NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

COLLECTING, RETRIEVING AND ANALYZING KNOWLEDGE VALUE ADDED (KVA) DATA FROM U.S. NAVY VESSELS AFLOAT

by

Jason B. Homer

September 2009

Thesis Advisor:	Thomas J. Housel
Second Reader:	Richard D. Bergin

Approved for public release; distribution is unlimited

REPORT DOCUMENTATION PAGE | *Form Approved OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE**	**3. REPORT TYPE AND DATES COVERED**
	September 2009	Master's Thesis

4. TITLE AND SUBTITLE: Collecting, Retrieving and Analyzing Knowledge Value Added (KVA) Data from U.S. Navy Vessels Afloat

5. FUNDING NUMBERS

6. AUTHOR(S) Jason B. Homer

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (maximum 200 words)

Program managers throughout the Department of Defense (DoD) are faced with technology portfolio management problems. Critical to these efforts is the need to track the performance of the technology on a routine, ongoing basis. This thesis focuses on solving this general problem in the specific context of the United States Navy's Cryptologic Carry-On Program (CCOP). This study provides a method that can gather real world data from United States Naval vessels afloat and use that data to generate Return On Investment (ROI) estimates based upon Knowledge Value Added (KVA) analysis. This research builds upon the already developed KVA analysis method through providing a means by which a constant flow of real world data can feed this process, thereby providing an output that is both current and meaningful. The ability of decision makers to access this information will provide them with a critical tool that they can leverage to help them make wise financial decisions with respect to the CCOP program.

14. SUBJECT TERMS

ROI, return on investment, ROA, return on asset, IT ROI, IT performance, IT valuation, KVA, Knowledge Value Added, public sector finance

15. NUMBER OF PAGES
83

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

COLLECTING, RETRIEVING AND ANALYZING KNOWLEDGE VALUE ADDED (KVA) DATA FROM U.S. NAVY VESSELS AFLOAT

Jason B. Homer
Lieutenant, United States Navy
B.S., Evangel University, 1999

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION WARFARE SYSTEMS ENGINEERING

from the

NAVAL POSTGRADUATE SCHOOL
September 2009

Author: Jason B. Homer

Approved by: Thomas J. Housel
Thesis Advisor

Richard D. Bergin
Second Reader

Dan C. Boger,
Chairman, Department of Information Sciences

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

Program managers throughout the Department of Defense (DoD) are faced with technology portfolio management problems. Critical to these efforts is the need to track the performance of the technology on a routine, ongoing basis. This thesis focuses on solving this general problem in the specific context of the United States Navy's Cryptologic Carry-On Program (CCOP). This study provides a method that can gather real world data from United States Naval vessels afloat and use that data to generate Return On Investment (ROI) estimates based upon Knowledge Value Added (KVA) analysis. This research builds upon the already developed KVA analysis method through providing a means by which a constant flow of real world data can feed this process, thereby providing an output that is both current and meaningful. The ability of decision makers to access this information will provide them with a critical tool that they can leverage to help them make wise financial decisions with respect to the CCOP program.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

My first thanks must certainly go to my loving wife, who has done the lion's share of keeping our home in order while I concentrated on my studies—no small feat with five small children underfoot. Without her love and support, I certainly would have failed most miserably. I also thank Dr. Tom Housel; his patience and guidance have led me through this research and writing process. The grandest pursuit in education is to discover new and improved ways of doing things and he has provided the vision for just such a journey. Finally, I would like to thank Dr. Richard Bergin and Ms. Yaara Bergin who ignored the pain inflicted on them in order to help me turn this thesis into a professional work.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. PURPOSE / PROBLEM STATEMENT

The objective of this research is to build an implementation plan for collecting, retrieving and analyzing data that will be used to perform Knowledge Value Added (KVA) analysis on Cryptologic Carry-On Program (CCOP) systems. The output of the KVA analysis can be used to generate Return on Investment (ROI) estimates for those CCOP systems. The methodology for producing ROI estimates based on KVA analysis was developed by Lieutenant Commander Cesar Rios in his thesis, "Return on Investment of Information Warfare Systems." The concept was further refined by Lieutenant Hubert Clapp and Lieutenant Ira Lambeth in their thesis, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation." This research builds upon the previous work by developing an implementation model that will provide a stream of real-world data from U.S. Naval vessels afloat. The importance of this research is that a consistent flow of accurate ROI estimates for CCOP systems will provide a valuable tool for program managers to gauge the performance of various CCOP systems relative to each other and to other types of systems. With this type of knowledge available, CCOP acquisition and budget personnel will have a powerful tool that they can use to help validate difficult financial decisions.

Clapp and Lambeth say that KVA "is the underlying foundation used to develop and analyze Measures of Performance (MOPs) which are used to quantify and value the outputs. A cost and price per unit of output is estimated using the KVA methodology which describes all outputs in common units."[1] It is the concept of common units that makes this process so powerful because it allows for the comparison of seemingly disparate systems through the analysis of identical outputs.

[1] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation" (MS thesis, Naval Postgraduate School, 2007).

Additionally, the market comparable valuation method[2] is used to estimate surrogate revenue pricing to enable an estimate of Return on Investment (ROI) for each CCOP system. Previous thesis work has applied this methodology to historical data collected from the CCOP systems in use during an 18-month deployment of the USS GONZALES (DDG 66). ROI data was analyzed and modeled using GaussSoft™ KVA Performance Accounting Modeling Software.[3]

This research seeks to introduce several possible data-collection procedure options that will define and collect the pieces of data required to conduct KVA analysis, outline the means by which that data can be retrieved from the operational unit, and identify what needs to be accomplished in order to transform that data into usable GaussSoft™ input. Consideration will also be given to what portions of the data collection and analysis process can and should be automated. Further, this research will recommend the option that obtains the required information in the most cost-effective and manpower-efficient way while still providing the quality needed to produce reliable and accurate output.

B. BACKGROUND

This thesis provides an implementation plan for collecting, retrieving and analyzing data so that the KVA method can be applied to that data. The KVA method was developed and refined in two previous thesis works. The first was developed under the direction of Dr. Thomas Housel by LCDR Rios in his thesis titled, "Return on Investment Analysis of Information Warfare Systems."[4] This research was conducted at the Naval Postgraduate School (NPS) and focused on developing a KVA analysis method that provides ROI estimates. While such a method has applications for any organizational process that is technology enabled, the method was specifically applied to the Navy's

---

[2] Steven Pratt, Robert Reilly, and Robert Schweihs, Valuing a Business. Fourth Edition. New York: McGraw-Hill, 2000.

[3] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation" (MS thesis, Naval Postgraduate School, 2007).

[4] Cesar G. Rios, Jr., "Return on Investment Analysis of Information Warfare Systems" (MS thesis, Naval Postgraduate School, 2005).

CCOP. The KVA method is designed to provide decision makers with ROI estimates they can use to evaluate system performance and the value associated with the output those systems provide. The second thesis project was developed by LT Ira Lambeth and LT Hubert Clapp and was supervised by Dr. Thomas Housel. In their thesis, titled "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation," they took the KVA method developed by LCDR Rios and applied it to a real-world implementation.[5] They were able to refine the process used to conduct KVA analysis on CCOP systems and improve the overall accuracy of the ROI estimates produced.

LCDR Rios' thesis, "Return on Investment Analysis of Information Warfare Systems," focused on building a foundation for using KVA to analyze performance metrics. An abstract from that thesis is below:

> The United States Navy's Cryptologic Carry-On Program Office manages a portfolio of Information Warfare (IW) systems. This research and case study demonstrate how the Knowledge Value Added (KVA) Methodology can be used to formulate a framework for extracting and analyzing performance parameters and measures of effectiveness for each system. KVA measures the effectiveness and efficiency of CCOP systems and the impact they have on the Intelligence Collection Process (ICP) on board U.S. Navy Ships. By analyzing the outputs of the subprocesses involved in the ICP in common units of change, a price per unit of output can be generated to allocate both cost and revenue at the subprocess level. With this level of financial detail, a return on investment (ROI) analysis can be conducted for each process, or asset.[6]

The second thesis written by LT Clapp and LT Lambeth, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation," is the follow-on research into the feasibility of an operational implementation of the above concepts. An abstract of it follows:

> This study provides a demonstration of how a software suite that monitors process performance and its supporting technology can be implemented to provide ongoing return on investment information about CCOP technology. This follow-

[5] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation" (MS thesis, Naval Postgraduate School, 2007).

[6] Cesar G. Rios, Jr., "Return on Investment Analysis of Information Warfare Systems" (MS thesis, Naval Postgraduate School, 2005).

> on research and trial implementation demonstrate how the Knowledge Value Added (KVA) Methodology that is embedded in the performance monitoring software is used to formulate a framework for extracting and analyzing performance parameters and measures of effectiveness for each CCOP system. KVA was used to measure the effectiveness and efficiency of CCOP systems and the impact they have on the Intelligence Collection Process (ICP) onboard the USS GONZALES.[7]

Due to the high quality of the previous work done on using KVA analysis to generate ROI estimates, this thesis is able to focus on how to effectively collect real world data on a ship, retrieve that data from the ship and present it for analysis using previously developed methods. This introductory chapter serves to highlight areas related to the problem, and the background and theoretical frameworks of each. The focus of this thesis is in creating procedures for providing a data stream that can then be used by the KVA analysis method developed by LCDR Rios, LT Clapp and LT Lambeth.

1. Intelligence Surveillance and Reconnaissance in the Navy

The Naval Transformation Roadmap (NTR) of 2003 sets direction for the future of Navy Intelligence, Surveillance, and Reconnaissance (ISR). The objective of NTR is to completely redesign Intelligence sensor capabilities, operational concepts, processes, and organizational relationships and culture[8]. This redesign of the ISR is to replace previous guidance that took little account of an environment in which all branches of the military are fully integrated. Escalating costs and the complexity of developing new technology dictates that greater coordination and stewardship take place.

Rising costs combined with shrinking budgets demand that frivolous spending be eliminated. Good intelligence saves lives and money so the end result of the NTR is projected improvements in Navy ISR capabilities. These improvements will integrate Navy ISR with other services in a joint environment to leverage all available resources to accomplish the operational mission and fulfill national level strategic objectives. Integration will be accomplished by developing systems that are capable of working

---

7 Hubert N. Clapp and Ira D. Lambeth, III, “Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation,” (MS thesis, Naval Postgraduate School, 2005)

8 Department of the Navy. Naval Transformation Roadmap 2003: Assured Access & Power Projection…From the Sea. Washington: Dept. of the Navy, 2003, 68–69.

across service boundaries, replacing service specific stove-piped models. The Navy's ability to integrate into truly cohesive operations and their ability to field a fully integrated ISR program that the joint warfighter can use will continue to be a challenge into the future.

Of course, there are difficulties inherent in changing a business model as large and complex as the Navy's ISR program and technology developers are asked to provide new technology that is capable of defeating our enemies, protecting our allies and functioning in a networked environment. The cost associated with developing and supporting these technologies is substantial. The limit on financial resources makes an accurate estimation of a systems capability and worth through scientific means extremely valuable. Decision makers need an evaluation method to provide them with some measurable output on exactly what is being produced by the technologies in question and its value relative to its cost. This is a significant shift away from the pattern of just spending millions of dollars on a system that is not well understood. This research uses KVA analysis as a way to help with the system valuation problem as it applies to the CCOP.

2. The Cryptologic Carry-on Program

The Cryptologic Carry-on Program (CCOP) is a product of the Advanced Cryptologic Systems Engineering program, which develops state-of-the-art ISR capabilities in response to Combatant Command requirements for a quick-reaction surface, subsurface and airborne cryptologic carry-on capability.[9] Each CCOP system is a complex series of subsystems that often carry classification issues with them. For this reason, the CCOP systems are referenced simply by a letter throughout all previous research, and will continue to be referenced as such in this research. The design and functionality of each CCOPS system was analyzed within a previous research project, however, these system specifics are outside of the scope of this paper and were omitted to maintain an unclassified level in this analysis.

---

[9] Cesar G. Rios, Jr., "Return on Investment Analysis of Information Warfare Systems" (MS thesis, Naval Postgraduate School, 2005).

CCOP systems are designed to be flexible and thus have the ability to be installed with many different configuration possibilities depending on the platform CCOPS is being installed on and its intended usage. LCDR Rios, LT Clapp and LT Lambeth all used a standard CCOP load in their KVA method to determine the ROI estimates for those CCOP systems.

3. A Brief Definition of ROI

ROI analysis is a ratio used for building a financial business case. ROI provides decision makers with the ability to evaluate past and future performance of a system or organization as illustrated by the following formula.[10]

$$PERCENTAGE\ ROI = \frac{EARNINGS}{INVESTMENT}$$

For the above formula, the "earnings" represent the difference between revenue and expenses, and "investment" represents the capital and assets of the organizations. The ROI then produces a metric to determine how efficiently the capital and assets are applied. A high ROI represents a high level of asset allocation towards the business objectives.[11]

Clarence Nickerson, a Professor at the Harvard University Graduate School of Business Administration, writes, "The value of a business property is dependent on what it can produce."[12] He also states, "in order to judge the value of the wealth created, we should take into account the property required to produce it."[13] These principles have long been critical in the business world as the use of ROI is often used to help in the determination of how valuable a product or service is relative to its cost. It is logical to apply these very same investment principles to the public sectors and military to better

[10] Nickerson, Clarence B. Accounting Handbook for Nonaccountants. 3rd Ed. New York: Van Nostrand Reinhold Co., 1986. 632.

[11] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation," (MS thesis, Naval Postgraduate School, 2005)

[12] Nickerson, Clarence B. Accounting Handbook for Nonaccountants. 3rd Ed. New York: Van Nostrand Reinhold Co., 1986. 652

[13] Ibid.

inform investment decisions. In the previous thesis research conducted by LCDR Rios, LT Clapp and LT Lambeth, earnings were defined as the output of the CCOP system (reporting), and the investment represents both the system and personnel costs.

Not all of the systems presently used by Navy ISR are worth the financial the human cost required to operate and maintain them. As transformation occurs within Navy ISR it provides an opportunity to evaluate the complete range of ISR systems and make informed investment decisions based on sound financial principles.

One of the more complex facets of applying ROI calculation to Navy ISR, and CCOP specifically is that the output must be converted into a common unit of analysis. In the for profit segment of the private sector financial world this is mostly accomplished using dollars, however, intelligence reports don't convert into dollars therefore some type of conversion mechanism is required. To address this issue, an analysis of cost of developing business intelligence reports is used to estimate a portion of the "value" of an intelligence report. Since various subsystems contained within CCOP have different costs associated with building intelligence reports, there are different inherent complexities resulting in different human costs to develop the reports. These inherent complexities can be handled more effectively by applying the Knowledge Value Added theory.[14]

4. Knowledge Value Added

Knowledge Value-Added (KVA) theory was created by Dr. Tom Housel (Naval Postgraduate School) and Dr. Valery Kanevsky (Agilent Labs). KVA is based on the assumption that humans and technology in organizations add value by taking inputs and changing them into outputs through core processes.[15]

LT Clapp and LT Lambeth wrote about KVA theory, "KVA is a general theory for estimating the value added by knowledge assets, using a methodology that is analytic and tautological. It is based on the premise that businesses and other organizations produce outputs (e.g., products and services) through a series of processes and

[14] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation," (MS thesis, Naval Postgraduate School, 2007).

[15] T. Housel and A. Bell, Measuring and Managing Knowledge. Boston: McGraw-Hill, 2001, 92–93.

subprocesses that change, in some manner, the raw inputs (i.e., labor into services, information into reports). KVA explains the changes made on the inputs by organizational processes to produce outputs in terms of the equivalent corresponding changes in entropy. The concept of entropy is defined in the American Heritage Dictionary as a "measure of the degree of disorder [or change] in a closed system." In the business context, it can be used as a surrogate for the amount of changes that a process makes to inputs to produce the resulting outputs."[16]

C. RESEARCH OBJECTIVES

The objective of this research is to develop a data collection method for gathering real world CCOP KVA data from any deployed United States Navy ship. This study builds upon prior research conducted by LCDR Rios, LT Clapp and LT Lambeth and assumes that data will be formatted and analyzed in accordance with the processes as described in their study. This research develops an implementation plan for a data analysis method developed in the previous studies. The primary goal of this study is to provide an implementation process that assists in operationalizing the use of the KVA evaluation method in the budgeting process for the United States Navy's Chief of Naval Operations (OPNAV) CCOP Program Office (OPNAV N201) acquisition of information warfare systems.

D. METHODOLOGY

This thesis provides a data collection method implementation plan that can be used to gather real world data from deployed naval units. Previous work in this area developed an extremely robust means for using KVA data to determine ROI estimates of CCOP systems. However, the previous research lacked the granularity required to begin actual collection and analysis of data from the fleet. This work is an attempt to bridge the gap between the proposed method and the real world application of that method. The data collection implementation plan consists of the following steps:

[16] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation," (MS thesis, Naval Postgraduate School, 2007).

1. Determine critical pieces of KVA information that need to be captured by the ship to conduct an ROI analysis.
2. Analyze data collection assumptions that need to be made in order to facilitate shipboard processes concerning the gathering and forwarding of data required for conducting KVA analysis.
3. Generate three cost effective and manpower efficient options for gathering, retrieving, and analyzing the data.
4. Develop a post deployment report, which will produce immediate value added to the CCOP program using ROI data.

THIS PAGE INTENTIONALLY LEFT BLANK

II. THREE OPTIONS FOR DATA COLLECTION, RETRIEVAL AND ANALYSIS

A. INTRODUCTION

The thesis conducted by LCDR Rios for Navy CCOP systems was initiated by then program officer of United States Navy's Chief of Naval Operations (CNO) Cryptologic Carry-On Program Office (OPNAV N201) LCDR Brian Prevo. LCDR Prevo contacted fellow Information Warfare Officer and NPS student, LCDR Cesar Rios, concerning a CNO directive to focus on three goals for the following fiscal year: Efficiencies, Metrics, and Return on Investment.[17] LCDR Rios' thesis research under the direction of Dr. Thomas Housel constructed the initial framework that facilitated the utilization of the KVA method to determine ROI for CCOP systems. LT Clapp and LT Lambeth were then able to leverage that foundational work to both baseline and further refine their research. LT Clapp and LT Lambeth then tested the feasibility of implementing the new model in an operational environment and were able to show, using historical data, that such analysis can be completed and will render the desired ROI estimates. Based on LT Clapp and LT Lambeth's work and under the guidance of Dr. Thomas Housel, LT Jason Homer constructed three framework options for collecting, retrieving and analyzing KVA data from US Navy vessels at sea. The following is a synopsis of that research.

1. Objective

The overall objective of this thesis work was to develop three viable options for collecting, retrieving and analyzing real world CCOP data from US Navy vessels afloat with the ultimate goal of feeding a decision support model and methodology to assist in the POM/Budgeting process for OPNAV N20's acquisition of IW CCOP systems. The research conducted by LCDR Rios, LT Clapp and LT Lambeth created a method of

[17] Department of the Navy, CCOP Program Briefing. Power Point. Washington: Dept. of the Navy, CCOP Program Office (OPNAV N201C), 25 April 2005.

producing ROI estimates using KVA analysis that can be used to support decision makers by giving them access to important system valuation data. Using their work as a new baseline, this thesis work sought to outline an effective process to provide a steady stream of CCOP data into the KVA analysis model. Providing this data for analysis will enable CCOP acquisition decision makers to use empirical data and KVA analysis to evaluate the performance of individual CCOP systems for future investment.

2. Method

In previous research conducted by LCDR Rios, LT Clapp and LT Lambeth,

> The Knowledge Value Added (KVA) method was used to develop and analyze Measures of Performance (MOPs) which were used to quantify and value the outputs of the KVA analysis. A cost-per-output was calculated using KVA data in conjunction with market comparable pricing to determine a Return on Investment (ROI) for each CCOP sub-system.[18]

This thesis describes three different options for gathering and analyzing real world data from US Navy vessels afloat.

B. RESEARCH QUESTION

Assuming the research done by LCDR Rios, LT Clapp and LT Lambeth as a baseline, how can the data required for KVA analysis of CCOP systems be collected, retrieved and analyzed. Additionally, this research will seek to determine how this information can be used to benefit both the financial and the operational decision maker.

C. DETERMINATION OF REQUIRED INFORMATION

In order to effectively collect, retrieve and analyze real world data there must first exist a clear and concise understanding of exactly what information is required to conduct

[18] Hubert N. Clapp and Ira D. Lambeth, III, "Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation," (MS thesis, Naval Postgraduate School, 2005).

KVA analysis. The Klieglight (KL) is a highly classified report that the thesis research conducted by LCDR Rios has determined to be an acceptable measurable unit of output for any CCOP system.

1. KVA Analysis Process

The KVA model as applied to CCOP systems is a complex analysis of systems, subsystems, and operator involvement, all of which function together to produce a value that has been assigned to a common output, namely the KL report. What follows is an example of how this process was applied in the research conducted by Lieutenants Clapp and Lambeth. This example of the KVA process is provides background information to help describe what the KVA analysis produces in terms of evaluation metrics and insight into how it functions. For further information, on how KVA analysis generates evaluation data see “Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation” by Lieutenants Hubert Clapp and Ira Lambeth.

A CCOP system consists of one or more subsystems. The Intelligence Collection Process (ICP) is broken down into strictly defined subprocesses. Each subsystem within a CCOP system will perform one or more of these ICP subprocesses. For example, a CCOP system might have a subsystem that was responsible for carrying out subprocesses P3 and P4 from the table below. Such responsibilities would include all actions listed for P3 and P4 on the right had side of Table 1.

	Subprocess Name	Subprocess Description
P1	Review Request	• Determine if collection capability is available • Determine if further direction or info required
P2	Determine Op/Equip Mix	• Review directives and target information to determine type/category of target
P3	Input Search/Function into CCOP	• Assign search blocks and allocate system resources to each target
P4	Search/Collection Process	• Targeted or full spectrum search • Observe sensor data for target cues
P5	Target Data Acquisition/Capture	• Audio Routing • Record/Capture Data
P6	Target Data Processing	• Demodulate, decrypt, direction find (DF), or Geo-locate • Translate
P7	Target Data Analysis	• Human or IT-based analysis of captured data
P8	Format Data for Report Generation	• Input data into required reporting formats
P9	QC Report	• Check format, accuracy and adherence to tasking, regulations and laws
P10	Transmit Report	• Transmit via secure voice radio, secure internet relay chat, US Message Traffic Format

Table 1. The Intelligence Collection Process (ICP)

The actions associated with the subprocesses can then be broken down with even more granularity into the individual components that are required to make that particular subprocess function. As an example, the components involved within subprocess P6 in Table 1, "Target Data Processing" is as follows.

P6	Target Data Processing
	Human-based (no automation required)
	Manual copy directly into report
	Human translation & processing
	IT-based
	Direct transfer into report
	Demodulate
	All IT-based
	Human-enabled
	Decrypt
	All IT-based
	Human-enabled
	Direction finding
	Automatic - Local Line Of Bearing (LOB)
	Human-enabled - local LOB
	Human-enabled - B-rep request
	Geolocation
	Special processing

Table 2. Process P6 Actions

There are also humans involved in the ICP and since the output from all of the CCOP systems is the same, the members of the crew assigned to operate the CCOP system are considered in the KVA method as well. As an example: as crew members are assigned to their respective ICP processes, not only might several crew members be involved in the same process but each crew member is also involved in multiple processes as well. This complexity can be seen when analyzing the performance of CCOP systems under different crews. A more efficient and knowledgeable crew often knows how to make the best use of the system they are using and so the return for that system is higher. This is also a good example of why detailed analysis is required when reviewing KVA analysis results. Factors such as crew experience are difficult to capture in an algorithm but can be explained through analysis. An example of how humans integrate into a CCOP system can be seen in Table 3.

IW Operator	Assigned to ICP Processes
Div Officer	1,2,9
Div LPO	2-7, 9
SigOp 1	3-7,9
SigOp 2	4-7
SigOp 3	4-7
ComOp1	8,10
ComOp2	8,10
ComOp3	8,10

Table 3. Sample Crew from Ship A

Table 4 shows the CCOP system breakdown for Ship A. There are six different CCOP systems, which, for the sake of classification issues, are represented below by letters A-F. These systems work together to accomplish the ICP processes and subprocesses, further complicating the inner workings of the KVA method.

	Subprocess Name	CCOP Assigned
P1	Review Request/Tasking	A
P2	Determine Op/Equip Mix	A
P3	Input Search Function/Coverage Plan	A
P4	Search/Collection Process	A
P5	Target Data Acquisition/Capture	A
P5.1	Signal Type 1	B
P5.2	Signal Type 2	C
P5.3	Signal Type 3	D
P5.4	Signal Type 4	E
P6	Target Data Processing	
P6.1	Signal Type 1	B
P6.2	Signal Type 2	C
P6.3	Signal Type 3	D
P6.4	Signal Type 4	E
P7	Target Data Analysis	
P7.1	Signal Type 1	B
P7.2	Signal Type 2	C
P7.3	Signal Type 3	D
P7.4	Signal Type 4	E
P8	Format Data for Report Generation	A,F
P9	QC Report	A,F
P10	Transmit Report	F

Table 4. Ship A CCOP System Breakdown

Just as processes and subprocess can be broken down into the actions that comprise them, so too can systems also be broken down into their related components. Below is CCOP system A from Table 4 as an example to show the complexity of said system and the interdependence of these systems upon each other.

CCOP A (Example)	
Component	**Description/Functions**
Radio Frequency Management System	• RF management
Signal Acquisition System	• Energy Search
Audio Distribution System	• Audio Routing & Recording
Intermediate Frequency Signal Processing System	• Spectrum Display Operations • Signal Processing Applications
Control & Processing System	• Coverage Plan Creation/Management
Common Cryptologic Workstation (CCWS)	• Database Operations • JMCIS Applications • Cryptologic Unified Build Applications • Microsoft Applications • Signal Processing Applications

Table 5. Ship A CCOP System A Components

2. Data Required for Analysis

The thesis work done by LCDR Rios, LT Clapp and LT Lambeth has proven the concept of generating ROI estimates based on KVA analysis. The next step in moving KVA analysis research forward is finding a data collection method that facilitates the inject of real world data from US Naval vessels afloat into the KVA method. The common form of output used in determining the value of a CCOP system is the generation of KL reports. It would therefore be the simplest solution if a means could be devised by which KL reports were fed directly into the KVA analysis engine as they were issued. However, there is a fundamental problem with that approach, namely that the KL does not necessarily contain all of the data needed to accomplish accurate KVA analysis.

Since the KL is a highly classified report, the specifics of what it contains cannot be discussed here. As it turns out, the specifics of what is contained in the actual KL report is essentially irrelevant to the KVA process anyway. The only thing the KVA analysis cares about is the fact that a KL was sent, not the actual content of the message. The reason for this is that as far as the KVA analysis is concerned the KL acts more like a counter than a data delivery device. The fact that a KL was sent is more important than the content of the message. A KL being sent indicates that a CCOP process fired and value was gained from the system. The end result is that there is additional information that will be required if KVA analysis is to be conducted using KL reports as its motivation.

There are two critical and two non-critical data types that either do not appear in a KL report or are optional fields in the output and thus cannot be counted on to be present. The first two are CCOP systems used and total work time. The others are the latitude and longitude of the system at time of collect and the KL date time group.

a. KL Date Time Group

This data type is used for ease of correlating the KVA data with the actual KL report. It is not required for KVA analysis but it is necessary if any correlation is to be done in the future between the ROI data and the operational data.

b. CCOP Systems Used

Which specific CCOP systems are used in the generation of a KL report is a critical piece of information in the KVA analysis process. Without it, an accurate cost estimate cannot be obtained. The integration of CCOP systems is shown in Table 4 and the movement of information through the collection and reporting process often requires the services of numerous systems in order to transition from intelligence collection to a KL report. It is important to capture each of the systems involved.

c. Total Work Time

Another critical piece of information required in the accurate calculation is the time that each CCOP subsystem is used to produce the KL output. Essentially, the amount of time a particular resource within each subsystem is occupied such that the particular resource cannot be used to service another system.

There is a potentially significant difference between total work time and total elapsed time. The total time the intelligence is in the CCOP system is not necessarily what is desired for KVA analysis. What is needed to conduct an accurate KVA analysis is the amount of time during which CCOP sub-system work is actually being done. A simplified example of this difference would occur when 10 minutes of analytic work is done, at which point the operator leaves to go to the bathroom for 10 minutes and then returns to finish the final 5 minutes of work. The total elapsed time would be 25 minutes while the total work time would be 15 minutes. Again, it is the total work time that is of consequence to KVA analysis.

d. Latitude and Longitude

The latitude and longitude (lat/long) of the system at the time of the collect is not a required piece of information in order to conduct KVA analysis. However, it does have practical and potentially important secondary benefits. The importance of this data type is not for the actual KVA analysis but rather for the secondary analysis that can be conducted on the ROI data.

The most useful immediate analytic capability that lat/long data provides is maximized in a near real-time (NRT) data scenario. If KVA analysis can be done in NRT utilizing lat/long data then it allows for mapping capabilities that would be useful to the operational planner on the fly. One possible implementation of such a mapping capability would reside with the Cryptologic Resource Coordinator (CRC) and his ability to maintain situational awareness of the CCOP systems under his authority. One way this could be done would be through a central repository where ROI data is stored and translated into a visual display. This display could show the CRC at a glance the effectiveness of all of the CCOP systems under his authority. The display would assist the operational decision maker (the CRC) in assessing which systems are most effective against certain targets, where the best locations are for reception, which systems are performing at, below, or above expectations and where potential problems might be. Once this concept is expanded beyond the limitations of the KL report and beyond the scope of strictly CCOP systems, the CRC would have at his disposal a complete picture of the location and health of all of his assets. He could potentially also recognize equipment or training deficiencies based on fluctuations in expected ROI for a system.

Another benefit for recording lat/long data is in the generation of historical analysis reports such as a post deployment ROI report. Using a Google Earth™ type of interface a summary report could potentially show a map of the entire deployment from which you could analyze the performance of specific systems based on geographical location, range from shore or any other number of factors. It would also help with analysis of circumstantial oddities such as long transits, where systems are often idle due to no fault of their own.

e. Data Capture Form

Since the KL report does not reliably provide the data types required for KVA analysis, a second means of data capture is required to capture them. A simple form should be all that is needed, as the number of elements of required data is relatively small. The form below is offered as a solution for capturing the required data.

KL Date Time Group					
231905Z JUN 09					
CCOP system used					
System A	System B	System C	System D	System E	System F
☑	☐	☑	☑	☐	☐
Total work time					
Start		Finish			
231900Z JUN 09		231905Z JUN 09			
Lat	Long				
29.11 N	80.44 W				

Table 6. Data Capture Form

3. Assumptions

In order to facilitate crewmember data collection it is important to find ways to minimize the impact on crew activities while at the same time maintaining the integrity of the data. This results in the generation of a small list of logical assumptions that will ease the workload on both ship's company and the KVA data analyst. Listed first are assumptions carried forward from the thesis research conducted by LCDR Rios, LT Clapp and LT Lambeth concerning the underlying assumptions governing the KVA process. The KVA analysis assumptions are included for the benefit of the reader and can be studied in depth in the thesis work conducted by LCDR Rios. Following that are the assumptions made during this current research.

a. KVA Assumptions

The assumptions that provide the foundation for KVA analysis have not changed and are provided here as background for the reader.

- Humans and technology in organizations take inputs and change them into outputs through core processes.

- By describing all process outputs in common units (i.e., the knowledge required to produce the outputs) it is possible to assign revenue, as well as cost, to those processes at any given point in time.
- All outputs can be described in terms of the time required to learn how to produce them.
- Learning Time is measured in common units of time and is also a surrogate for knowledge. Thus, units of Learning Time can also be called Common Units of Output (**K**).
- Having a common unit of output makes it possible to compare all outputs in terms of cost per unit as well as price per unit, since revenue can now be assigned at the sub-organizational level.
- Once cost and revenue stream have been assigned to sub-organizational outputs, normal accounting and financial performance and profitability metrics can be applied to them.

b. Embedded Knowledge Estimates

The estimates used to measure the amount of knowledge embedded in a CCOP system has not appreciably changed since the thesis work conducted by LT Clapp and LT Lambeth. This section is provided to give the reader an understanding of how the amount of knowledge embedded in a particular sub-process is determined.

According to LCDR Rios, the knowledge "embedded in information technology (IT) systems can be derived by averaging the time it would take an average learner to learn how to produce the outputs produced by the IT systems in a single subprocess output cycle. CCOP systems are highly complex and at times, comprise multiple components with varying functions. To estimate the time to learn of a single CCOP system, the components were analyzed individually. Academic authorities on the functions performed by each were consulted to determine the length of time it would take an average learner (assuming at least a Bachelor's of Science (B.S.) degree in Electrical

Engineering or in a field related to the component) to learn how to produce the IT outputs. In this case, subject matter experts in the functional fields of each system were consulted to estimate the IT time to learn."[19] An example of this process is included as Figure 1.

CCOP C Learning Time Derivation Example

To determine the learning time of CCOP C, the team first dissected the system into its basic functional components. CCOP C is the AN/SSQ-120(V) Transportable-Radio Direction Finder (T-RDF). T-RDF provides a low-cost Medium/High/Very High/Ultra High Frequency (MF/HF/VHF/UHF) Direction Finding (DF) capability to selected U.S. Navy ships. T-RDF has two major components, the receiving equipment and the processing unit.

To analyze the system and determine its time to learn, the team consulted Dr. Richard Adler, an authority on signals intelligence (SIGINT) systems and antenna technologies. It was assumed that, as a baseline, the "average learner" to be taught the functions of T-RDF would have an undergraduate degree in a related technical field such as Electrical Engineering. Dr. Adler suggested that the underlying disciplines that would have to be learned are:

–Basic RF Theory (66 days)
–EM Theory/Formal EM (198 days)
–Basic Communications Theory (132 days)
–Propagation Theory (66 days)
–Antenna Theory (66 days)
–Basic Radio Direction Finding (66 days)

Aggregating the results, an estimate of 594 days of learning time would be required for the average learner to learn how to produce the outputs of CCOP C.

Figure 1. Example of Embedded Knowledge in a CCOP System

c. *Total Work Time Estimates*

Ideally, there would be a start time and a stop time for each individual system involved in the generation of the KL report. Information about system use times would give an exact representation of how long resources were unavailable due to being consumed with the task in question. However, such granularity would require the operator using the equipment to record all such data for every system involved from start

[19] Cesar G. Rios, Jr., "Return on Investment Analysis of Information Warfare Systems" (MS thesis, Naval Postgraduate School, 2005).

to finish. As was shown previously, this process could involve numerous different systems, some of which trigger each other without even signaling to the operator that a handoff has occurred.

The difficulty inherent in trying to time all of these events makes the job of recording all such information tedious, time consuming and even beyond the operator's abilities in some instances. The best way to gather the desired information without placing undue burden on the ship's crew is to collect only the start and stop times for the entire process from collection of intelligence to KL report release. The level of detail lost by taking this approach can be minimized by using historical data to generate averages for the times required by each system. These averages should be reassessed at specified intervals to ensure that they remain accurate. The loss in granularity through this process is compensated for by the reduction in human error and the amount of data that will be received. There is also an intangible benefit to simplifying this process, one that cannot be stressed enough, and that is the willingness for the operator to take the time to gather the data needed for KVA analysis. Any way that can be devised to simplify and shorten the process for the operator reduces the cost exacted on their time and increases the likelihood of cooperation and compliance.

d. Start and Stop Time Calculation

Due to the nature of intelligence collection there are many aspects of the collection and reporting process that can be affected by the interpretation of an individual crewmember. One such interpretative bias is when the clock starts and when it stops. In other words at what point can it be said that the product has officially entered the system and when it leaves. The start and stop data collection techniques provide information on how long resources are unavailable to service other CCOP processes.

The start time has two possible definitions. The first definition is from the moment of collection and the second is from the moment of recognition. The difference is that the former always happens first while the latter may correspond or it may happen later. In U.S. Naval intelligence gathering the clock always starts upon recognition by the system or by the operator that the collection is of value and should be reported.

Therefore, it makes sense to follow suit with the start time for KVA analysis. It is true that system resources are dedicated starting at moment of first collection, however that time can be extremely difficult to determine and is open to interpretation by the operator. The moment of recognition is concrete and easily recordable, resulting in a much greater degree of accuracy.

Like start time, stop time also has two possible definitions. The first is the moment of message release and the second is the time at which the KL report is received by the consumer. For many of the same reasons it is much more accurate to record message release time as it is directly controlled by the operator and is easily determined. Message reception by the consumer is affected by many factors outside the scope of the system being considered. Some potential factors of influence are message precedence, relay station outages and amount of message traffic on the lines at the time. For all of these reasons the moment of message release is the best choice for stop time.

To summarize, this study assumes a start time of the moment of recognition of a piece of intelligence and a stop time of the moment of KL report released by the ship's crew.

e. Total Elapsed Time vs. Total Work Time

There can be a significant difference between the total amount of time that elapses and the total amount of time a system spends working. If an operator takes a break between the moment of recognition, which has been determined as the start time, and the moment of message release, which has been determined as the end time, then there can be significant error in the resulting ROI calculation. However, given personal experiences of those who have worked as members of ship's company and the time constraints placed on KL release by the classified documents governing KL reports, it is very unusual for such a delay to take place. In fact, it is so unlikely that this research assumes that as far as KL reports are concerned, total elapsed time and total work time are equal.

D. THREE OPTIONS FOR CONDUCTING KVA ANALYSIS

The thesis research conducted by LCDR Rios, LT Clapp and LT Lambeth established a rigorous method for generating ROI estimates for CCOP systems using KVA analysis. What has been missing is a functional way to collect, retrieve and analyze data from US Navy units afloat. This research will develop and analyze three possible solutions to this problem.

1. Option 1–Standalone Laptop

In this method, the researcher will provide a laptop to the Ship's Signal Exploitation Space (SSES) Division Officer (DIVO) with a database installed and preconfigured with the Data Capture Form discussed previously. This laptop will function as a standalone computer dedicated to KVA data entry. In this method the operator will be required to enter the specified KVA data into the standalone after the KL report has been released. The effort required of the member of ship's company for data entry is minimal and is comprised of the four extra pieces of information outlined in the Data Capture Form.

At the completion of the reporting period the data that is resident on the laptop will be retrieved from the ship to facilitate analysis of the captured data. There exist two primary means by which this can be accomplished. The first and easiest to accomplish is for the laptop to be collected from the ship at the conclusion of the deployment. The second and more difficult is to periodically download the data from the laptop onto a disk, move it over to the ship's network and send it back via File Transfer Protocol (FTP) to either NPS or SPAWAR. This could be done at any set interval (i.e., daily which is most desirable or weekly which is most likely) but would require additional effort from SSES personnel. This method is preferable and if an agreement could be reached for daily transmission would result in a close to NRT effect.

If physical collection of the laptop is employed then the laptop will be collected at the conclusion of deployment. At that point the data can be retrieved and analyzed using KVA analysis to provide historical ROI data for the entire deployment. If the FTP collection method is employed then an analyst at either NPS or SPAWAR can receive the data at the agreed upon time intervals, run the data through the KVA analysis process and provide timely feedback to the ship on CCOP system performance.

a. Advantages

The main advantage of this option is the ease of setup and the low cost. This method could be employed almost immediately on one ship for no more than the cost of a laptop and a plane ticket for someone to fly to the ship to explain what is required of them. The laptop could be picked up or shipped at the conclusion of operations and analysis can be conducted at either NPS or SPAWAR. This data is perfectly suited for historical analysis and can be used to show how each CCOP system performed during the duration of the deployment.

b. Disadvantages

Since this option uses a standalone laptop it is going to require the operator in SSES to physically get up from his workstation after sending the KL and enter the data into a separate terminal creating yet one more task on top of an already potentially busy schedule. The problem with this is that such a situation could lend itself to the operator putting off and forgetting to enter the additional data or just not having the time to do so. Also, if the data is not collected at least daily, then the NRT aspect of the analysis is lost along with all the advantages such a capability provides.

2. Option 2–Additional Message

A second option that exists as a possibility is to create a new message that can be sent through the Navy's message handling system via the same means as the KL itself. In such a situation, the operator would complete his KL report just as he normally would. After he finished he would pull up a message mask on the same computer he had just used and cut and paste any relevant information needed from the KL report. He would then fill in the remaining required information as outlined in the Data Capture Form and release the message in much the same way as he had just released the KL. At this point, the operator has completed his role in the process and need not think of it again.

There are two possible methods of retrieving and analyzing the data. One is a manual method, which is more time consuming and human intensive, the other of which is essentially completely automated.

In the manual method, an analyst would manually pull the message traffic off of the message server each day, run the analysis, generate any reports or graphs that are needed and then send that output to whoever desires it. In the second method, the data would be pulled out of the message traffic stream in exactly the same fashion as the KL and stored in a database. A KVA analysis server can pull the data and run its analysis. The server can then generate any reports of any type and content required and email those out to a preset distribution list.

a. Advantages

The first advantage of Option 2 – Additional Message is that it requires very little of the operator's time, thus increasing the likelihood that procedures will be followed as expected and the data set will be complete. The less extra effort that is required of SSES personnel, the more likely they are to fully comply. Option 2– Additional Message also eliminates the necessity for the operator to send the data via FTP or any other method where yet another extra step is added.

Data retrieval is possible whenever the receiving node makes a request, taking the responsibility away from the ship. If manual retrieval is being conducted then it could certainly be done once or even twice a day. As soon as the KVA analysts are trained in how to enter the KVA data and generate the desired output it could be put in place, creating a relatively simple training requirement for the analyst doing the work. If automated retrieval is done then it can be done in NRT. An additional benefit with the automated method is a reduction in human error. Once the scripts and programs are in place to generate an automated response it will require minimal human interference, reducing associated manpower costs as well.

b. Disadvantages

Disadvantages of Option 2–Additional Message reside almost entirely on the data retrieval and analysis side. If manual analysis is done because of the lower initial costs then problems caused by human involvement must be dealt with such as increased error rates, likely loss of NRT capability and manpower costs. However, if an automated solution is selected then a different set of problems arise involving higher upfront costs. A dedicated server will be required to pull the required messages from message traffic. A text parser will then need to be developed in order to translate the message into the correct input format for the KVA analysis. After the analysis is done and the appropriate reports and graphs have been generated the server will need to disseminate those to the appropriate individuals via email. Finally, a script will need to be developed that executes all of the aforementioned functions. However, none of these problems are too difficult and once overcome will require only routine maintenance and periodic tweaks.

3. Option 3–Changing the KL Report Format

The third option is to make a change to the format of the actual KL itself. Since it already contains the KL date time group the change would consist of making the three remaining pieces of information (systems used, the start/stop times and the lat/long) required data fields on the KL mask. This option functions very much like Option 2–Additional Message, with the exception that the operator would not have to do any extra work whatsoever. Since the required information would be a part of the KL report the operator need not be involved further.

Data retrieval would function in essentially the same manner as in Option 2–Additional Message, with the exception that the message being pulled would be the KL itself and not an alternate message.

a. Advantages

Aside from the advantages for Option 2–Additional Message, there are other significant benefits. A successful change to the format of the KL would mean that everyone who writes a KL would have to use the new format. This would mean that, as long as a platform issued KL reports, data would become available for every system, not just CCOP, used on all of those units around the world. There would be no need to request data from certain ships as all ships would be feeding the data automatically. It would be a relatively easy task to expand the scope of KVA analysis from CCOP systems to other systems as well.

b. Disadvantages

While the potential benefits are significant, the disadvantages are also significant. The format for the KL report is governed by national-level policy and would be extremely difficult to change. Convincing national level policy makers to alter doctrine on behalf of an NPS thesis would be a daunting challenge that could take years with little hope of success.

Another problem arises from the likelihood that the full ramifications of changing the format of the KL report cannot be fully known until the change takes place. KL reports are fed into national level databases automatically. Changing the format for the root message could force all other customers of KL reports to also have to change their systems, resulting in potentially high reprogramming costs. It would, at the very least, require changes to the training that operators receive and all costs associated with reeducating the fleet.

E. EXAMPLE OF USAGE: POST-DEPLOYMENT REPORT

Most project approvals in the Navy's marketplace, involves answering the question "What does it do for me?" In anticipation of just such a question, the following is provided for the reader as a simple example of what might be expected as a potential value added product resulting from ROI data generated by KVA analysis.

Such a report should include historical visualization of how each system performed per deployment, a map showing where CCOP system activity took place throughout the deployment and a detailed performance analysis to ensure fair treatment of the given CCOPs, accounting for transit time, range requirements, system downtime, etc. Possible content for such a report follows.

1. Deployment Dates by Fleet

This section would provide pertinent data about how long the unit spent in a specific Area Of Responsibility (AOR). For example, to indicate that part of the deployment was spent in the Sixth Fleet AOR and the rest in the Fifth Fleet AOR the report might say something like this.

- C6F–45 days, C5 –188 days, Total–233 days

2. Operations Summary

Here is where data concerning any major operations and exercises would go. Anything that might lend understanding to where and how the assets of concern were used is important to mention. Examples would be Operation Enduring Freedom, Operation Iraqi Freedom, Maritime Security, etc.

3. Cryptologic Capabilities

This list should be as extensive as possible as it will help explain things in the detailed analysis that will come later. It should include such things as units involved, systems available, ranges, personnel numbers, training levels, etc.

4. Collection Priorities

Similar to capabilities, this list should be as comprehensive as possible and should include such things as countries, platforms, systems, etc.

5. Reporting Statistics (KLs)

This is where deployment statistics for the systems in question would go. There are near infinite ways to break this section down but some possibilities are total number, number for each CCOP system, number by geographic region, etc.

6. Map Display

The visual demonstration of the deployment will likely dominate the report and as such should provide as much illumination into the performance of the systems under question as possible. One possible way to use this feature is to place pins along the deployment route showing the location of each collect.

7. Analysis

This is the most important section of the report since it is the opportunity to support or rebut the systems in question. It is here that the report would take into consideration any factors not made apparent by statistics or the map. Generally, the analysis will address things that might lower a CCOP system's ROI estimate unfairly such as periods of long transit where collection is impossible, equipment failures, range limitations, interference, etc. Carrying out a detailed analysis of the ROI data will provide a perspective on the raw numbers that decision makers need to make informed decisions.

F. CHOOSING THE RIGHT OPTION

Each of the three options (Option 1–Standalone Laptop, Option 2–Additional Message and Option 3–Changing the KL Report Format) can collect, retrieve and analyze the data. For the purposes of this thesis however, Option 3–Changing the KL Report Format is being removed from consideration. The process for achieving organizational adoption is time consuming and resource intensive offsetting potential economic benefits.

Option 1–Standalone Laptop and Option 2–Additional Message function in fundamentally different ways. Option 1 has the benefit of being easily deployable on a very limited basis very quickly. It is ideal for a trial run on a single ship. It can be deployed on a ship with very little effort and then collected at the end of the deployment and taken home for analysis. The cost is one laptop, approximately 2 hours of training for the operators on the ship and approximately the same amount of training for the KVA analyst after the deployment is finished. What is lost is the ability to receive data in NRT and all of the benefits that go along with NRT data analysis

On the other hand, with Option 2–Additional Message NRT data analysis and the situational awareness inherent in NRT data flow are attained. Also gained is a system that is easier to scale up. Once operators on the ship and the analysts back stateside have been trained, another ship can be added to the data stream simply by training the second ship's operators. The down side to having a NRT capability is that the process needs to be automated and all of the upfront costs associated with that process have to be accepted.

With all of the discussed factors under consideration, the best course of action is to use Option 1–Standalone Laptop in the immediate. It makes a great first run test bed with little cost risk should anything go wrong. While Option 1–Standalone Laptop is running its course, further implementation research should continue on Option 2–Additional Research so that it is ready to be implemented at the successful conclusion of Option 1–Standalone Laptop. This course of action would allow for real world data collection to begin while preparation for a long-term solution continues.

III. CONCLUSIONS

America is currently dealing with an economy that is in recession. It is more important than ever to maximize the benefits received from the expenditure of taxpayer dollars to defend our nation. As government agents, it is important that members of the Department of Defense and specifically the Navy make the best use of the resources we are afforded. Navy ISR is a critical piece of our ability to both attack and defend and as such deserves the absolute best we can provide. ROI analysis is an attempt to help decision makers equip themselves with the best information they can possibly get in order to make informed decisions concerning the stewardship of our resources.

This research project represents the extension of an existing KVA method that has operated within a static environment into a dynamic platform that can function among emerging DoD needs. This thesis presents a set of options and proposes a capability to gather data from US Naval vessels afloat. That collected data will then be used to conduct KVA analysis in order to generate ROI estimates. The ROI estimates will provide key decision makers with a valuable and proven method to evaluate technology options in the acquisition process.

The combination of options that have been recommended in this research will allow for valuable data collection to begin now, while preparing for a larger scale and more permanent solution in the near future. This process will begin to provide key decision makers with the valuable tools they need to make budgetary decisions. The output produced by this process will help shape the future of Navy systems acquisitions for years to come.

The requirement for Navy ISR is going to increase as time goes by and warfare becomes more and more unconventional. Additionally, budgetary constraints will always be present and resources will always be limited. Given those two factors, it is imperative to the continued growth and development of ISR technology that money be spent wisely and with clarity. Applying the tools provided by this research will help track the value of current technologies and provide decision makers with the ability to make better informed investment decisions.

IV. RECOMMENDATIONS

Measuring systems effectiveness based the output of a KL report does not provide us with a comprehensive understanding of CCOP system performance or the ability to make informed procurement decisions. The limitation is supported by the fact that the issuance of KL reports can vary greatly depending on the personalities of the operators involved and thus does not provide an objective measure of CCOP system performance. In July of 2009 a group of CCOP system managers met at SPAWAR in San Diego, CA to discuss a detailed data set that would provide a larger base of historical data and a more reliable stream of new CCOP system performance data. This data set came from an automated reporting system that is tied directly into the CCOP system, reducing and possibly even eliminating the need for human intervention within the data feedback loop. This would eliminate any inconvenience imposed on the ship's crew, reduce the potential for operator data errors, and also eliminate the need for any additional KVA data collection equipment installation or implementation procedures. Additionally, once the procedures for analyzing automated data feeds have been established it should be relatively straightforward to attain a near real time data stream.

According to the information distributed at the San Diego meeting on collecting KVA data, it appears that all required data needed to conduct KVA analysis were present in the CCOP automated data feed. Further research needs to be done to verify that all required KVA data input is present in order to conduct a reliable and valid KVA analysis. Once the presence of all those elements describes in the Data Capture Form has been verified, both the data collection process and the KVA analysis process need to be reassessed to ensure that all of the previously established assumptions and procedures are valid. Specifically, there needs to be research done that answers the question "What is the relative value of various automated reports compared to the value of human-in-the-loop reports such as the KL." There needs to be research performed on defining the fundamental differences between human generated and automated reporting with a focus on developing a means of objectively comparing the differences and similarities between them. It is possible that the two different types of reports may be used to validate and/or calibrate each other, especially if there is any overlap or duplication of effort in the generation of each report.

Additionally, this research is now mature enough to facilitate looking for other venues to apply KVA analysis to OPNAV information technology performance assessment. An ROI estimate based on KVA analysis is a valuable acquisition decision making tool and can be used to aid decision makers in making informed acquisition and portfolio optimization decisions. The next phase of research into applications of KVA analysis needs to take these possible extensions into account.

The next step in implementing KVA analysis to generate ROI estimates is to implement Option 1–"Standalone Laptop" as described previously. The reasons for selecting this option are as follows: low set up costs and ease of implementation for a trial run. Once a ship is identified and committed to the trial implementation, prior to vessel deployment a laptop computer with all required software installed needs to be delivered to the participating vessel and operators need to be trained on which data need to be input into the software interface. When the vessel returns from deployment the laptop can either be picked up or shipped back to either NPS or SPAWAR. The next steps also involve working with the SPAWAR team to set up data collection procedures at the Point Loma facilities using the Gauss Soft KVA performance accounting software.

There are many potential benefits that can be attained from a trial implementation. Even though continuing research on automated reports as well as in automating the collection, retrieval and analysis process, the data collected on the laptop will enable the application of the KVA data collection and analysis using performance accounting software. While "Option 1" is not an optimal long-term solution, the software implementation learning curve benefits make it a worthwhile effort. During the time period when the data generated by implementing "Option 1" is being collected it is recommended that research be conducted on how to accommodate the type and volume of automated data. Additionally, work should continue on automating the processes associated with retrieving, analyzing and reporting readily available KVA data.

To summarize, the results of this study suggest that “Option-1” standalone laptop be implemented to enable fine-tuning the process of collecting, retrieving and analyzing real world data from US Naval vessels afloat to facilitate KVA analysis. In addition, continuing research should focus on automating data collection procedures and expanding use of KL report data set.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A. GAUSSSOFT OVERVIEW

GaussSoft is the analysis tool by which the KVA analysis is done. This GAUSS overview provided courtesy of GaussSoft, Inc. <http:www.gausssoft.com>

GAUSS is a line of software created by GaussSoft, Inc., a privately held U.S. corporation founded in 1993, with headquarters in San Jose, California and an extended presence with offices and partners in North America, Europe and Latin America.

GaussSoft delivers scalable Business Intelligence solutions of unrivaled performance, enabling large and medium-sized companies to control and reduce the cost of enterprise operations, increase profitability and improve organizational productivity by providing unsurpassed flexibility, scalability and ease of use.

GaussSoft's solutions are built on an integrated suite of high performance products for Profit and Cost Analysis, Multidimensional Query, and Activity Reporting that are scalable, function-rich, and easy to use.

GaussSoft has installed performance intelligence solutions in over 200 enterprise and consulting companies all around the world, including telecommunication, banking, manufacturing and agribusiness firms and government organizations. They have been implemented in customer premises by leading consulting firms including Deloitte, KPMG and Price.

GaussSoft suite includes:

Gauss–-Profit and Cost Allocation Engine: This strategic decision-making and analysis solution enables companies to know which products, services, and customers are making profits and which are not. Using different value and costing methodologies this solution helps reduce and control the cost of enterprise operations, increase profitability and improve organizational productivity.

Gauss–KVA: Knowledge Value Added (KVA) is a methodology that allows any organization to calculate the economic performance of core processes by providing an objective way to allocate revenue to the processes at any level within the organization.

Knowing how much revenue corporate knowledge is producing, allows organizations to dramatically improve their effectiveness and efficiency.

Gauss–Planning: This enterprise collaborative solution allows thousands of users to perform corporate enterprise planning, including financial planning, budgeting and forecasting up to 10 times faster. When used with Gauss Profit and Gauss KVA, an organization can create plans optimized for profitability and value.

Gauss–Radial Viewer: This is a Business Intelligence (BI) front-end with graphical interaction. This tool enables all End Users to create their own queries and professional looking reports from scratch –in seconds.

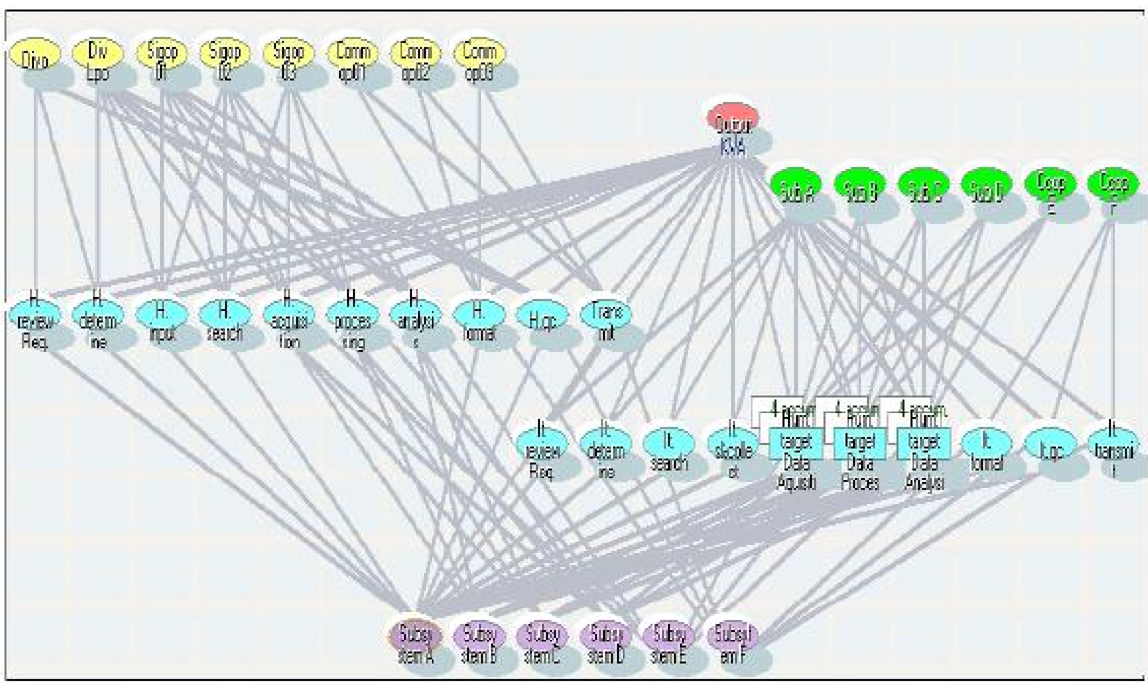


Figure 2. GaussSoft Accumulator View for USS GONZALES Case Study

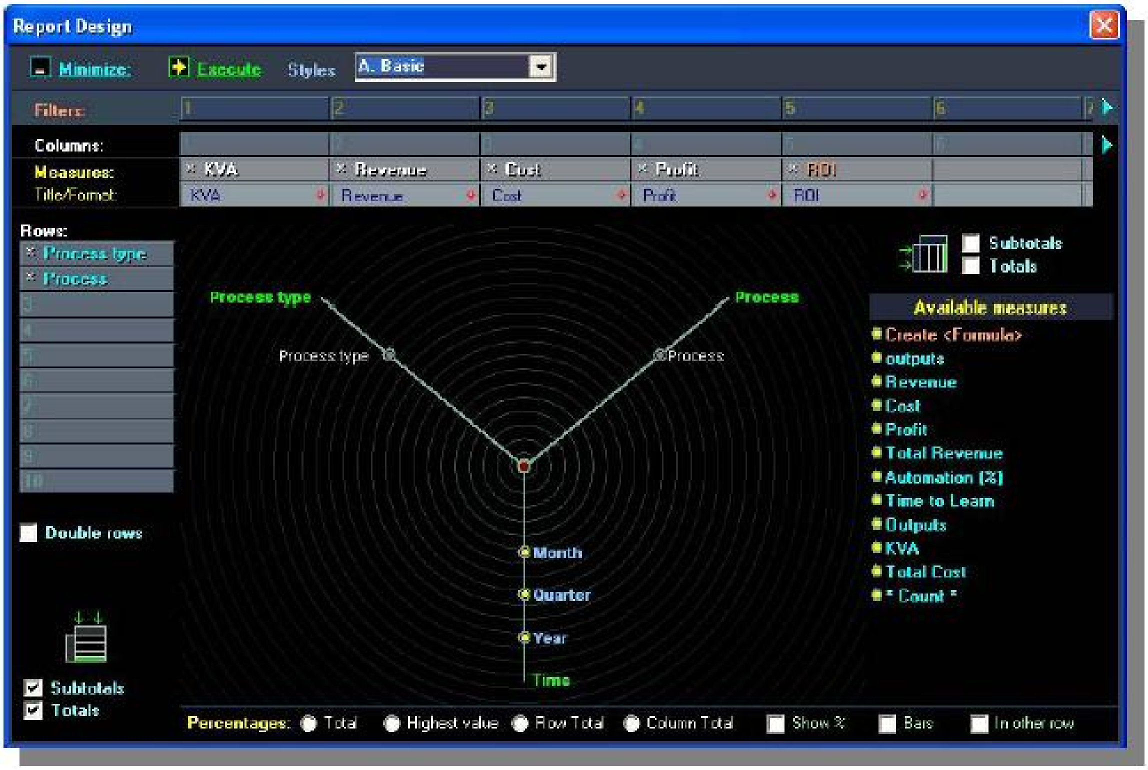
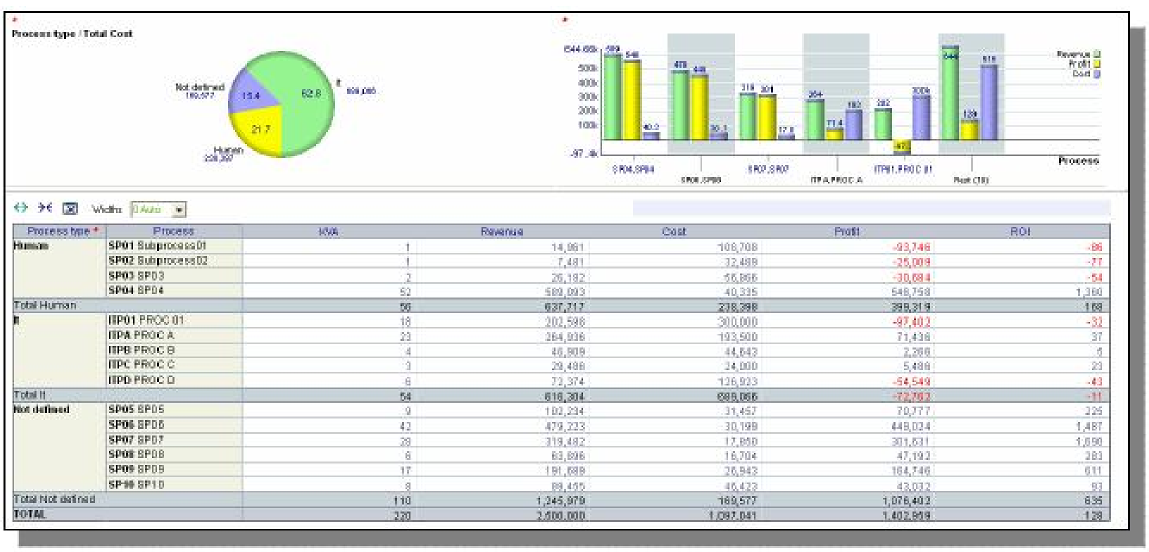


Figure 3. GaussSoft Radial Viewer Report Design Screen



Process type *	Process	KVA	Revenue	Cost	Profit	ROI
Human	SP01 Subprocess01	1	14,961	108,708	-93,746	-86
	SP02 Subprocess02	1	7,481	32,489	-25,009	-77
	SP03 SP03	2	26,182	56,866	-30,684	-54
	SP04 SP04	52	589,093	40,335	548,758	1,360
Total Human		56	637,717	238,398	399,319	168
It	ITP01 PROC 01	18	202,598	300,000	-97,402	-32
	ITPA PROC A	23	264,936	193,500	71,436	37
	ITPB PROC B	4	46,909	44,643	2,266	5
	ITPC PROC C	3	29,486	24,000	5,486	23
	ITPD PROC D	6	72,374	126,923	-54,549	-43
Total It		54	616,304	689,066	-72,762	-11
Not defined	SP05 SP05	9	102,234	31,457	70,777	225
	SP06 SP06	42	479,223	30,199	449,024	1,487
	SP07 SP07	28	319,482	17,850	301,631	1,690
	SP08 SP08	6	63,896	16,704	47,192	283
	SP09 SP09	17	191,689	26,943	164,746	611
	SP10 SP10	8	89,455	46,423	43,032	93
Total Not defined		110	1,245,979	169,577	1,076,402	635
TOTAL		220	2,500,000	1,097,041	1,402,959	128

Figure 4. GaussSoft Radial Viewer Sample Report

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. USS READINESS KVA ANALYSIS

CREW 1						PERSONNEL TIME SPENT PER PROCESS									
Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals	Assigned to Processes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Div Officer	730.00	15	292	1,037	1,2,9	40.00%	25.00%							35.00%	
Div LPO	4124.50	15	524	4,664	2-7, 9		10.00%	10.00%	20.00%	20.00%	10.00%	25.00%		5.00%	
SigOp 1	1131.50	30	486	1,648	3-7,9			20.00%	30.00%	20.00%	10.00%	10.00%		10.00%	
SigOp 2	1131.50	30	366	1,528	4-7				50.00%	25.00%	10.00%	15.00%			
SigOp 3	1131.50	30	325	1,487	4-7				50.00%	25.00%	15.00%	10.00%			
ComOp1	4124.50	20	325	4,470	8,10								90.00%		10.00%
ComOp2	1898.00	20	219	2,137	8,10								90.00%		10.00%
ComOp3	1131.50	20	184	1,336	8,10								90.00%		10.00%

CCOP A Aggregated Time to Learn =	3,443
CCOP B Time to Learn =	936
CCOP C Time to Learn =	594
CCOP D Time to Learn =	1,825
CCOP E Time to Learn =	851
CCOP F Time to Learn =	570

Assumptions:
(CCOP System Time to Learn is divided evenly over subprocesses in which they operate)

	Sub-Process Name	CCOP Assigned	Process Training t_{LH} (days)	Other Relevant t_{LH} (days)	TOTAL Tlh (days)	Tot $t_{LH-\%\ auto}$ (days)	CCOP t_{LIT} (days)	Avg % Automat'n	Tot t_{LIT} times % Automat'n (days)	Tot t_L for 1 Process Output (days)
P1	Review Request/Tasking	A	**20**	332	352	264	492	25.00%	579.82	843.70
P2	Determine Op/Equip Mix	A	**10**	580	590	531	492	10.00%	550.91	1,082.34
P3	Input Search Function/Coverage Plan	A	**35**	637	672	537	492	20.00%	626.19	1,163.54
P4	Search/Collection Process	A	**35**	2347	2382	1548	492	35.00%	1,325.61	2,874.02
P5	Target Data Acquisition/Capture	A	**16**	1613	1629	1059	492	35.00%	605.86	1,664.42
P5.1	Signal Type 1	B					312	35.00%	426.00	426.00
P5.2	Signal Type 2	C					198	35.00%	312.00	312.00
P5.3	Signal Type 3	D					608	35.00%	722.33	722.33
P5.4	Signal Type 4	E					284	35.00%	397.67	397.67
P6	Target Data Processing		**340**	805	1145	573		50.00%		
P6.1	Signal Type 1	B					312	50.00%	455.18	455.18
P6.2	Signal Type 2	C					198	50.00%	341.18	341.18
P6.3	Signal Type 3	D					608	50.00%	751.52	751.52
P6.4	Signal Type 4	E					284	50.00%	426.85	426.85
P7	Target Data Analysis		**50**	1367	1417	708		50.00%		
P7.1	Signal Type 1	B					312	50.00%	489.09	489.09
P7.2	Signal Type 2	C					198	50.00%	375.09	375.09
P7.3	Signal Type 3	D					608	50.00%	785.42	785.42
P7.4	Signal Type 4	E					284	50.00%	460.76	460.76
P8	Format Data for Report Generation	A,F	**10**	5718	5728	2864	682	50.00%	3,545.98	6,410.10
P9	QC Report	A,F	**30**	609	639	575	682	10.00%	745.73	1,320.56
P10	Transmit Report	F	**14**	635	649	97	190	85.00%	741.96	839.36
			560			8757			14,665.13	22,141.11

	Subprocess Name	Total t_{LIT} times % Automat'n (days)	Total t_{LH} (days)	Total t_L for 1 Process Executns (days)
P1	Review Request/Tasking	580	264	844
P2	Determine Op/Equip Mix	551	531	1,082
P3	Input Search Function/Coverage Plan	626	537	1,164
P4	Search/Collection Process	1,326	1,548	2,874
P5.1	Target Data Acquisition/Capture	606	1,059	1,664
	1	426		426
	2	312		312
	3	722		722
	4	398		398
P6	Target Data Processing		573	
	1	456		455
	2	341		341
	3	752		752
	4	427		427
P7	Target Data Analysis		708	
	1	489		489
	2	375		375
	3	785		785
	4	461		461
P8	Format Data for Report Generation	3,546	2,864	6,410
P9	QC Report	746	575	1,321
P10	Transmit Report	742	97	839
		14,666	8,757	22,141

ASSUMPTIONS	Sample Pd	Prior Pd		
			days	183.00
Avg # Reports during sample period	116		Search Mult	3.00
Length of sample period as %	100.00%	0.00%		
Avg # Reports executed/sample pd	116	-		

Asset	# executns by Asset *P1*	Total K *P1*	# executns by Asset P2	Total K *P2*	# executns by Asset P3	Total K *P3*	# executns by Asset P4	Total K *P4*
Div Officer	183	48290.04	131	69465.75	0	0.00	0	0.00
Div LPO	0	0.00	52	27786.30	61	32777.98	46	71845.95
SigOp 1	0	0.00	0	0.00	122	65555.97	70	107768.92
SigOp 2	0	0.00	0	0.00	0	0.00	116	179614.86
SigOp 3	0	0.00	0	0.00	0	0.00	116	179614.86
ComOp1	0	0.00	0	0.00	0	0.00		0.00
ComOp2	0	0.00	0	0.00	0	0.00		0.00
ComOp3	0	0.00	0	0.00	0	0.00		0.00
	P1 Human K	48290.04	P2 Human K	97252.06	P3 Human K	98333.95	P4 Human K	538844.59
CCOP A	183	106106.54	183	100815.64	183	114593.35	348	461313.37
CCOP B	0	0.00	0	0.00	0	0.00	0	0.00
CCOP C	0	0.00	0	0.00	0	0.00	0	0.00
CCOP D	0	0.00	0	0.00	0	0.00	0	0.00
CCOP E	0	0.00	0	0.00	0	0.00	0	0.00
CCOP F	0	0.00	0	0.00	0	0.00	0	0.00
	P1 IT K	106106.54	P2 IT K	100815.64	P3 IT K	114593.35	P4 IT K	461313.37
	Total P1 K	154396.58	Total P2 K	198067.70	Total P3 K	212927.30	Total P4 K	1000157.97

# executns by Asset P5	Total K *P5*	# executns by Asset P6	Total K *P6*	# executns by Asset P7	Total K *P7*	# executns by Asset P8	Total K *P8*	# executns by Asset P9	Total K *P9*	# executns by Asset P10	Total K *P10*	
0	0.00	0	0.00	0	0.00	0	0.00	81	46676.20	0	0.00	
26	27287.43	26	14763.71	48	34237.40	0	0.00	12	6668.03	0	0.00	
26	27287.43	26	14763.71	19	13694.96	0	0.00	23	13336.06	0	0.00	
32	34109.28	26	14763.71	29	20542.44	0	0.00	0	0.00	0	0.00	
32	34109.28	39	22145.56	19	13694.96	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	39	110745.97	0	0.00	39	3766.29	
0	0.00	0	0.00	0	0.00	39	110745.97	0	0.00	39	3766.29	
0	0.00	0	0.00	0	0.00	39	110745.97	0	0.00	39	3766.29	Total Human K
P5 Human K	122793.42	P6 Human K	66436.68	P7 Human K	82169.76	P8 Human K	332237.92	P9 Human K	66680.28	P10 Human K	11298.86	1464337.57
13	7876.13	0	0.00	0	0.00	58	205666.67	58	43252.17	0	0.00	
13	5537.99	13	5917.37	13	6358.17	0	0.00	0	0.00	0	0.00	
52	16223.96	52	17741.49	52	19504.68	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	
103	40959.58	103	43965.46	103	47457.94	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	58	205666.67	58	43252.17	116	86066.90	Total IT K
P5 IT K	70597.66	P6 IT K	67624.33	P7 IT K	73320.79	P8 IT K	411333.35	P9 IT K	86504.35	P10 IT K	86066.90	1578276.27
Total P5 K	193391.09	Total P6 K	134061.01	Total P7 K	155490.55	Total P8 K	743571.27	Total P9 K	153184.63	Total P10 K	97365.76	

Historical KVA for USS READINESS for Intelligence Collection Process

Total K Contribution and Human K

Assigned to Processes	Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
1,2,9	Div Officer	$ 59,328	$ 23,731
2-7, 9	Div LPO	$ 53,098	$ 21,239
3-7,9	SigOp 1	$ 38,925	$ 15,570
4-7	SigOp 2	$ 38,925	$ 15,570
4-7	SigOp 3	$ 38,925	$ 15,570
8,10	ComOp1	$ 47,436	$ 18,974
8,10	ComOp2	$ 37,668	$ 15,067
8,10	ComOp3	$ 33,564	$ 13,426
	Total Human		$ 139,148
1-5, 8, 9	CCOP A	$ 158,333	$ 83,500
5-7	CCOP B	$ 29,167	$ 16,917
5-7	CCOP C	$ 54,545	$ 30,606
5-7	CCOP D	$ 40,000	$ 24,500
5-7	CCOP E	$ 35,000	$ 19,833
8-10	CCOP F	$ 58,000	$ 29,000
	Total IT		$ 155,523
			$ -
	Other Fixed Costs		$ -
	GRAND TOTALS		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	116
Avg Proxy for Revs - Sample Pd =	$ 440,800
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%
	$ -

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per sub-process	Proxy Revenue Assigned to Sub-process ($US)	Cost Assigned to Sub-process ($US)	% of Total K for Human per Sub-process	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P1	Receive/Review Request/Tasking	106,106.54	48,290.04	154,396.58	5.0745%	$ 22,368	$ 21,421	1.5871%	$ 6,996	$9,492.48
P2	Determine Op/Equip Mix	100,815.64	97,252.06	198,067.70	6.5098%	$ 28,695	$ 19,985	3.1963%	$ 14,089	$8,056.72
P3	Load Search Func/Coverage Plan	114,593.35	98,333.95	212,927.30	6.9982%	$ 30,848	$ 17,166	3.2319%	$ 14,246	$5,237.92
P4	Search/Collection	461,313.37	538,844.59	1,000,157.97	32.8717%	$ 144,898	$ 36,417	17.7099%	$ 78,065	$24,488.84
P5	Target Data Acquisition/Capture	70,597.66	122,793.42	193,391.09	6.3561%	$ 28,018	$ 57,694	4.0358%	$ 17,790	$15,146.84
P6	Target Data Processing	67,624.33	66,436.68	134,061.01	4.4061%	$ 19,422	$ 38,192	2.1835%	$ 9,625	$7,573.42
P7	Target Data Analysis	73,320.79	82,169.76	155,490.55	5.1104%	$ 22,527	$41,377.99	2.7006%	$ 11,904	$10,759.30
P8	Format Data for Report Generation	411,333.35	332,237.92	743,571.27	24.4386%	$ 107,725	$ 64,316	10.9195%	$ 48,133	$42,720.48
P9	QC Report	86,504.35	66,680.28	153,184.63	5.0346%	$ 22,193	$ 32,520	2.1915%	$ 9,660	$10,924.88
P10	Transmit Report	86,066.90	11,298.86	97,365.76	3.2001%	$ 14,106	$ 14,413	0.3714%	$ 1,637	$4,746.72
		1,578,276.27	1,464,337.57	3,042,613.84	100.0000%	$ 440,800	$ 343,504	48.1276%	$ 212,147	$ 139,148

KVA Metrics for Total K

	Subprocess Name	ROK as Ratio	ROK *as %*	ROKA	ROKI
P1	Receive/Review Request/Tasking	1.04	104.42%	4.23%	4.42%
P2	Determine Op/Equip Mix	1.44	143.58%	30.35%	43.58%
P3	Load Search Func/Coverage Plan	1.80	179.70%	44.35%	79.70%
P4	Search/Collection	3.98	397.88%	74.87%	297.88%
P5	Target Data Acquisition/Capture	0.49	48.56%	-105.92%	-51.44%
P6	Target Data Processing	0.51	50.85%	-96.64%	-49.15%
P7	Target Data Analysis	0.54	54.44%	-83.68%	-45.56%
P8	Format Data for Report Generation	1.67	167.49%	40.30%	67.49%
P9	QC Report	0.68	68.24%	-46.54%	-31.76%
P10	Transmit Report	0.98	97.87%	-2.18%	-2.13%
Metrics for Aggregated		13.13	1313.05%	-140.86%	313.05%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

KVA Metrics for Human K

	Subprocess Name	ROK as Ratio	ROK *as %*	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.74	73.70%	-35.68%	-26.30%
P2	Determine Op/Equip Mix	1.75	174.88%	42.82%	74.88%
P3	Load Search Func/Coverage Plan	2.72	271.98%	63.23%	171.98%
P4	Search/Collection	3.19	318.78%	68.63%	218.78%
P5	Target Data Acquisition/Capture	1.17	117.45%	14.86%	17.45%
P6	Target Data Processing	1.27	127.09%	21.32%	27.09%
P7	Target Data Analysis	1.11	110.64%	9.62%	10.64%
P8	Format Data for Report Generation	1.13	112.67%	11.25%	12.67%
P9	QC Report	0.88	88.43%	-13.09%	-11.57%
P10	Transmit Report	0.34	34.49%	-189.98%	-65.51%
	Metrics for Aggregated	14.30	1430.10%	-7.03%	430.10%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

Historical KVA for USS READINESS for Intelligence Collection Process

IT Contribution

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
Div Officer	$ 59,328	$ 23,731
Div LPO	$ 53,098	$ 21,239
SigOp 1	$ 38,925	$ 15,570
SigOp 2	$ 38,925	$ 15,570
SigOp 3	$ 38,925	$ 15,570
ComOp1	$ 47,436	$ 18,974
ComOp2	$ 37,668	$ 15,067
ComOp3	$ 33,564	$ 13,426
Total Human		$ 139,148
CCOP A	$ 158,333	$ 83,500
CCOP B	$ 29,167	$ 16,917
CCOP C	$ 54,545	$ 30,606
CCOP D	$ 40,000	$ 24,500
CCOP E	$ 35,000	$ 19,833
CCOP F	$ 58,000	$ 29,000
Total IT		$ 155,523
		$ -
Other Fixed Costs		$ -
GRAND TOTALS		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	116
Avg Proxy for Revs - Sample Pd =	$ 440,800
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%

	CCOP A K	CCOP B K	CCOP C K	CCOP D K	CCOP E K	CCOP F K	Total IT K
P1	106,106.54						106,106.54
P2	100,815.64						100,815.64
P3	114,593.35						114,593.35
P4	461,313.37	-					461,313.37
P5	7,876.13	5,537.99	16,223.96	-	40,959.58		70,597.66
P6		5,917.37	17,741.49	-	43,965.46		67,624.33
P7		6,358.17	19,504.68	-	47,457.94		73,320.79
P8	205,666.67					205,666.67	411,333.35
P9	43,252.17					43,252.17	86,504.35
P10						86,066.90	86,066.90
	1,039,623.88	17,813.53	53,470.13	-	132,382.99	334,985.74	1,578,276.27

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)	% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)
P1	Receive/ Review Request/ Tasking	106,106.54	48,290.04	154,396.58	3.49%	$ 15,372	$ 11,929						
P2	Determine Op/Equip Mix	100,815.64	97,252.06	198,067.70	3.31%	$ 14,606	$ 11,929						
P3	Load Search Func/ Coverage	114,593.35	98,333.95	212,927.30	3.77%	$ 16,602	$ 11,929						
P4	Search/ Collection	461,313.37	538,844.59	1,000,157.97	15.16%	$ 66,833	$ 11,929						
P5	Target Data Acquisition/Capture	70,597.66	122,793.42	193,391.09	0.26%	$ 1,141	$ 11,929	0.18%	$ 802	$ 5,639	0.53%	$ 2,350	$ 10,202
P6	Target Data Processing	67,624.33	66,436.68	134,061.01				0.19%	$ 857	$ 5,639	0.58%	$ 2,570	$ 10,202
P7	Target Data Analysis	73,320.79	82,169.76	155,490.55				0.21%	$ 921	$ 5,639	0.64%	$ 2,826	$ 10,202
P8	Format Data for Report Generation	411,333.35	332,237.92	743,571.27	6.76%	$ 29,796	$ 11,929						
P9	QC Report	86,504.35	66,680.28	153,184.63	1.42%	$ 6,266	$ 11,929						
P10	Transmit Report	86,066.90	11,298.86	97,365.76									
		1,578,276.27	1,464,337.57	3,042,613.84	34.17%	$ 150,616	$ 83,500	0.59%	$ 2,581	$ 16,917	1.76%	$ 7,747	$ 30,606

% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)	Cost Assigned to CCOP F Process K ($US)
0.00%	$ -	$ 8,167	1.35%	$ 5,934	$ 6,611			
0.00%	$ -	$ 8,167	1.44%	$ 6,370	$ 6,611			
0.00%	$ -	$ 8,167	1.56%	$ 6,875	$ 6,611			
						6.76%	$ 29,796	$ 9,667
						1.42%	$ 6,266	$ 9,667
						2.83%	$ 12,469	$ 9,667
0.00%	$ -	$ 24,500	4.35%	$ 13,245	$ 19,833	11.01%	$ 48,531	$ 29,000

KVA Metrics for CCOP A K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	1.29	128.87%	22.40%	28.87%
P2	Determine Op/Equip Mix	1.22	122.44%	18.33%	22.44%
P3	Load Search Func/ Coverage Plan	1.39	139.18%	28.15%	39.18%
P4	Search/ Collection	5.60	560.28%	82.15%	460.28%
P5	Target Data Acquisition/Capture	0.10	9.57%	-945.40%	-90.43%
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	2.50	249.79%	59.97%	149.79%
P9	QC Report	0.53	52.53%	-90.36%	-47.47%
P10	Transmit Report				
Metrics for Aggregated		12.63	1262.65%	-824.76%	562.65%

KVA Metrics for CCOP B K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.14	14.23%	-602.82%	-85.77%
P6	Target Data Processing	0.15	15.20%	-557.76%	-84.80%
P7	Target Data Analysis	0.16	16.34%	-512.16%	-83.66%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.46	45.77%	-1672.75%	-254.23%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.23	23.04%	-334.04%	-76.96%
P6	Target Data Processing	0.25	25.19%	-296.92%	-74.81%
P7	Target Data Analysis	0.28	27.70%	-261.04%	-72.30%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.76	75.93%	-892.00%	-224.07%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	-	0.00%	#DIV/0!	-100.00%
P6	Target Data Processing	-	0.00%	#DIV/0!	-100.00%
P7	Target Data Analysis	-	0.00%	#DIV/0!	-100.00%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		-	0.00%	#DIV/0!	-300.00%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.90	89.76%	-11.41%	-10.24%
P6	Target Data Processing	0.96	96.35%	-3.79%	-3.65%
P7	Target Data Analysis	1.04	104.00%	3.85%	4.00%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		2.90	290.10%	-11.36%	-9.90%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	3.08	308.23%	67.56%	208.23%
P9	QC Report	0.65	64.82%	-54.27%	-35.18%
P10	Transmit Report	1.29	128.99%	22.47%	28.99%
Metrics for Aggregated		5.02	502.05%	35.76%	202.05%

	UPC	X-DECK COST *PER X-DECK INCURRED BY N20	TRAINING *PER EVENT	AMORITIZATION FIGURE
A	$950,000	$8,000	$5,000	6
B	$175,000	$2,000	$5,000	6
C	$600,000	$5,000	$5,000	11
D	$200,000	$6,000	$7,500	5
E	$175,000	$2,000	$5,000	5
F	$58,000			1
		*System is not cross-decked		
		**Training not provided by CCOP		

	A	B	C	D	E	F			
Coverage Plan Creation/ Management	210								
Control and Processing System	120							A	3443
Database Operations	155							B	936
JMCIS Applications	260							C	594
Microsoft Applications	330					330		D	1825
KL Writer	200							E	851
Other CUB Applications	750							F	570
basic RF	66	66	66	66	66				
EM theory	198	198	198	198	198				
Basic Comms Theory	132	132	132	132	132				
Propogation Theory	66		66	66					
Antenna Theory	66		66	66					
Basic Radio DF			66	66					
SCI Network Interface	120			120					
TDOA/FDOA				360					
Geolocation processing				121					
TCP/IP Communications				120		120			
VPN				240					
ALE		180							
Near Real-time Signals Analysis		300							
RF Routing		60							
Ship navigation interface				120					
National Asset interface				150					
RF Management System	90								
Signal Acquisition System	230								
Audio Distribution & Recording	60								
Spectrum Display Operations	90								
Signal Processing Applications	300								
Demodulation/Decoding					90				
Audio/Visual Analysis					35				
Digital Signal Processing/Wireless Processing					330				
Mail Server/Exchange						90			
Data Encryption						30			

Historical Learning Time and Automation Data - 6 Month Deployment Sample Period
USS GONZALES

CREW 2

Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals	Assigned to Processes
Div Officer	730.00	15	292	1,037	1,2,9
Div LPO	4124.50	15	524	4,664	2-7, 9
SigOp 1	4124.50	30	486	4,641	3-7,9
SigOp 2	1898.00	30	366	2,294	4-7
SigOp 3	1131.50	30	325	1,487	4-7
ComOp1	4124.50	20	325	4,470	8,10
ComOp2	1898.00	20	219	2,137	8,10
ComOp3	1131.50	20	184	1,336	8,10
ComOp4	1131.50	20	184	1,336	8,10

PERSONNEL TIME SPENT PER PROCESS

Operator	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Div Officer	40.00%	25.00%							35.00%	
Div LPO		10.00%	10.00%	20.00%	20.00%	10.00%	25.00%		5.00%	
SigOp 1			20.00%	30.00%	20.00%	10.00%	10.00%		10.00%	
SigOp 2				50.00%	25.00%	10.00%	15.00%			
SigOp 3				50.00%	25.00%	15.00%	10.00%			
ComOp1								90.00%		10.00%
ComOp2								90.00%		10.00%
ComOp3								90.00%		10.00%
ComOp4								90.00%		90.00%

CCOP A Aggregated Time to Learn =	3,443
CCOP B Time to Learn =	936
CCOP C Time to Learn =	594
CCOP D Time to Learn =	1,825
CCOP E Time to Learn =	851
CCOP F Time to Learn =	570

Assumptions:
(CCOP System Time to Learn is divided evenly over subprocesses in which they operate)

	Sub-Process Name	CCOP Assigned	Process Training t_{LH} (days)	Other Relevant t_{LH} (days)	TOTAL Tlh (days)	Tot $t_{LH - \% auto}$ (days)	CCOP t_{LIT} (days)	Avg % Automat'n	Tot t_{LIT} times % Automat'n (days)	Tot t_L for 1 Process Output (days)
P1	Review Request/Tasking	A	20	332	352	264	492	25.00%	579.82	843.70
P2	Determine Op/Equip Mix	A	10	580	590	531	492	10.00%	550.91	1,082.34
P3	Input Search Function/Coverage Plan	A	35	1116	1151	920	492	20.00%	721.97	1,642.42
P4	Search/Collection Process	A	35	3372	3407	2215	492	35.00%	1,684.34	3,898.94
P5	Target Data Acquisition/Capture	A	16	2245	2261	1469	492	35.00%	887.49	2,356.97
P5.1	Signal Type 1	B					312	35.00%	410.91	410.91
P5.2	Signal Type 2	C					198	35.00%	296.91	296.91
P5.3	Signal Type 3	D					608	35.00%	707.24	707.24
P5.4	Signal Type 4	E					284	35.00%	382.57	382.57
P6	Target Data Processing		340	1106	1446	723		50.00%		
P6.1	Signal Type 1	B					312	50.00%	492.78	492.78
P6.2	Signal Type 2	C					198	50.00%	378.78	378.78
P6.3	Signal Type 3	D					608	50.00%	789.11	789.11
	Signal Type 4	E					284	50.00%	464.44	464.44
P7	Target Data Analysis		50	1698	1748	874		50.00%		
P7.1	Signal Type 1	B					312	50.00%	530.52	530.52
P7.2	Signal Type 2	C					198	50.00%	416.52	416.52
P7.3	Signal Type 3	D					608	50.00%	826.85	826.85
	Signal Type 4	E					284	50.00%	502.18	502.18
P8	Format Data for Report Generation	A,F	10	6680	6690	4014	682	40.00%	3,357.78	7,371.66
P9	QC Report	A,F	30	848	878	790	682	10.00%	769.67	1,560.00
P10	Transmit Report	F	14	1597	1611	242	190	85.00%	1,559.28	1,800.92
			560			12043			16,310.05	26,755.74

Subprocess Name	Total t_{LIT} times % Automat'n (days)	Total t_{LH} (days)	Total t_L for 1 Process Executns (days)
Review Request/Tasking	580	264	844
Determine Op/Equip Mix	551	531	1,082
Input Search Function/Coverage Plan	722	920	1,642
Search/Collection Process	1,684	2,215	3,899
Target Data Acquisition/Capture	887	1,469	2,357
1	411		411
2	297		297
3	707		707
4	383		383
Target Data Processing		723	
1	493		493
2	379		379
3	789		789
4	464		464
Target Data Analysis		874	
1	531		531
2	417		417
3	827		827
4	502		502
Format Data for Report Generation	3,358	4,014	7,372
QC Report	770	790	1,560
Transmit Report	1,559	242	1,801
	16,310	12,043	26,756

ASSUMPTIONS

	Sample Pd	Prior Pd		
			Days	150.00
Avg # Reports during sample period	102		KL Mult	3.00
Length of sample period as %	100.00%	0.00%		
Avg # Reports executed/sample pe	102	-		

Asset	# executns by Asset *P1*	Total K *P1*	# executns by Asset P2	Total K *P2*	# executns by Asset P3	Total K *P3*	# executns by Asset P4	Total K *P4*
Div Officer	150	39582.00	107	56939.14	0	0.00	0	0.00
Div LPO	0	0.00	43	22775.66	50	46022.40	41	90355.76
SigOp 1	0	0.00	0	0.00	100	92044.80	61	135533.64
SigOp 2	0	0.00	0	0.00	0	0.00	102	225889.40
SigOp 3	0	0.00	0	0.00	0	0.00	102	225889.40
ComOp1	0	0.00	0	0.00	0	0.00		0.00
ComOp2	0	0.00	0	0.00	0	0.00		0.00
ComOp3	0	0.00	0	0.00	0	0.00		0.00
ComOp4	0	0.00	0	0.00	0	0.00		0.00
	P1 Human K	39582.00	P2 Human K	79714.80	P3 Human K	138067.20	P4 Human K	677668.21
CCOP A	150	86972.57	150	82635.77	150	108295.37	265	446685.68
CCOP B	0	0.00	0	0.00	0	0.00	0	0.00
CCOP C	0	0.00	0	0.00	0	0.00	0	0.00
CCOP D	0	0.00	0	0.00	0	0.00	0	0.00
CCOP E	0	0.00	0	0.00	0	0.00	0	0.00
CCOP F	0	0.00	0	0.00	0	0.00	0	0.00
	P1 IT K	86972.57	P2 IT K	82635.77	P3 IT K	108295.37	P4 IT K	446685.68
	Total P1 K	126554.57	Total P2 K	162350.57	Total P3 K	246362.57	Total P4 K	1124353.89

# executns by Asset P5	Total K *P5*	# executns by Asset P6	Total K *P6*	# executns by Asset P7	Total K *P7*	# executns by Asset P8	Total K *P8*	# executns by Asset P9	Total K *P9*	# executns by Asset P10	Total K *P10*	
0	0.00	0	0.00	0	0.00	0	0.00	71	56429.28	0	0.00	
23	33308.24	23	16390.49	43	37147.98	0	0.00	10	8061.33	0	0.00	
23	33308.24	23	16390.49	17	14859.19	0	0.00	20	16122.65	0	0.00	
28	41635.30	23	16390.49	26	22288.79	0	0.00	0	0.00	0	0.00	
28	41635.30	34	24585.74	17	14859.19	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	Total Human K
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	
P5 Human K	149887.06	P6 Human K	73757.22	P7 Human K	89155.14	P8 Human K	307061.82	P9 Human K	80613.25	P10 Human K	18485.31	1653992.01
67	59461.61	0	0.00	0	0.00	51	171246.63	51	39253.23	0	0.00	
67	27530.79	67	33016.09	67	35544.67	0	0.00	0	0.00	0	0.00	
1	296.91	1	378.78	1	416.52	0	0.00	0	0.00	0	0.00	
153	108207.83	153	120733.96	153	126508.18	0	0.00	0	0.00	0	0.00	
35	13390.09	35	16255.55	35	17576.45	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	51	171246.63	51	39253.23	102	159046.76	Total IT K
P5 IT K	208887.23	P6 IT K	170384.37	P7 IT K	180045.81	P8 IT K	342493.27	P9 IT K	78506.46	P10 IT K	159046.76	1863953.30
Total P5 K	358774.29	Total P6 K	244141.59	Total P7 K	269200.95	Total P8 K	649555.09	Total P9 K	159119.71	Total P10 K	177532.07	

Historical KVA for USS READINESS for Intelligence Collection Process

Total K Contribution and Human K

Assigned to Processes	Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
1,2,9	Div Officer	$ 59,328	$ 23,731
2-7, 9	Div LPO	$ 53,098	$ 21,239
3-7,9	SigOp 1	$ 38,925	$ 15,570
4-7	SigOp 2	$ 38,925	$ 15,570
4-7	SigOp 3	$ 38,925	$ 15,570
8,10	ComOp1	$ 47,436	$ 18,974
8,10	ComOp2	$ 37,668	$ 15,067
8,10	ComOp3	$ 33,564	$ 13,426
8,10	ComOp4	$ 33,564	$ 13,426
	Total Human		$ 139,148
1-5, 8, 9	CCOP A	$ 158,333	$ 83,500
5-7	CCOP B	$ 29,167	$ 16,917
5-7	CCOP C	$ 54,545	$ 30,606
5-7	CCOP D	$ 40,000	$ 24,500
5-7	CCOP E	$ 35,000	$ 19,833
8-10	CCOP F	$ 58,000	$ 29,000
	Total IT		$ 155,523
			$ -
	Other Fixed Costs		$ -
	GRAND TOTALS		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	102
Avg Proxy for Revs - Sample Pd =	$ 387,600
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%
	$ -

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per sub-process	Proxy Revenue Assigned to Sub-process ($US)	Cost Assigned to Sub-process ($US)	% of Total K for Human per Sub-process	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P1	Receive/Review Request/Tasking	86,972.57	39,582.00	126,554.57	3.5974%	$ 13,944	$ 21,421	1.1251%	$ 4,361	$9,492.48
P2	Determine Op/Equip Mix	82,635.77	79,714.80	162,350.57	4.6149%	$ 17,887	$ 19,985	2.2659%	$ 8,783	$8,056.72
P3	Load Search Func/Coverage Plan	108,295.37	138,067.20	246,362.57	7.0030%	$ 27,144	$ 17,166	3.9247%	$ 15,212	$5,237.92
P4	Search/Collection	446,685.68	677,668.21	1,124,353.89	31.9605%	$ 123,879	$ 36,417	19.2632%	$ 74,664	$24,488.84
P5	Target Data Acquisition/Capture	208,887.23	149,887.06	358,774.29	10.1984%	$ 39,529	$ 57,694	4.2606%	$ 16,514	$15,146.84
P6	Target Data Processing	170,384.37	73,757.22	244,141.59	6.9399%	$ 26,899	$ 38,192	2.0966%	$ 8,126	$7,573.42
P7	Target Data Analysis	180,045.81	89,155.14	269,200.95	7.6522%	$ 29,660	$41,377.99	2.5343%	$ 9,823	$10,759.30
P8	Format Data for Report Generation	342,493.27	307,061.82	649,555.09	18.4640%	$ 71,567	$ 76,399	8.7284%	$ 33,831	$54,803.52
P9	QC Report	78,506.46	80,613.25	159,119.71	4.5231%	$ 17,531	$ 32,520	2.2915%	$ 8,882	$10,924.88
P10	Transmit Report	159,046.76	18,485.31	177,532.07	5.0465%	$ 19,560	$ 26,496	0.5255%	$ 2,037	$16,829.76
		1,863,953.30	1,653,992.01	3,517,945.31	100.0000%	$ 387,600	$ 367,670	47.0159%	$ 182,233	$ 163,314

KVA Metrics for Total K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.65	65.09%	-53.63%	-34.91%
P2	Determine Op/Equip Mix	0.90	89.50%	-11.73%	-10.50%
P3	Load Search Func/Coverage Plan	1.58	158.12%	36.76%	58.12%
P4	Search/Collection	3.40	340.16%	70.60%	240.16%
P5	Target Data Acquisition/Capture	0.69	68.51%	-45.95%	-31.49%
P6	Target Data Processing	0.70	70.43%	-41.98%	-29.57%
P7	Target Data Analysis	0.72	71.68%	-39.51%	-28.32%
P8	Format Data for Report Generation	0.94	93.68%	-6.75%	-6.32%
P9	QC Report	0.54	53.91%	-85.50%	-46.09%
P10	Transmit Report	0.74	73.82%	-35.46%	-26.18%
Metrics for Aggregated		10.85	1084.91%	-213.15%	84.91%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

KVA Metrics for Human K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.46	45.94%	-117.66%	-54.06%
P2	Determine Op/Equip Mix	1.09	109.01%	8.27%	9.01%
P3	Load Search Func/Coverage Plan	2.90	290.42%	65.57%	190.42%
P4	Search/Collection	3.05	304.89%	67.20%	204.89%
P5	Target Data Acquisition/Capture	1.09	109.03%	8.28%	9.03%
P6	Target Data Processing	1.07	107.30%	6.80%	7.30%
P7	Target Data Analysis	0.91	91.30%	-9.53%	-8.70%
P8	Format Data for Report Generation	0.62	61.73%	-61.99%	-38.27%
P9	QC Report	0.81	81.30%	-23.00%	-18.70%
P10	Transmit Report	0.12	12.10%	-726.34%	-87.90%
	Metrics for Aggregated	12.13	1213.02%	-782.40%	213.02%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

Historical KVA for USS READINESS for Intelligence Collection Process

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
Div Officer	$ 59,328	$ 23,731
Div LPO	$ 53,098	$ 21,239
SigOp 1	$ 38,925	$ 15,570
SigOp 2	$ 38,925	$ 15,570
SigOp 3	$ 38,925	$ 15,570
ComOp1	$ 47,436	$ 18,974
ComOp2	$ 37,668	$ 15,067
ComOp3	$ 33,564	$ 13,426
ComOp4	$ 33,564	$ 13,426
Total Human		$ 139,148
CCOP A	$ 158,333	$ 83,500
CCOP B	$ 29,167	$ 16,917
CCOP C	$ 54,545	$ 30,606
CCOP D	$ 40,000	$ 24,500
CCOP E	$ 35,000	$ 19,833
CCOP F	$ 58,000	$ 29,000
Total IT	$ 282,045	$ 155,523
		$ -
Other Fixed Costs		$ -
GRAND TOTALS		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	102
Avg Proxy for Revs - Sample Pd =	$ 387,600
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%

	CCOP A K	CCOP B K	CCOP C K	CCOP D K	CCOP E K	CCOP F K	Total IT K
P1	86,972.57						86,972.57
P2	82,635.77						82,635.77
P3	108,295.37						108,295.37
P4	446,685.68	-					446,685.68
P5	59,461.61	27,530.79	296.91	108,207.83	13,390.09		208,887.23
P6		33,016.09	378.78	120,733.96	16,255.55		170,384.37
P7		35,544.67	416.52	126,508.18	17,576.45		180,045.81
P8	171,246.63					171,246.63	342,493.27
P9	39,253.23					39,253.23	78,506.46
P10						159,046.76	159,046.76
	994,550.88	96,091.56	1,092.20	355,449.96	47,222.08	369,546.63	1,863,953.30

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)
P1	Receive/ Review Request/ Tasking	86,972.57	39,582.00	126,554.57	2.47%	$ 9,582	$ 11,929			
P2	Determine Op/Equip Mix	82,635.77	79,714.80	162,350.57	2.35%	$ 9,105	$ 11,929			
P3	Load Search Func/ Coverage	108,295.37	138,067.20	246,362.57	3.08%	$ 11,932	$ 11,929			
P4	Search/ Collection	446,685.68	677,668.21	1,124,353.89	12.70%	$ 49,215	$ 11,929			
P5	Target Data Acquisition/Capture	208,887.23	149,887.06	358,774.29	1.69%	$ 6,551	$ 11,929	0.78%	$ 3,033	$ 5,639
P6	Target Data Processing	170,384.37	73,757.22	244,141.59				0.94%	$ 3,638	$ 5,639
P7	Target Data Analysis	180,045.81	89,155.14	269,200.95				1.01%	$ 3,916	$ 5,639
P8	Format Data for Report Generation	342,493.27	307,061.82	649,555.09	4.87%	$ 18,868	$ 11,929			
P9	QC Report	78,506.46	80,613.25	159,119.71	1.12%	$ 4,325	$ 11,929			
P10	Transmit Report	159,046.76	18,485.31	177,532.07						
		1,863,953.30	1,653,992.01	3,517,945.31	28.27%	$ 109,578	$ 83,500	2.73%	$ 10,587	$ 16,917

% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)	% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)	Cost Assigned to CCOP F Process K ($US)
0.01%	$ 33	$ 10,202	3.08%	$ 11,922	$ 8,167	0.38%	$ 1,475	$ 6,611			
0.01%	$ 42	$ 10,202	3.43%	$ 13,302	$ 8,167	0.46%	$ 1,791	$ 6,611			
0.01%	$ 46	$ 10,202	3.60%	$ 13,938	$ 8,167	0.50%	$ 1,937	$ 6,611			
									4.87%	$ 18,868	$ 9,667
									1.12%	$ 4,325	$ 9,667
									4.52%	$ 17,523	$ 9,667
0.03%	$ 120	$ 30,606	10.10%	$ 27,241	$ 24,500	1.34%	$ 3,728	$ 19,833	10.50%	$ 40,716	$ 29,000

KVA Metrics for CCOP A K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	0.80	80.33%	-24.48%	-19.67%
P2	Determine Op/Equip Mix	0.76	76.33%	-31.02%	-23.67%
P3	Load Search Func/ Coverage Plan	1.00	100.03%	0.03%	0.03%
P4	Search/ Collection	4.13	412.58%	75.76%	312.58%
P5	Target Data Acquisition/Capture	0.55	54.92%	-82.08%	-45.08%
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	1.58	158.17%	36.78%	58.17%
P9	QC Report	0.36	36.26%	-175.82%	-63.74%
P10	Transmit Report				
Metrics for Aggregated		9.19	918.61%	-200.83%	218.61%

KVA Metrics for CCOP B K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.54	53.79%	-85.90%	-46.21%
P6	Target Data Processing	0.65	64.51%	-55.01%	-35.49%
P7	Target Data Analysis	0.69	69.45%	-43.99%	-30.55%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		1.88	187.75%	-184.90%	-112.25%

	KVA Metrics for CCOP C K				
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.00	0.32%	-31086.78%	-99.68%
P6	Target Data Processing	0.00	0.41%	-24345.97%	-99.59%
P7	Target Data Analysis	0.00	0.45%	-22130.96%	-99.55%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.01	1.18%	-77563.71%	-298.82%

	KVA Metrics for CCOP D K				
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.46	145.99%	31.50%	45.99%
P6	Target Data Processing	1.63	162.88%	38.61%	62.88%
P7	Target Data Analysis	1.71	170.67%	41.41%	70.67%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		4.80	479.54%	111.52%	179.54%

	KVA Metrics for CCOP E K				
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.22	22.32%	-348.12%	-77.68%
P6	Target Data Processing	0.27	27.09%	-269.13%	-72.91%
P7	Target Data Analysis	0.29	29.29%	-241.39%	-70.71%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.79	78.70%	-858.64%	-221.30%

	KVA Metrics for CCOP F K				
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	1.95	195.18%	48.77%	95.18%
P9	QC Report	0.45	44.74%	-123.52%	-55.26%
P10	Transmit Report	1.81	181.28%	44.84%	81.28%
Metrics for Aggregated		4.21	421.20%	-29.91%	121.20%

Historical Learning Time and Automation Data - 6 Month Deployment Sample Period
USS GONZALES

CREW 1						PERSONNEL TIME SPENT PER PROCESS									
Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals	Assigned to Processes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Div Officer	730.00	15	292	1,037	1,2,9	40.00%	25.00%							35.00%	
Div LPO	4124.50	15	524	4,664	2-7, 9		10.00%	10.00%	20.00%	20.00%	10.00%	25.00%		5.00%	
SigOp 1	1898.00	30	486	2,414	3-7,9			20.00%	30.00%	20.00%	10.00%	10.00%		10.00%	
SigOp 2	1898.00	30	366	2,294	4-7				50.00%	25.00%	10.00%	15.00%			
SigOp 3	1131.50	30	325	1,487	4-7				50.00%	25.00%	15.00%	10.00%			
ComOp1	4124.50	20	325	4,470	8,10								90.00%		10.00%
ComOp2	1131.50	20	219	1,371	8,10								90.00%		10.00%
ComOp3	1131.50	20	184	1,336	8,10								90.00%		10.00%

CCOP A Aggregated Time to Learn =	3,443
CCOP B Time to Learn =	936
CCOP C Time to Learn =	594
CCOP D Time to Learn =	1,825
CCOP E Time to Learn =	851
CCOP F Time to Learn =	570

Assumptions:
(CCOP System TTL is divided evenly over subprocesses in which it operates)

	Sub-Process Name	CCOP Assigned	Process Training t_{LH} (days)	Other Relevant t_{LH} (days)	TOTAL Tlh (days)	Tot $t_{LH - \% auto}$ (days)	CCOP t_{LIT} (days)	Avg % Automat'n	Tot t_{LIT} times % Automat'n (days)	Tot t_L for 1 Process Output (days)
P1	Review Request/Tasking	A	20	332	352	264	492	25.00%	579.82	843.70
P2	Determine Op/Equip Mix	A	10	580	590	531	492	10.00%	550.91	1,082.34
P3	Input Search Function/Coverage Plan	A	35	759	794	635	492	20.00%	650.72	1,286.18
P4	Search/Collection Process	A	35	2838	2873	1867	492	35.00%	1,497.31	3,364.58
P5	Target Data Acquisition/Capture	A	16	1889	1905	1238	492	35.00%	825.14	2,063.07
P5.1	Signal Type 1	B					312	35.00%	395.32	395.32
P5.2	Signal Type 2	C					198	35.00%	281.32	281.32
P5.3	Signal Type 3	D					608	35.00%	691.66	691.66
P5.4	Signal Type 4	E					284	35.00%	366.99	366.99
P6	Target Data Processing		340	928	1268	634		50.00%		
P6.1	Signal Type 1	B					312	50.00%	470.51	470.51
P6.2	Signal Type 2	C					198	50.00%	356.51	356.51
P6.3	Signal Type 3	D					608	50.00%	766.85	766.85
	Signal Type 4	E					284	50.00%	442.18	442.18
P7	Target Data Analysis		50	1520	1570	785		50.00%		
P7.1	Signal Type 1	B					312	50.00%	508.25	508.25
P7.2	Signal Type 2	C					198	50.00%	394.25	394.25
P7.3	Signal Type 3	D					608	50.00%	804.59	804.59
	Signal Type 4	E					284	50.00%	479.92	479.92
P8	Format Data for Report Generation	A,F	10	5166	5176	3106	682	40.00%	2,752.40	5,858.22
P9	QC Report	A,F	30	670	700	630	682	10.00%	751.86	1,381.88
P10	Transmit Report	F	14	574	588	88	190	85.00%	689.83	778.04
			560			9779			14,256.34	22,616.34

Subprocess Name	Total t_{LIT} times % Automat'n (days)	Total t_{LH} (days)	Total t_L for 1 Process Executns (days)
Review Request/Tasking	580	264	844
Determine Op/Equip Mix	551	531	1,082
Input Search Function/Coverage Plan	651	635	1,286
Search/Collection Process	1,497	1,867	3,365
Target Data Acquisition/Capture	825	1,238	2,063
1	395		395
2	281		281
3	692		692
4	367		367
Target Data Processing		634	
1	471		471
2	357		357
3	767		767
4	442		442
Target Data Analysis		785	
1	508		508
2	394		394
3	805		805
4	480		480
Format Data for Report Generation	2,752	3,106	5,858
QC Report	752	630	1,382
Transmit Report	690	88	778
	14,256	9,779	22,616

ASSUMPTIONS

	Sample Pd	Prior Pd		
			Days	170.00
Avg # Reports during sample period	368		KL Mult	3.00
Length of sample period as %	100.00%	0.00%		
Avg # Reports executed/sample p	368	-		

Asset	# executns by Asset *P1*	Total K *P1*	# executns by Asset P2	Total K *P2*	# executns by Asset P3	Total K *P3*	# executns by Asset P4	Total K *P4*
Div Officer	170	44859.60	121	64531.03	0	0.00	0	0.00
Div LPO	0	0.00	49	25812.41	57	36009.17	147	274861.85
SigOp 1	0	0.00	0	0.00	113	72018.35	221	412292.77
SigOp 2	0	0.00	0	0.00	0	0.00	368	687154.62
SigOp 3	0	0.00	0	0.00	0	0.00	368	687154.62
ComOp1	0	0.00	0	0.00	0	0.00		0.00
ComOp2	0	0.00	0	0.00	0	0.00		0.00
ComOp3	0	0.00	0	0.00	0	0.00		0.00
	P1 Human K	44859.60	P2 Human K	90343.44	P3 Human K	108027.52	P4 Human K	2061463.87
CCOP A	170	98568.91	170	93653.87	170	110622.59	957	1432625.39
CCOP B	0	0.00	0	0.00	0	0.00	0	0.00
CCOP C	0	0.00	0	0.00	0	0.00	0	0.00
CCOP D	0	0.00	0	0.00	0	0.00	0	0.00
CCOP E	0	0.00	0	0.00	0	0.00	0	0.00
CCOP F	0	0.00	0	0.00	0	0.00	0	0.00
	P1 IT K	98568.91	P2 IT K	93653.87	P3 IT K	110622.59	P4 IT K	1432625.39
	Total P1 K	143428.51	Total P2 K	183997.31	Total P3 K	218650.11	Total P4 K	3494089.26

# executns by Asset P5	Total K *P5*	# executns by Asset P6	Total K *P6*	# executns by Asset P7	Total K *P7*	# executns by Asset P8	Total K *P8*	# executns by Asset P9	Total K *P9*	# executns by Asset P10	Total K *P10*	
0	0.00	0	0.00	0	0.00	0	0.00	258	162292.64	0	0.00	
82	101234.76	82	51851.20	153	120368.20	0	0.00	37	23184.66	0	0.00	
82	101234.76	82	51851.20	61	48147.28	0	0.00	74	46369.32	0	0.00	
102	126543.44	82	51851.20	92	72220.92	0	0.00	0	0.00	0	0.00	
102	126543.44	123	77776.80	61	48147.28	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	123	380980.10	0	0.00	123	10819.94	
0	0.00	0	0.00	0	0.00	123	380980.10	0	0.00	123	10819.94	
0	0.00	0	0.00	0	0.00	123	380980.10	0	0.00	123	10819.94	Total Human K
P5 Human K	455556.40	P6 Human K	233330.40	P7 Human K	288883.68	P8 Human K	1142940.29	P9 Human K	231846.62	?10 Human K	32459.81	4689711.63
1	825.14	0	0.00	0	0.00	184	506441.81	184	138342.08	0	0.00	
1	395.32	1	470.51	1	508.25	0	0.00	0	0.00	0	0.00	
341	95930.76	341	121570.76	341	134440.10	0	0.00	0	0.00	0	0.00	
81	56024.07	81	62114.51	81	65171.45	0	0.00	0	0.00	0	0.00	
367	134684.79	367	162279.75	367	176130.33	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	184	506441.81	184	138342.08	368	253858.91	Total IT K
P5 IT K	287860.09	P6 IT K	346435.54	P7 IT K	376250.14	P8 IT K	1012883.62	P9 IT K	276684.16	P10 IT K	253858.91	4289443.24
Total P5 K	743416.49	Total P6 K	579765.94	Total P7 K	665133.82	Total P8 K	2155823.91	Total P9 K	508530.79	Total P10 K	286318.72	

Historical KVA for USS READINESS for Intelligence Collection Process

Total K Contribution and Human K

Assigned to Processes	Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
1,2,9	Div Officer	$ 59,328	$ 23,731
2-7, 9	Div LPO	$ 53,098	$ 21,239
3-7,9	SigOp 1	$ 43,887	$ 17,555
4-7	SigOp 2	$ 43,887	$ 17,555
4-7	SigOp 3	$ 38,925	$ 15,570
8,10	ComOp1	$ 47,436	$ 18,974
8,10	ComOp2	$ 33,564	$ 13,426
8,10	ComOp3	$ 33,564	$ 13,426
	Total Human		$ 141,476
1-5, 8, 9	CCOP A	$ 158,333	$ 83,500
5-7	CCOP B	$ 29,167	$ 16,917
5-7	CCOP C	$ 54,545	$ 30,606
5-7	CCOP D	$ 40,000	$ 24,500
5-7	CCOP E	$ 35,000	$ 19,833
8-10	CCOP F	$ 58,000	$ 29,000
	Total IT		$ 155,523
			$ -
	Other Fixed Costs		$ -
	GRAND TOTALS		$ 296,998

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	368
Avg Proxy for Revs - Sample Pd =	$ 1,398,400
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%
	$ -

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per sub-process	Proxy Revenue Assigned to Sub-process ($US)	Cost Assigned to Sub-process ($US)	% of Total K for Human per Sub-process	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P1	Receive/Review Request/Tasking	98,568.91	44,859.60	143,428.51	1.5973%	$ 22,337	$ 21,421	0.4996%	$ 6,986	$9,492.48
P2	Determine Op/Equip Mix	93,653.87	90,343.44	183,997.31	2.0492%	$ 28,655	$ 19,985	1.0061%	$ 14,070	$8,056.72
P3	Load Search Func/Coverage Plan	110,622.59	108,027.52	218,650.11	2.4351%	$ 34,052	$ 17,563	1.2031%	$ 16,824	$5,634.88
P4	Search/Collection	1,432,625.39	2,061,463.87	3,494,089.26	38.9133%	$ 544,164	$ 38,005	22.9583%	$ 321,049	$26,076.68
P5	Target Data Acquisition/Capture	287,860.09	455,556.40	743,416.49	8.2794%	$ 115,779	$ 58,587	5.0735%	$ 70,948	$16,040.00
P6	Target Data Processing	346,435.54	233,330.40	579,765.94	6.4568%	$ 90,292	$ 38,589	2.5986%	$ 36,339	$7,970.38
P7	Target Data Analysis	376,250.14	288,883.68	665,133.82	7.4075%	$ 103,587	$41,874.19	3.2173%	$ 44,990	$11,255.50
P8	Format Data for Report Generation	1,012,883.62	1,142,940.29	2,155,823.91	24.0092%	$ 335,745	$ 62,838	12.7288%	$ 178,000	$41,243.04
P9	QC Report	276,684.16	231,846.62	508,530.79	5.6635%	$ 79,198	$ 32,719	2.5821%	$ 36,107	$11,123.36
P10	Transmit Report	253,858.91	32,459.81	286,318.72	3.1887%	$ 44,591	$ 14,249	0.3615%	$ 5,055	$4,582.56
		4,289,443.24	4,689,711.63	8,979,154.88	100.0000%	$ 1,398,400	$ 345,832	52.2289%	$ 730,369	$ 141,476

KVA Metrics for Total K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	1.04	104.28%	4.10%	4.28%
P2	Determine Op/Equip Mix	1.43	143.38%	30.26%	43.38%
P3	Load Search Func/Coverage Plan	1.94	193.88%	48.42%	93.88%
P4	Search/Collection	14.32	1431.81%	93.02%	1331.81%
P5	Target Data Acquisition/Capture	1.98	197.62%	49.40%	97.62%
P6	Target Data Processing	2.34	233.98%	57.26%	133.98%
P7	Target Data Analysis	2.47	247.38%	59.58%	147.38%
P8	Format Data for Report Generation	5.34	534.30%	81.28%	434.30%
P9	QC Report	2.42	242.06%	58.69%	142.06%
P10	Transmit Report	3.13	312.94%	68.04%	212.94%
Metrics for Aggregated		36.42	3641.62%	550.05%	2641.62%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

KVA Metrics for Human K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.74	73.60%	-35.87%	-26.40%
P2	Determine Op/Equip Mix	1.75	174.64%	42.74%	74.64%
P3	Load Search Func/Coverage Plan	2.99	298.57%	66.51%	198.57%
P4	Search/Collection	12.31	1231.17%	91.88%	1131.17%
P5	Target Data Acquisition/Capture	4.42	442.32%	77.39%	342.32%
P6	Target Data Processing	4.56	455.92%	78.07%	355.92%
P7	Target Data Analysis	4.00	399.72%	74.98%	299.72%
P8	Format Data for Report Generation	4.32	431.59%	76.83%	331.59%
P9	QC Report	3.25	324.61%	69.19%	224.61%
P10	Transmit Report	1.10	110.31%	9.35%	10.31%
Metrics for Aggregated		39.42	3942.45%	551.07%	2942.45%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
Div Officer	$ 59,328	$ 23,731
Div LPO	$ 53,098	$ 21,239
SigOp 1	$ 43,887	$ 17,555
SigOp 2	$ 43,887	$ 17,555
SigOp 3	$ 38,925	$ 15,570
ComOp1	$ 47,436	$ 18,974
ComOp2	$ 33,564	$ 13,426
ComOp3	$ 33,564	$ 13,426
Total Human		$ 141,476
CCOP A	$ 158,333	$ 83,500
CCOP B	$ 29,167	$ 16,917
CCOP C	$ 54,545	$ 30,606
CCOP D	$ 40,000	$ 24,500
CCOP E	$ 35,000	$ 19,833
CCOP F	$ 58,000	$ 29,000
Total IT	$ 282,045	$ 155,523
		$ -
Other Fixed Costs		$ -
GRAND TOTALS		$ 296,998

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	368
Avg Proxy for Revs - Sample Pd =	$ 1,398,400
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%

	CCOP A K	CCOP B K	CCOP C K	CCOP D K	CCOP E K	CCOP F K	Total IT K
P1	98,568.91						98,568.91
P2	93,653.87						93,653.87
P3	110,622.59						110,622.59
P4	1,432,625.39	-					1,432,625.39
P5	825.14	395.32	95,930.76	56,024.07	134,684.79		287,860.09
P6		470.51	121,570.76	62,114.51	162,279.75		346,435.54
P7		508.25	134,440.10	65,171.45	176,130.33		376,250.14
P8	506,441.81					506,441.81	1,012,883.62
P9	138,342.08					138,342.08	276,684.16
P10						253,858.91	253,858.91
	2,381,079.81	1,374.09	351,941.62	183,310.04	473,094.88	898,642.80	4,289,443.24

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)
P1	Receive/ Review Request/ Tasking	98,568.91	44,859.60	143,428.51	1.10%	$ 15,351	$ 11,929			
P2	Determine Op/Equip Mix	93,653.87	90,343.44	183,997.31	1.04%	$ 14,586	$ 11,929			
P3	Load Search Func/ Coverage	110,622.59	108,027.52	218,650.11	1.23%	$ 17,228	$ 11,929			
P4	Search/ Collection	1,432,625.39	2,061,463.87	3,494,089.26	15.96%	$ 223,115	$ 11,929			
P5	Target Data Acquisition/Capture	287,860.09	455,556.40	743,416.49	0.01%	$ 129	$ 11,929	0.00%	$ 62	$ 5,639
P6	Target Data Processing	346,435.54	233,330.40	579,765.94				0.01%	$ 73	$ 5,639
P7	Target Data Analysis	376,250.14	288,883.68	665,133.82				0.01%	$ 79	$ 5,639
P8	Format Data for Report Generation	1,012,883.62	1,142,940.29	2,155,823.91	5.64%	$ 78,872	$ 11,929			
P9	QC Report	276,684.16	231,846.62	508,530.79	1.54%	$ 21,545	$ 11,929			
P10	Transmit Report	253,858.91	32,459.81	286,318.72						
		4,289,443.24	4,689,711.63	8,979,154.88	26.52%	$ 370,826	$ 83,500	0.02%	$ 214	$ 16,917

% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)	% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)	Cost Assigned to CCOP F Process K ($US)
1.07%	$ 14,940	$ 10,202	0.62%	$ 8,725	$ 8,167	1.50%	$ 20,976	$ 6,611			
1.35%	$ 18,933	$ 10,202	0.69%	$ 9,674	$ 8,167	1.81%	$ 25,273	$ 6,611			
1.50%	$ 20,937	$ 10,202	0.73%	$ 10,150	$ 8,167	1.96%	$ 27,430	$ 6,611			
									5.64%	$ 78,872	$ 9,667
									1.54%	$ 21,545	$ 9,667
									2.83%	$ 39,536	$ 9,667
3.92%	$ 54,811	$ 30,606	2.04%	$ 19,823	$ 24,500	5.27%	$ 52,703	$ 19,833	10.01%	$ 139,953	$ 29,000

KVA Metrics for CCOP A K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	1.29	128.69%	22.29%	28.69%
P2	Determine Op/Equip Mix	1.22	122.27%	18.22%	22.27%
P3	Load Search Func/ Coverage Plan	1.44	144.43%	30.76%	44.43%
P4	Search/ Collection	18.70	1870.42%	94.65%	1770.42%
P5	Target Data Acquisition/Capture	0.01	1.08%	-9182.45%	-98.92%
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	6.61	661.21%	84.88%	561.21%
P9	QC Report	1.81	180.62%	44.63%	80.62%
P10	Transmit Report				
Metrics for Aggregated		31.09	3108.72%	-8887.01%	2408.72%

KVA Metrics for CCOP B K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.01	1.09%	-9058.97%	-98.91%
P6	Target Data Processing	0.01	1.30%	-7595.32%	-98.70%
P7	Target Data Analysis	0.01	1.40%	-7023.90%	-98.60%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.04	3.80%	-23678.19%	-296.20%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.46	146.44%	31.71%	46.44%
P6	Target Data Processing	1.86	185.58%	46.12%	85.58%
P7	Target Data Analysis	2.05	205.23%	51.27%	105.23%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		5.37	537.25%	129.10%	237.25%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.07	106.84%	6.40%	6.84%
P6	Target Data Processing	1.18	118.45%	15.58%	18.45%
P7	Target Data Analysis	1.24	124.28%	19.54%	24.28%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		3.50	349.57%	41.52%	49.57%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	3.17	317.28%	68.48%	217.28%
P6	Target Data Processing	3.82	382.28%	73.84%	282.28%
P7	Target Data Analysis	4.15	414.91%	75.90%	314.91%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		11.14	1114.47%	218.22%	814.47%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	8.16	815.92%	87.74%	715.92%
P9	QC Report	2.23	222.88%	55.13%	122.88%
P10	Transmit Report	4.09	408.99%	75.55%	308.99%
Metrics for Aggregated		14.48	1447.79%	218.43%	1147.79%

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

Clapp, C. and I. Lambeth. (2007) *Using Knowledge Value Added (KVA) for Evaluating Cryptologic IT Capabilities: Trial Implementation.* Monterey: Naval Postgraduate School.

Department of the Navy (2005). *CCOP program briefing*. CCOP Program Office (OPNAV N201C).

———. (2003). *Naval Transformation Roadmap 2003: Assured Access & Power Projection…From the Sea*. Office of the Chief of Naval Operations.

———. (2002). *Vision…Presence…Power: A Program Guide to the U.S. Navy – 2002 Edition*. Office of the Chief of Naval Operations.

Housel, T., and A. Bell (2001). *Measuring and managing knowledge*. Boston: McGraw-Hill.

Housel, T., O. Sawy, J. Zhong, and W. Rodgers. (2001). *Models for measuring the return on information technology: a proof of concept demonstration.* Monterey: 22nd International Conference on Information Systems.

Housel, T., E. Jansen, P. Pavlou, and W. Rodgers. *Measuring the Return on Information Technology: A Knowledge-Based Approach for Revenue Allocation at the Process and Firm Level*. Monterey: Naval Postgraduate School.

Nickerson, C. (1986). *Accounting Handbook for Nonaccountants* (3rd ed.) New York: Van Nostrand Reinhold Co.

Pratt, S., R. Reilly, and R. Scheihs. (2000) *Valuing A Business* (4th ed.) New York: McGraw-Hill.

Rios, C. (2005) *Return on Investment Analysis of Information Warfare Systems*. Monterey: Naval Postgraduate School.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, VA

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, CA

3. Wayne Bratt
   SPAWAR
   San Diego, CA

4. NETWARCOM/N1/N17
   Norfolk, VA

5. Tom Housel
   Naval Postgraduate School
   Monterey, CA

6. Richard Bergin
   Naval Postgraduate School
   Monterey, CA

7. Michael Herrera
   Naval Postgraduate School
   Monterey, CA

8. Dan Boger
   Naval Postgraduate School
   Monterey, CA