaluated with respect to the change in cost is the change in technology of the system. Specifically, this metric pertains to the change in the type of handheld system to be deployed as part of the USMC JBC-P program. Originally, the USMC planned to build a ruggedized government off the shelf (GOTS) product to use for the handheld dismounted system. However, in an effort to further reduce costs, USMC decided to move to the U.S. Army Nett Warrior handheld COTS product for the dismounted system (MCSC, 2012b). The cost of the original GOTS system was $22,944 per unit while the Army system was $2,460 per unit (MCSC, 2012b). These per unit process are significantly different, with the Nett Warrior system costing much less than the original ruggedized solution.

E. DETERMINING TIPPING POINT

The success of the JBC-P FoS is built upon the ability to accurately see all friendly units in an AO. Fielding fewer systems could impact the proliferation of the system throughout the Marine Corps. For this study, the minimum number of system for the program to be considered successful is the same as the number of systems required for the system to achieve initial operating capability (IOC). Cost reductions initiatives implemented for the JBC-P program have resulted in a reduction of the AAO for the quantity of fielded systems. The limits to which the cost to the program can be reduced and still maintain a military capability can be determined using the initial operating capability (IOC) as a benchmark. The IOC is a useful benchmark for determining the minimum capability of the system as it used as development milestone to demonstrate the minimum initial capability upon fielding.

The number of IOC systems is defined as the number of systems required to be fielded for a Marine Corps Regiment (HQMC CD&I, 2012). This includes a minimum of 11,987 mounted systems, 508 TOC kits, and 1,354 dismounted systems to achieve IOC (HQMC CD&I, 2012). As a result, units without any of the JBC-P FoS will not be represented with PLI and therefore not visible to the system. Reducing the number of systems will impact the availability of the system to many USMC units and may result in reduced PLI in an AO. The Key Performance Parameter (KPP) 2 for the JBC-P specifies that the system must achieve a threshold of 75% and objective of 95% joint PLI in the immediate battle space and a threshold of 65% and an objective of 85% in the extended battle space (HQMC CD&I, 2012). Therefore, these PLI reception rates also represent a minimum performance criterion for program success. Success is also built upon the ability for the system to remain operational. This would include operation and maintenance done by support personnel and the time between system refreshes. Reducing the number of support personnel negatively impacts the ability to effectively conduct the operation and maintenance of the JBC-P FoS. Therefore, success criteria will include adequate support from FSTs. The complete reduction of FSTs is therefore considered to be a failure of the program. These minimums for the number of available systems, the minimum reception rate of PLI, and support personnel represent a method for measuring program success.

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IV. DATA ANALYSIS

This chapter will provide an analysis of the impact of cost reductions on the JBC-P FoS program with respect to the metrics outlined in the previous chapter. It will provide an analysis of the program's capabilities to determine ROI with relationship to these cost reductions.

A. IMPACT OF COST REDUCTIONS TO THE METRICS

1. Number of Systems

The cost reduction initiative for the JBC-P FoS has resulted in a reduced AAO. A smaller AAO would indicate that fewer systems would be manufactured and fielded for use by the USMC. From FY12 to FY13, cost reductions reduced the total AAO from 21,833 systems to 16,062 systems. This is a reduction of 5,771 systems and represents a 21% decrease in the total number of systems scheduled to be fielded. The success of the JBC-P FoS is built upon the ability to accurately see all friendly units in an AO. Fielding fewer systems could impact the proliferation of the system throughout the Marine Corps. As a result, units without any of the JBC-P FoS may not be represented with PLI and therefore not visible to the system. Reducing the number of systems will impact the availability of the system to many USMC units and may result in reduced PLI in an AO. The Key Performance Parameter 2 for the JBC-P FoS specifies the system must receive a minimum of 75% of the PLI in a battle space with a objective of receiving 95% of the PLI in the immediate battle space (HQMC CD&I, 2012). In addition, the system must be able to receive a minimum of 65% of the PLI in the extended battle space with the objective received PLI to be 85% (HQMC CD&I, 2012). Reducing the number of systems to be fielded could impact the ability for all units in a given immediate or extended battle space to have their PLI actively received at minimum acceptable levels.

2. Field Support Technicians (FSTs)

The number of personnel dedicated to support the JBC-P was reduced and will be further reduced after several iterations of cost reductions. Originally, the total number of

Field Support Technicians (FSTs) consisted of 18 contractor personnel (MCSC, 2012b). However, after the implementation of initial cost reduction initiatives, that number was reduced to 8 total personnel, 4 contractor supplied and 4 DoD employees. Nevertheless, after another round of the implementation of cost reduction initiatives, that number was further reduced to 4 DoD personnel (MCSC, 2012b). The reduction in the number and type of available personnel can have significant impacts on the support available to maintain the effectiveness of the fielded JBC-P systems.

Reducing the number of personnel available to provide support to the JBC-P program has several implications. First, reducing the number of personnel increases the scope of responsibilities for the remaining personnel. This includes repairing, training, installing, and maintaining a larger amount of systems per person (MCSC, 2012b). Reducing available qualified personnel while increasing the individual workload will also reduce the availability of those personnel to respond to support requests in a timely manner. This could impact the ability of the systems to continue to operate and therefore reduce their availability.

The change in the type of FST available to support the system can also have an impact on its ability to operate effectively. Government employees have overtime caps and now are restricted by mandated furloughs which can impact their ability to support he fielded systems (ClearanceJobs.com, 2013). However, using government employees does allow for greater "in house" knowledge retention about the system. (Acquisition Advisory Panel, 2007). However, it can also be argued that contractors who developed the system have their own tools and potentially more intimate knowledge of the system than a government employee. Therefore, reducing the number of support personnel negatively impacts the ability to effectively conduct the operation and maintenance of the JBC-P FoS. As a result, the requirement category of system availability could be negatively impacted from cost reductions in this area.

3. Refresh Rates

Cost reduction initiatives include changing the rate at which the JBC-P system variants would be refreshed with new updated systems. Refresh rates have been changed from occurring every three years for all system types, to two to five years per system type. Improvements to the dismountable variants of the JBC-P FoS will be made through planned hardware refreshes (MCSC, 2012b). This may result in a reduced ability to keep pace with technology advancement. According to Moore's law, technology advances in integrated circuit technology will occur exponentially over time (Kurzweil, 2001). In addition, Ray Kurzweil suggests in the Law of Accelerating Returns that all technologies will continue to advance over time exponentially (Kurzweil, 2001). Therefore, increases in the time between scheduled technology refreshes could result in outdated systems not taking advantage of technological improvements required for the system to maintain a competitive advantage over other similar systems.

4. Expected Life Cycle

The expected life cycle of the JBC-P FoS was extended from 10 to 20 years as a result of the implementation of the cost reduction initiatives. Extending the life cycle incurs several risks to the effectiveness of the program. First, similar to the impact of reducing the number of system refreshes, extending the expected life cycle of the JBC-P may lead to the program becoming obsolete over time, or outdated by newer better systems (Tritsch & Young, 2011). In addition, the older a systems are at higher the risk of failures to the system due to system wear over time (Tritsch & Young, 2011). This is significant because doubling the expected life cycle of the system could result in the system's life extending beyond the maturity phase of technological, life cycle and into the decline phase, where the utility of the technology is reduced continuously over time. According to Dr. Chandana Jayalath, "Towards the end of its life cycle, growth slows and may even begin to decline. In the later stages, no amount of new investment in that product will yield a normal rate of return" (2010). Therefore, the cost reduction initiatives have resulted in extending the life cycle of the JBC-P FoS that could impact the effectiveness of the system over time. As the program ages, advances in technology may outpace the capabilities of the system.

5. System Technology Type

In an attempt to save money and meet the interoperability requirements with the Army as set forth in the JCR, the Marine Corps has adopted several of the technologies implemented in the Army's Nett Warrior system. First, the requirement for the fielding of the Miniature Transmitter (MTX) beacon was dropped (MCSC, 2012b). The MTX Beacon was a tactical one-way PLI transmitter that was determined to be obsolete and removed from future systems (Alexander, 2013). This change in technology reduced the per unit cost for the JBC-P models (MCSC, 2012b). Dropping the beacon in favor of a more up to date technology did not likely negatively impact the capability provided by the JBC-P FoS. However, changes to the technology of the handheld systems to save on costs may have implications on system availability.

The technology used for the dismounted handheld system of the JBC-P was changed to reduce cost. The requirement for the Dismounted Data Automated Communications Terminal (D-DACT), which was the Marine Corp's handheld variant of the primary digital C2/SA system used in the initial BFT FBCB2 system, was removed from the program in favor of the Army's Nett Warrior handheld solution. In addition, The JBC-P PM authorized the procurement of a COTS solution for the JBC-P handheld solution. The JBC-P PM decided that the U.S. Army's handheld hardware component used in their Nett Warrior program, was to be used for the Marine Corps handheld device due to its significantly lower cost (MCSC, 2012b). However, a working group has been established to map the Nett Warrior device to the Marine Corps' interoperability requirements. The impact that this system will have on the interoperability and functionality of the JBC-P handheld system is currently uncertain (Alexander, 2013). Development of this more inexpensive system could provide an increase interoperable capability at less cost. However, as a COTS system, the system may not perform as well in austere environments as the originally planned ruggedized GOTS handheld system. Significant savings have been made in reducing redundant handheld systems and in the elimination of older technology such as the MTX beacon; however using unproven COTS systems indicates an uncertain expected capability of performance of the new technology. Therefore, the impact of cost reduction initiatives on the technology type can be said to be mixed and uncertain.

B. EVALUATE CHANGE IN ROI FOR THE JBC-P

1. Change in System Availability Capability Category

This study analyzed several metrics that represented system availability for the JBC-P FoS. The return on investment (ROI) of the JBC-P FoS program for this study is described as capability over cost. Capability has been defined in two ways, as system availability and system effectiveness. Therefore, the change in ROI of the JBC-P FoS is evaluated as the change in system availability as a result of cost reduction initiatives. System availability was operationally defined as the number of fielded JBC-P Systems, the number of technical support personnel to maintain the systems, and the technology used. Cost was measured in dollars as the expected life cycle cost of the program. Both system availability and cost were evaluated over four fiscal years and three iterations of the implementation of cost reduction initiatives.

In FY11, the life cycle cost estimate of the program was $4,607,604,000. In terms of system availability, this planned expenditure provided a program that consisted of 21,833 total systems, supported by 18 contractor provided field support technicians, and a ruggedized handheld solution developed by the Marine Corps. By FY12, after initial cost reduction initiatives had been implemented, the life cycle cost estimate had been reduced by 9.6% to $4,163,764,430. Changes to system availability caused by this new level of funding include a reduction in the number of FSTs from 18 to 8 and the replacement of the handheld dismounted system for a COTS system. In addition, the beacon MTX was removed from future systems. However, these changes to technology type may not necessarily negatively impact the system availability of the JBC-P. The reason for this is that the COTS system is based on the Army's Nett Warrior program and may therefore increase interoperability, which is a requirement of the program outlined in the JCR (Alexander, 2013). In addition, eliminating the MTX from the program may not negatively affect the program as the MTX was already becoming an outdated technology (Alexander, 2013). The second cost reduction initiative from FY12 to FY13 resulted in further reduction in the life cycle cost estimate by another 54% from the original life cycle cost estimate to $1,661,449,101. This reduced cost was the result of changes to system availability to include the reduction in the AAO for the JBC-P by 26% from

21,833 to 16,062 systems (MCSC, 2012b). This cost reduction also resulted in further reductions to the number of FSTs by 50%. This was a change from 8 FSTs, 4 government employees and 4 contractors, to only 4 government support personnel (MCSC, 2012b). These iterations of cost reductions have reduced the return on investment in terms of system availability, with each subsequently larger reduction in cost having a larger reduction in system availability.

2. Change in System Effectiveness Capability Category

This study analyzed several metrics that represented system availability for the JBC-P FoS. The return on investment (ROI) of the JBC-P FoS program is described as capability over cost. In addition to system availability as already discussed, the change in ROI of the JBC-P FoS was evaluated as the change in system effectiveness as a result of cost reduction initiatives. System effectiveness has been operationally defined in this study as the reception rate of position location information (PLI), the rate at which the fielded systems are refreshed with new ones, and the expected life of the program. Cost is measured in dollars as the expected life cycle cost estimate of the program. Both system effectiveness and cost were evaluated over four fiscal years and three iterations of the implementation of cost reduction initiatives.

In FY11, the life cycle cost estimate of the program was $4,607,604,000. In terms of system effectiveness, system refreshes were to occur every 3 years, and the expected life cycle of the program was 10 years. After initial cost reduction initiatives had been implemented, the cost had been reduced by 9.6% to $4,163,764,430 by FY12 (MCSC, 2012b). Changes to system effectiveness include the revision of the technology refresh schedules. Instead of the original 3-year refresh schedule for all system types (mounted, dismounted, and TOC kits), the new schedule has scheduled refreshes to the dismounted systems every 2 years, the mounted systems every 5 years, and the TOC systems every 3 years (MCSC, 2012b). Extending the refresh schedules results in longer time periods before fielded system are upgraded and kept up to date. In addition, subsequent cost reductions resulted in the extension of the expected life of the program from 10 years to 20. The longer life expectancy of the system may risk system obsolescence. The last metric for system effectiveness that was implemented prior to the cost reduction initiatives is the reception rate for PLI. Early in the program the PLI reception rate standard was reduced from a threshold and objective of 100% reception rate to a minimum threshold of 75% of the PLI in a battle space and an objective of 95% of the PLI in the immediate battle space. In addition, the system must be able to receive a minimum threshold of 65% of the PLI in the extended battle space and an objective of received PLI to be 85% (HQMC CD&I, 2012). This change, though not directly related to budget reduction impacts the standard for performance of the system and therefore it's effectiveness. As a result of these iterations of cost reduction and programmatic changes, it can be concluded that over time and subsequent cost reduction initiatives, system effectiveness of the JBC-P has been iteratively reduced.

C. RISK

The analysis of the JBC-P cost reduction initiatives has provided insight into the risks associated with such measures. This study outlines how several iterations of cost reduction initiatives have resulted in an systematic decline in system availability and system effectiveness. As a result, several risks have been identified as a result of this cost reduction strategy. These risks include financial risk, operational risk, compliance risk, strategic risk, and reputational risk (KPMG International, 2009). Financial risk is defined as the risk of failure to deliver on the business case for the program or the risk for program failure and wasted funding as a result of program failure. Operational risk includes risk to the organizations ability to deliver an effective product that will enhance the warfighter (KPMG International, 2009). Compliance risk is the risk associated with the program's ability to meet its requirements. Strategic risk is the risk that the failure to deliver an effective program will impact the ability for the organization to meet its strategic priorities. Lastly, reputational risk is the risk of damage to the organization's reputation, image and perceived commitment to its stakeholders.

The JBC-P FoS cost reduction initiatives have incurred financial, operational, compliance, strategic, and reputational risk. With each cost reduction initiative that is implemented, the program becomes closer to falling below acceptable performance standards. This study defined this failure point, or "tipping point," as falling below the minimum capability required for system IOC. Failure to provide the capabilities outlined in the business case for the program resulting from these cost reductions would be a financial loss for the taxpayer and the organization. Therefore, cost reductions for the JBC-P have incurred financial risk. The cost reductions outlined in this study also create operational risk to the Marine Corps. As evidenced in this study, cost reductions have reduced the available support personnel for the JBC-P FoS, extended the refresh schedules, changed the technology of the systems, and lengthened the expected life of the program. All of these changes impact the ability of the system to support the warfighter. Therefore, these cost reductions have incurred operational risk to the warfighter and the Marine Corps.

The JBC-P cost reduction initiatives have also created compliance, strategic and reputational risk. Compliance risk is created as cost reductions further degrade the ability of the program to meet the program requirements outlined by the JROC. However, the compliance risk created from cost reductions is less compared to the other types of risk outlined in this section. Cost reductions for the JBC-P FoS have also resulted in the adoption of the Army's nett warrior technology, which may or may not be compatible with current Marine Corps C2/SA architecture and interoperability requirements (Alexander, 2013). Therefore, the degree of compliance risk generated from the cost reduction initiatives is uncertain. In addition to compliance risk, strategic risk is also created with the large scale cost reductions. There is the strategic risk that if cost reductions continue, the JBC-P program may continue to lose capabilities and fail to support the Marine Corp's larger IT strategy. Lastly, reputational risk is created from the cost reduction initiatives. Failure to develop a functional, joint C2/SA system as mandated by the JROC may negatively damage the perceived ability for the Marine Corps to develop joint capable systems. In addition, there is potential for reputational damage as a result of the austere financial environment of the DoD. Any program failure could be perceived by the taxpayer as financial waste and could potentially damage the image of the organization. The analysis conducted for this study has determined and identified that the cost reduction initiatives implemented with the JBC-P program have created all of these risk areas.

V. CONCLUSION

A. MANAGING RISK AND ROI WITH REGARD TO REDUCING FUNDING FOR IT PROGRAMS

The analysis in this study has highlighted the importance of understanding the importance of accurately measuring the return on investment of IT programs as the funding for those programs is reduced. As a result, accurate measures for ROI and risk management should be employed to facilitate better decision making by DoD leadership. We assume that the cost reduction measures implemented for the JBC-P FoS program were implemented in order to achieve the greatest reduction in cost while making the least change to the program. The data in this study does not provide explicit justification for the cost reduction initiatives implemented in the JBC-P program. According to the JBC-P FoS LCCE, the justification for the cost reduction was to:

> Identify program initiatives which, if implemented, would result in cost reductions for the program. The Should Cost Analysis used the Will-Cost Estimate (i.e., LCCE) that was developed in August 2011 as the base, and developed discrete, measurable items, management initiatives, efficiencies, and risk mitigation actions for savings against that base. (MCSC, 2012b, p 83)

This study has identified and described how the JBC-P program has undergone a series of significant budget reductions. These reductions have changed and reduced the capability of the program. This study has identified that the impact of cost savings on the program has only been identified through joint program capability areas, such as JCA 5.1 and 5.2. The data indicates that there is not a clear understanding of the effect that the impact on the cost reduction initiatives have on the program holistically. In order to more accurately understand the impact of such cost reduction measures, the USMC and DoD decision makers should develop of metric for measuring the value of the program in all its aspects. This study has described these impacts through a variety of different metrics. A single metric would provide a better measurement for understanding how to better reduce funding for this program and future programs.

Similar to understanding the impact cost reduction has on the ROI of IT programs, it is important to understanding and measure the risks associated with such measures. This study has highlighted that there is risk to the organization as well as risk to the program, when cost reductions are implemented. For this study we established six risk areas, financial, operational, compliance, strategic, and reputational risk. These risk categories provide a framework for understanding the impact that cost reduction for the JBC-P program had on both the program and the organization. Improved risk management and implementation of cost reductions in such large scale cost reduction measures may improve program management and the value of the program.

B. EFFECTIVELY MANAGING BUDGET REDUCTIONS

The importance of valuing ROI in Department of Defense programs has become even more important in ensuring that funding is being allocated for the most effective and valuable programs (Bingham & Goudreau, 2004). This study has measured the impact of cost reductions heuristically and descriptively as a function of output (value) over input (cost). Assigning a single metric for measuring the value of a program would provide a more accurate representation of ROI for such investments. We recommend that such an approach could be achieved through the Knowledge Value Added (KVA) methodology. The KVA approach provides a method for creating market comparable revenue for non-profit organizations using a common output called units of Knowledge (Bourazanis & Gusnadi, 2005). We recommend that this same approach could be applied the JBC-P program as well as any IT investment throughout the USMC.

C. CONCLUSION

The analysis conducted in this case study of the JBC-P program has provided insight in to the impact of cost reductions on this IT program. The data clearly shows consistent and repeated implementation of cost reduction initiatives over several fiscal years. In addition, the data also shows that the military capability provided by the program has also been consistently reduced over several fiscal years. These findings show that the ability of the program to meet the JCA 5.1 and 5.2 are reduced as funding is reduced. The data does not definitely demonstrate that the cost reductions are incurring a vicious cycle of further cost reductions. However, vicious cycle behavior with regards to consistent cost cutting is evident. Each cost reduction to the program is associated with subsequent reduction in the military value of the program. In addition, over the several fiscal years examined in this study, the cost reductions became larger over time and so did the reduction in capability. Due to the relatively short period of time analyzed in this study, we cannot determine whether this trend will continue. Therefore, it cannot be determined if this program is in a vicious cycle death spiral. However, if the trends identified do continue than there would be strong evidence to indicate that the program is in danger of reducing its cost to the point of destroying the value provided by the program. In order to prevent this, we recommend conducting a systematic analysis of all activities and elements of the program to determine where cost reductions can be best applied if further reductions are deemed necessary. We also recommend doing the same analysis throughout all IT programs in the Marine Corps to better manage the Marine Corps IT portfolio.

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VI. RECOMMENDATION

This chapter provides recommendations for further research to better determine how to better conduct cost reductions and manage the Marine Corps IT portfolio to prevent vicious cycles generated from cost reductions.

A. RECOMMENDATIONS FOR FURTHER STUDY

1. Further Research into Cost Reductions and the Marine Corps IT Acquisition Portfolio

Findings from this analysis provide a practical view from the perspective of program management regarding the complexity of responding to budget pressures while simultaneously maintaining continued military effectiveness. Conducting an analysis of cost reductions across all IT program through the Marine Corps may provide greater insight to the impact that cost reductions are having on the IT capability of the organization as a whole. A thorough analysis of the Marine Corps IT portfolio may provide a better picture of the value provided by IT investments. Such an analysis may allow the Marine Corps to identify vicious cycles and manage them before they significantly impact the organizations capability.

2. Analyze JBC-P Program Using KVA Analysis

The analysis in this study is insufficient to determine the best method for conducting further cost reductions for the JBC-P. There is a need for better identification of the activities within the program where cost reductions will have the most limited effect on the value produced. KVA analysis is a useful tool that could enable more effective cost reductions and would provide important data regarding the program. We recommend conducting a KVA analysis of this program or any other Marine Corps IT investment undergoing cost reductions.

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APPENDIX A. FY13 MAGTF C2 SYSTEM OF SYSTEMS

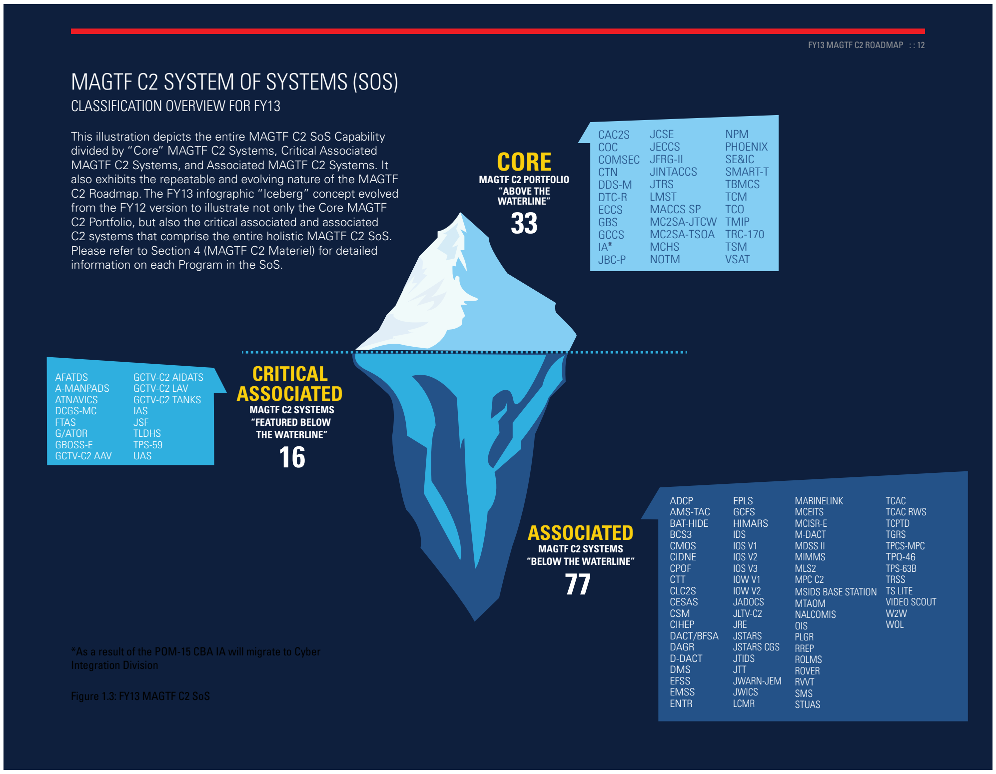

Figure 10. FY13 MAGTF C2 System of Systems (From HQMC CD&I, 2012)

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APPENDIX B. CORE USMC MAGTF C2 PROGRAMS V. JOINT CAPABILITY AREAS

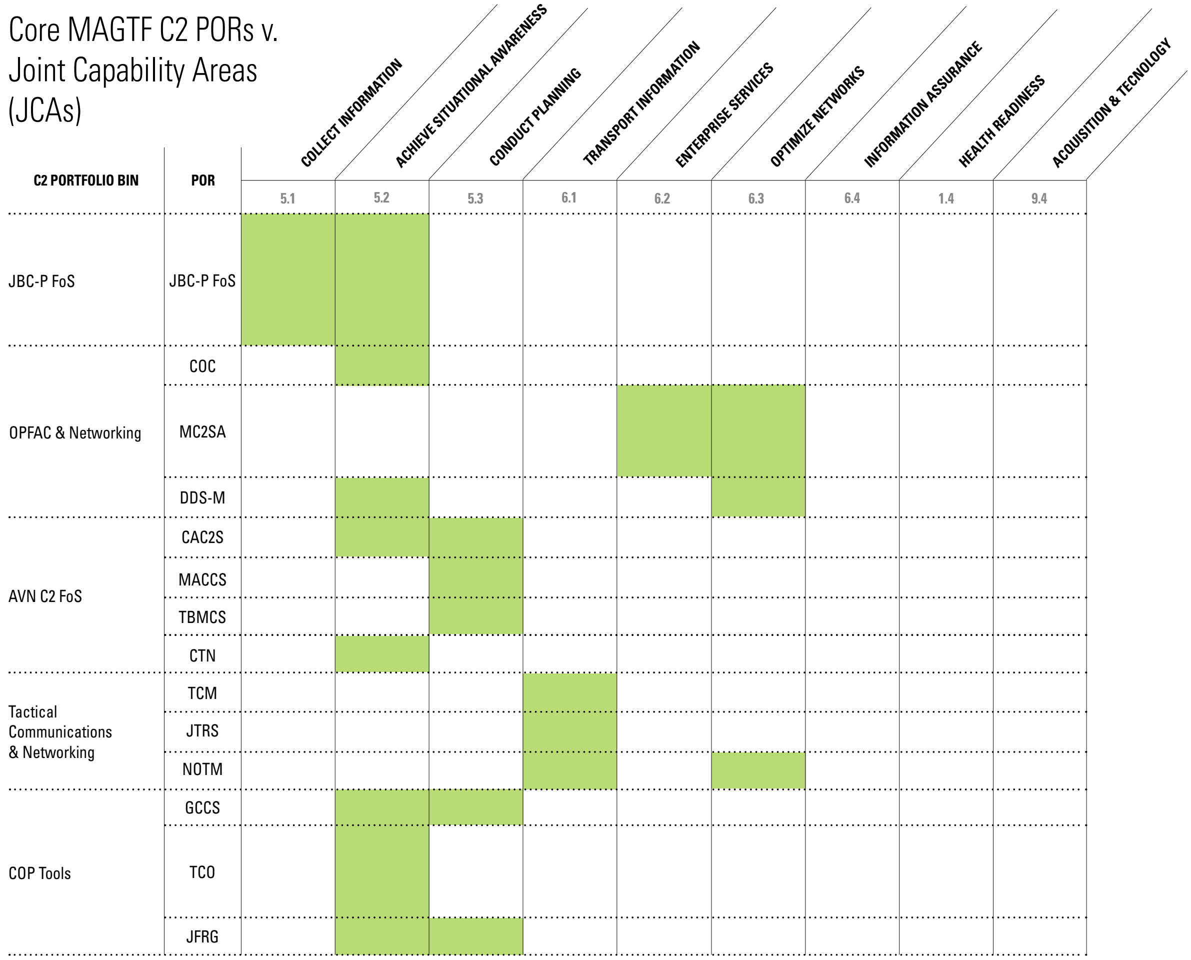

Figure 11. Core MAGTF C2 PORs v. Joint Capability Areas (From HQMC CD&I, 2012)

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