



Calhoun: The NPS Institutional Archive

Theses and Dissertations

Thesis Collection

2011-06

An analysis of the return on investment of Navy Enterprise Resource Planning as implemented Navy-wide FY04-FY15

Kovack, Robert G.

Monterey, California. Naval Postgraduate School



Calhoun is a project of the Dudley Knox Library at NPS, furthering the precepts and goals of open government and government transparency. All information contained herein has been approved for release by the NPS Public Affairs Officer.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

MBA PROFESSIONAL REPORT

**An Analysis of the Return on Investment
of Navy Enterprise Resource Planning
as Implemented Navy-Wide FY04–FY15**

**By: Robert Kovack Jr., and
Philip R. Lindley
June 2011**

**Advisors: Douglas Brook
Douglas Brinkley**

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE June 2011	3. REPORT TYPE AND DATES COVERED MBA Professional Report	
4. TITLE AND SUBTITLE: An Analysis of the Return on Investment of Navy Enterprise Resource Planning as Implemented Navy-Wide FY04-FY15			5. FUNDING NUMBERS
6. AUTHOR(S) Robert G. Kovack Jr. and Philip R. Lindley			8. PERFORMING ORGANIZATION REPORT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			11. SUPPLEMENTARY NOTES The views expressed in this report are those of the author(s) and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB protocol number <u> N.A. </u> .
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			12b. DISTRIBUTION CODE A
13. ABSTRACT (maximum 200 words) Since 2003, the United States Navy has invested hundreds of millions of dollars into the Enterprise Resource Planning (ERP) Program. ERP evolved from four pilot programs into a single solution. Furthermore, the Navy has invested approximately \$2 billion for ERP implementation and developed several programs to streamline the financial reporting practices. This thesis project analyzes the evolution and development of ERP, identifies the Navy's projections for ERP, and calculates the cost and benefits of executing ERP between FY04 and FY15. We compare the return on investment (ROI) on Navy ERP to the ROI from ERP implementation in the private sector. Our objective is to understand the ROI for the Navy ERP compared to the ROI for the private sector.			
14. SUBJECT TERMS ERP, Enterprise Resource Planning, Navy			15. NUMBER OF PAGES 71
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

**AN ANALYSIS OF THE RETURN ON INVESTMENT OF NAVY
ENTERPRISE RESOURCE PLANNING AS IMPLEMENTED NAVY-
WIDE FY04–FY15**

Robert G. Kovack Jr., Lieutenant Commander, United States Navy
Philip R. Lindley, Lieutenant Commander, United States Navy.

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

**NAVAL POSTGRADUATE SCHOOL
June 2011**

Authors:

Robert G. Kovack, Jr.

Philip R. Lindley

Approved by:

Douglas Brook, Thesis Advisor

Douglas Brinkley, Support Advisor

William Gates, Dean
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

**AN ANALYSIS OF THE RETURN ON INVESTMENT OF
NAVY ENTERPRISE RESOURCE PLANNING AS
IMPLEMENTED NAVY-WIDE FY04–FY15**

ABSTRACT

Since 2003, the United States Navy has invested hundreds of millions of dollars into the Enterprise Resource Planning (ERP) Program. ERP evolved from four pilot programs into a single solution. Furthermore, the Navy has invested approximately \$2 billion for ERP implementation and developed several programs to streamline the financial reporting practices. This thesis project analyzes the evolution and development of ERP, identifies the Navy's projections for ERP, and calculates the cost and benefits of executing ERP between FY04 and FY15. We compare the return on investment (ROI) on Navy ERP to the ROI from ERP implementation in the private sector. Our objective is to understand the ROI for the Navy ERP compared to the ROI for the private sector.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	BACKGROUND	1
B.	PURPOSE.....	2
C.	RESEARCH QUESTIONS.....	3
1.	Primary Research Question.....	3
2.	Secondary Research Questions.....	3
D.	THESIS SCOPE.....	3
E.	METHODOLOGY	4
F.	ORGANIZATION	4
II.	LITERATURE REVIEW	7
A.	WHAT IS ENTERPRISE RESOURCE PLANNING?	7
B.	HISTORY AND EVOLUTION OF ERP	9
C.	NAVY ERP.....	13
D.	RETURN ON INVESTMENT (ROI).....	17
III.	DATA PRESENTATION.....	21
A.	INITIAL AND REVISED ERP COST AND SCHEDULE.....	21
B.	CURRENT HISTORY OF ERP.....	22
C.	ERP COST AND BENEFIT DATA	24
IV.	ANALYSIS	35
A.	INTRODUCTION.....	35
B.	CHART ANALYSIS.....	36
1.	Deployment Costs.....	36
2.	Costs and Benefits.....	36
3.	Benefits by Savings Category.....	37
4.	Benefits by SYSCOM	37
C.	RETURN ON INVESTMENT CALCULATION.....	38
1.	Return on Investment Using Actual Cost and Benefit Data	38
2.	Return on Investment Using Projected Cost and Benefit Data	38
3.	Return on Investment Using Total Cost and Benefit Data	39
D.	ANALYSIS OF RETURN ON INVESTMENT CALCULATION	39
E.	LIMITATIONS OF ROI CALCULATION.....	41
V.	CONCLUSIONS AND RECOMMENDATIONS.....	45
A.	SUMMARY	45
B.	PRIMARY RESEARCH QUESTIONS.....	46
C.	SECONDARY RESEARCH QUESTIONS.....	46
D.	CONCLUSION	47
E.	IMPLICATIONS OF THESIS	47
F.	RECOMMENDATIONS FOR FUTURE STUDY	48
	LIST OF REFERENCES.....	49
	INITIAL DISTRIBUTION LIST	53

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

Figure 1.	Integrated Enterprise Resource Planning Solution (From Veit, 2005, p. 12).....	8
Figure 2.	ASN-FMC, Office of the Financial Operations ERP Definition (From Veit, 2010, Slide 2)	9
Figure 3.	ERP Development and Progress Through the Years (From Sysoptima, 2005)	12
Figure 4.	Single ERP Solution As Evolved From Pilots (From Veit, 2005, p. 13).....	15
Figure 5.	The ROI Process Model (From Phillips & Pulliam Phillips, 2007, p. 19)	18
Figure 6.	ERP Deployment Timeline (Carter, 2010, Slide 3)	23
Figure 7.	Total Deployment Costs (Actual and Projected) (From Herren Associates, Economic Analysis, January 12, 2011).....	30
Figure 8.	Actual Costs and Benefits FY04–FY10 (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan 2010, Slides 7–9; Keller et al., 2006, pp. 6–15)	31
Figure 9.	Projected Costs and Benefits FY11-FY15 (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan, 2010 Slides 7–9; Keller et al., 2006, pp. 6–15)	31
Figure 10.	Total Costs and Benefits FY04–FY15 (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan 2010 Slides 7–9; Keller et al., 2006, pp. 6–15)	32
Figure 11.	Benefit by Savings Category (From Ingram & Jordan, 2010, Slides 7–9).....	32
Figure 12.	Actual and Projected Benefit Achieved by Each SYSCOM (From Ingram & Jordan, 2010 Slides 7–9).....	33
Figure 13.	Total Costs (Actual and Projected) vs. Total Benefits (Actual and Projected) (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan, 2010 Slides 7–9).....	34
Figure 14.	Intangible Benefits (Murphy & Simon, 2002, p. 306).....	42
Figure 15.	Intangible Benefits Realized (From O’Leary, 2004, p. 65)	43

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1.	Navy ERP Pilot Projects (in Millions) (From GAO, 2005, p. 13).....	14
Table 2.	Description of Functionality Added by Template 1's Releases (From GAO, 2009, p. 4).....	22
Table 3.	Actual ERP Deployment Costs (From Herren Associates, personal communication, January 12, 2011).....	26
Table 4.	Projected ERP Deployment Costs (From Herren Associates, personal communication, January 12, 2011).....	26
Table 5.	Projected Cost Savings From Legacy System Retirement (From Ingram & Jordan, 2010 Slide 8)	27
Table 6.	Actual Cost Avoidance From Legacy System Retirement (From Ingram & Jordan, 2010 Slide 7)	27
Table 7.	Projected Cost Avoidance From Legacy System Retirement (From Ingram & Jordan, 2010 Slide 7)	28
Table 8.	Projected Inventory Cost Savings (From Ingram & Jordan, 2010 Slide 9).....	28
Table 9.	Actual Labor Savings (From Keller et al., 2006, pp. 6–15).....	29
Table 10.	Projected Labor Savings (From Keller et al., 2006, pp. 6–15).....	29
Table 11.	ROI Performance Comparison Between ERP Adopters and Non-ERP Adopters (Hunton et al., p. 177).	41

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

CBPWG	Commercial Business Practices Working Group
CFO	Chief Financial Officer
CIO	Chief Information Officer
COTS	Commercial Off-the-Shelf
DFAS	Defense Finance and Accounting Services
DoD	Department of Defense
DON	Department of the Navy
ERP	Enterprise Resource Planning
FISC	Fleet and Industrial Supply Center
FTE	Full-Time Equivalent
FYDP	Future Years Defense Program
GAO	General Accounting Office
IOC	Initial Operational Capability
IV&V	Independent Verification and Validation
MPC	Manufacturing Planning and Control
MRP	Material Requirements Planning
MRP II	Manufacturing Resource Planning II
NAVAIR	Naval Air Systems Command
NAVICP	Naval Inventory Control Point
NAVSEA	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NCCA	Naval Center for Cost Analysis
NEMAIS	Navy Enterprise Maintenance Automated Information System
NWCF	Navy Working Capital Fund
OM&N	Operation and Maintenance, Navy
OPNAV	Office of the Chief of Naval Operations
OSS	On-Site Support
RDT&E	Research, Development, Test and Evaluation
ROI	Return On Investment
ROP	Reorder Point

SMART	Supply Maintenance Aviation Reengineering Team
SPAWAR	Space and Naval Warfare Command
SYSCOM	System Commands
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics

ACKNOWLEDGMENTS

I would like to thank our two advisors, Dr. Douglas Brook and Dr. Douglas Brinkley, for your help and direction. Your advice and guidance were of invaluable assistance. Tracy, my wife, and my two daughters, Kate and Emma, offered a never-ending amount of moral support. Their support motivated me to finish this project. To my dad, Dr. Lester Lindley, thank you for your editorial support and constructive criticism, both of which resulted in a better end product.

Phil Lindley

I would like to express my deepest gratitude to our advisors, Dr. Douglas Brook and Dr. Douglas Brinkley, for their mentoring, coaching, and guidance. Thank you for giving us the opportunity to work for you and conduct research on this project. I would like to thank my parents and family for their tremendous support and encouragement throughout this process. Our appreciation also reaches out to all those who took time out of their busy schedules to provide information and data for us to conduct our research.

Bob Kovack

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND

The Department of the Navy (DON) adopted the Enterprise Resource Planning (ERP) Program as the single system solution to unite all Navy legacy systems, allowing for the removal of numerous redundant legacy systems and eliminating nonvalue adding practices (Veit, 2005, p. 14). The DON's budget has seen a steady increase since 1998. However, this is predicted to change, and the Navy is expected to operate in a more financially constrained environment. Experts predict the Navy's budget will decrease, if the pattern of the last 50 years continues (Brook & Candreva, 2007, pp. 51–53).

Since the early 1990s, legislative initiatives have been directed at both the Department of Defense (DoD) and the DON to improve both the management and accountability of their financial operations. The Chief Financial Officer (CFO) Act of 1990 sought to institute a new standard for financial management practices within the federal government. The creation of a well-planned financial control system was central to the success of the CFO Act (General Accounting Office [GAO], 1991, p. 12).

The external pressure from the DON's budget and the increased pressure from Congress led the Navy to look for a single solution that would standardize its acquisition practices, provide reliable and timely financial data (both externally and internally), and allow for the management of the Navy's worldwide assets. Doing all of these things would allow senior Navy leadership to make more informed decisions by looking across the entire enterprise and seeing the effects of their decisions (Veit, 2005, p. 11).

This led the Navy to look to a Commercial Off-the-Shelf (COTS) solution for its requirement. ERP was the solution put forth by the DON's Commercial Business Practices Working Group (DoNCBPWG). ERP developed from hardware and software created in the 1960s and the 1970s. The mainframe computers created in the 1960s forever altered business practices. Improvements in hardware offered more power over

those of the past and possessed untapped potential. Advancements in hardware led to software improvements that tapped into the available hardware's potential (Monk & Wagner, 2009, pp. 20–21).

Material Requirements Planning (MRP) was the next step along the developmental path toward ERP. However, these systems were still compartmentalized and did not share information or communicate across departmental boundaries. This system grew into Manufacturing Resource Planning (MRP-II) software (Monk & Wagner, 2009, p. 21).

In the early 1990s, ERP programs emerged. ERPs are the result of:

(1) the advancement of hardware and software technology (computing power, memory, and communications) needed to support the system, (2) the development of a vision of integrated information systems, and (3) the reengineering of companies to shift from a functional focus to a business process function. (Monk & Wagner, 2009, p. 19)

A separate ERP pilot program was initiated at each of the Navy's four system commands (SYSCOMs). ERP proved its usefulness at the SYSCOM level. However, having the four separate pilot programs at the SYSCOM level only created four more stove-piped systems. In order to achieve the desired goal, in 2003, the DON united all four ERPs into one Navy-wide solution managed by one program office. Associated legacy systems are being retired as the ERP replacement system is brought online and all data have been successfully transferred. The Navy's ERP system will be the largest system deployed to date, when all stages have been released.

B. PURPOSE

The primary purpose for developing the ERP system was to coordinate data and information across every area of any one business. The DON, like many commercial companies, has expended large sums of money implementing its ERP system. The DON, like several companies, was not fully successful in its initial attempts at deploying equally complex ERP systems.

In this project, we examine the DON's expected return on investment (ROI) from its ERP program implementation. A comparison between the DON's ROI to a successful private-sector ROI was done to see if the DON is achieving the same degree of success as private companies.

C. RESEARCH QUESTIONS

The purpose of this thesis was to provide an understanding of the direct costs and benefits incurred while executing the ERP system and to determine the DON's ROI to date of the ERP.

In this research, we look at the ROI from employing ERP. First, we collected and normalized the actual benefits received and actual costs to date so that all financial information is in fiscal year (FY) 2010 dollars. Then, we normalized the forecasted benefits and costs to the same base year. Finally, we calculated two ROIs, one actual and one forecasted. Both were calculated because most of the costs to implement an ERP are upfront, and most of the benefits are seen over time.

1. Primary Research Question

- Has implementing ERP provided the DON with a current positive ROI at the end of FY10? If not, will the ERP provide the DON with a positive forecasted ROI by the end of FY15?

2. Secondary Research Questions

- How do the actual ROI and the forecasted ROI compare to those of private companies?
- Were there any nonmonetary benefits not considered in the calculation?

D. THESIS SCOPE

The focal point of our thesis was the actual ROI the DON received at the end of FY10. Our secondary focus was on the expected ROI the DON will receive at the end of FY15.

E. METHODOLOGY

In our research, we did the following: (1) conducted a thorough literature review on the origins and evolution of ERP; (2) summarized the history of ERP, as implemented by the DON; (3) developed a definition of ROI used on technology projects; (4) presented the ROI experienced by several private companies implementing ERP systems; (5) collected data from members of the ERP program office; and (6) analyzed the cost and benefit data of implementing the DON's ERP collected by the DON and normalized it.

In the literature review, (1) we created a common definition of what an ERP is and the value of implementing it; (2) we provided a brief history of ERP, as implemented by the DON; (3) we established a shared understanding of ROI; and (4) we devised a yard stick for comparing the DON's ROI to that of private companies.

All DON financial cost and benefit data were provided to us in then-year dollars. To conduct our analysis, the data needed to be normalized. Converting all financial cost and benefit data to a common base year was required. The base year we chose was 2004. A base year of 2004 was chosen because it was the beginning of the program. All data were normalized using the Naval Center for Cost Analysis's (NCCA) joint inflation calculator. The appropriation account we chose was the Other Appropriation Navy Account (1810). A then-year to constant-year conversion was done for each.

There are many tools one can employ to analyze an investment, such as the DON's ERP Program. We chose ROI because this equation allowed us to isolate the DON's ERP Program from potentially confounding factors. Separating the DON's ERP Program allowed an examination of the costs and benefits of the Program, determined how well the DON used their scarce resources and compared how the DON measured up to similar private industry ERP programs.

F. ORGANIZATION

In Chapter II, we include a literature review that provides a summary of what an ERP system is and the benefits of implanting such a system. We follow this with a

summary of the evolution of ERP in the commercial sector. Next, we examine a brief history of the Navy's attempts to implement ERP. We conclude this chapter with a definition of ROI and with the equation we used to determine the Navy's ROI from its ERP system.

In Chapter III, we present data from each of the SYCOMS for actual and projected costs from FY04 to FY15. Then, we introduce the actual and projected benefits from FY04 to FY15. We calculate the Navy's ROI and compare it to commercial-sector ROIs. Finally, we examine the primary research question and the secondary questions.

In Chapter IV, we analyze the data presented in Chapter III. We compare the ROI the Navy achieved from FY04 to FY10 and its projected ROI to those the commercial sector realized by implementing ERP systems. We compare these two ROIs for two reasons: first, to determine how the DON's ROI compares to that of private firms, and second, to make a determination as to whether the DON is doing better or worse than a private firm.

In Chapter V, we give conclusions and recommendations based on our evaluation of the data presented.

THIS PAGE INTENTIONALLY LEFT BLANK

II. LITERATURE REVIEW

A. WHAT IS ENTERPRISE RESOURCE PLANNING?

A business process is an accumulation of activities that takes one or more features of input and creates an output, such as a report or forecast, which is of value to the customer. ERP programs help to administer company-wide business processes by using a common database and shared management reporting tools (Monk & Wagner, 2009, p. 1). Aladwani (2001) defined ERP as the following:

The enterprise resource planning (ERP) system is an integrated set of programs that provides support for core organizational activities such as manufacturing and logistics, finance and accounting, sales and marketing, and human resources. An ERP system helps the different parts of the organization share data and knowledge, reduce costs, and improve management of business processes. (p. 266)

It aspires to amalgamate all departments and functions across a company into a single computer system that can perform and serve all the particular needs of the different departments (Batz, Koch, & Slater, 1999). Each department has its own computer system, optimized for the selective ways in which that the department does its work. However, ERP combines these systems into a single, merged software program that runs from a single database, so that the various departments can more easily communicate and share information (Batz et al., 1999).

The integrated software program approach can have a tremendous payback if companies successfully integrate all business processes as they install the software (Batz et al., 1999, p. 1). The tasks involved in performing business functions are automated by ERP. With ERP, when a service representative takes an order from a customer, all the information necessary to provide a quote to the customer is supplied by the ERP system (Batz et al., 1999, p. 1). The order process should move quickly through the organization, with customers getting their orders faster and with more efficiency than before. Sharing data and information between and within functional areas leads to more

productive business processes (Monk & Wagner, 2009, p. 4). ERP can apply that benefit to other major business processes, such as employee benefits or financial reporting (Baatz et al., 1999, p. 1).

An ERP system supports the integration of business processes across an organization or enterprise (e.g., supply chain, finance, manufacturing/maintenance, human resources; Veit, 2005, p. 12). As Figure 1 displays, the functional areas of a business process that are currently supported by stove-piped, government-unique legacy systems can be better supported by an integrated ERP solution that crosses the entire enterprise (Veit, 2005, p. 12).

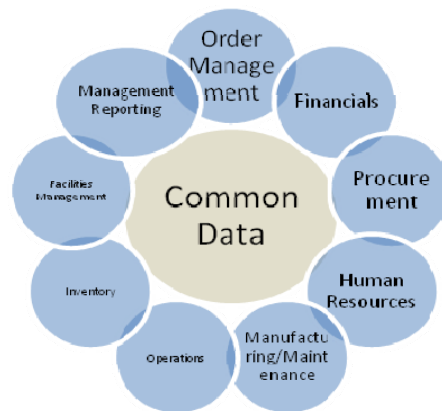


Figure 1. Integrated Enterprise Resource Planning Solution
(From Veit, 2005, p. 12)

ERP demands change in business processes through integration; therefore, business process reengineering is the key to a successful ERP implementation (Veit, 2005, p. 12). Business processes need to align with ERP software to be effective. Business process reengineering becomes an enterprise-wide effort under ERP. All necessary data and information are entered into the system one time and remain available to all involved in the business process, thus providing “consistent, complete, relevant, timely, and reliable information for decision making” (Veit, 2005, p. 12). Successful implementation of ERP systems allows organizations to remove costly existing internal business systems and interfaces (especially financial feeder systems) and to support a more auditable, manageable processing environment (Veit, 2005, p. 12). Successful

system execution seeks to reduce costs and provide a dramatic improvement in business information. Figure 2 exhibits the ERP relationships from the viewpoint of the Office of Financial Operations under the Office of the Assistant Secretary of the Navy.

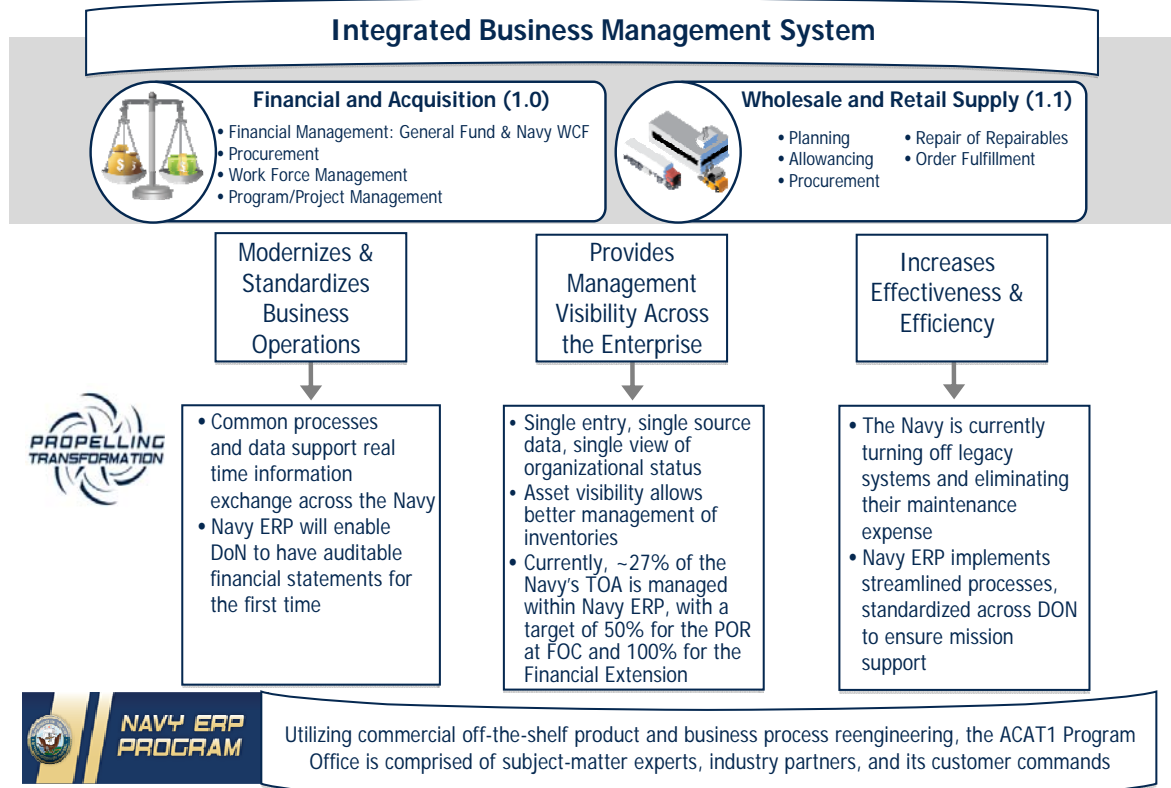


Figure 2. ASN-FMC, Office of the Financial Operations ERP Definition (From Veit, 2010, Slide 2)

According to Sheldon (2005), high performance in a business requires discipline and execution. The disciplines inherent in ERP processes allow enterprises to connect customers and top-management decisions all the way through to execution in the supply chain and the factory floor (Sheldon, 2005, p. 2). “Well-executed ERP not only starts with top management, it is totally dependent on top management” (Sheldon, 2005, p. 2).

B. HISTORY AND EVOLUTION OF ERP

In the 1960s, cost minimization became a major focus for manufacturing companies that had high-volume production. Computer hardware and software began to

develop rapidly and changed the way business was conducted. Over time, computers emerged to provide integrated, real-time data for business decision-making because computer hardware and software capabilities were doubling every 18 months (Monk & Wagner, 2009, p. 19). The introduction of new computerized reorder point (ROP) systems fulfilled basic manufacturing planning and control (MPC) obligations of firms (Jacobs & Weston, 2007, p. 358). An example of the challenges and concerns facing companies was provided by chief internal consultant C. Botter, manager of the Central Industrial Engineering Department at Royal Philips Electronics:

One of the most difficult problems in this area (the area of operations management for assembled products, JP) is the calculation of future demand of materials. This can be accomplished by exploding bills-of-material or by extrapolation of past demand. Especially in the business-to-business companies this is the problem, because of the large numbers of parts in the files (approximately 20,000 items), the long lead times and the many changes to plans and designs. (Peeters, 2009, p. 58)

Emphasis on management control and inventory became particularly evident when most systems' software was designed to handle inventory based on traditional inventory concepts (Kampf, 2006, p. 1). This led to the establishment of Material Requirements Planning (MRP) in the 1970s, the predecessor of ERP.

The evolution to MRP developed with a joint effort between J. I. Case, a manufacturer of tractors and other construction machinery, and IBM (Jacobs & Weston, 2007, p. 358). The newly created software allowed managers to plan, build, and purchase inventory requirements based on finished product requirements, inventories, and expected arrivals (Keller et al., 2006, pp. 1–4). It was designed to guarantee that a manufacturer had the necessary inventory on hand when it was needed. It gave planners and managers more control by allowing them to be actively involved so that they could employ time-phased orders instead of reacting to production delays (LMI, 2006, pp. 1–4). As of the 1960s, the MRP application software was the most advanced method to date for planning and scheduling materials for complex manufactured products (ERPandMore.com, 2007; Jacobs & Weston, 2007, p. 358).

Initial MRP solutions required large technical staffs to support the mainframe computers on which the software ran (Jacobs & Weston, 2007, p. 358). Throughout the 1970s, companies such as Systemanalyse und Programmentwicklung (SAP), J. D. Edwards, Oracle, and Baan Corporation were established. These companies emerged to create, produce, and market new standard software for integrated business solutions. As a result of their combined labors, the integration between forecasting, master scheduling, and procurement became established as the fundamental parts and materials planning concept used in management and control (Jacobs & Weston, 2007, p. 358).

In the 1980s, J. D. Edwards began to center its attention on writing software for the IBM System/38. This system had a lower cost than the mainframe computers because it offered flexible disk drives with capacities useful for small- and medium-sized businesses (Jacobs & Weston, 2007, p. 359). The term *MRP* was applied to the increasingly encompassing business functions, contributing to the use of the phrase *manufacturing resource planning* rather than the phrase *material requirements planning* (Jacobs & Weston, 2007). The change from MRP I to Manufacturing Resource Planning II (MRP II) was conceived to recognize the newer systems' capabilities, and the change was designed to integrate business planning, sales, support, and other functions. New software programs were created to capitalize on the advances made in software technology and to capture the improvements in manufacturing. MRP II improved the efficiency of manufacturing enterprises by combining information and manufacturing technologies (LMI, 2006, pp. 1–5). It linked different departments (such as engineering, finance, personnel management, manufacturing, and marketing) using a computer-based simulation model (LMI, 2006, pp. 1–5). Although MRP II tended to unite different functions of a company, the functional units are not fully integrated; MRP II cannot truly be considered an enterprise-wide system (LMI, 2006, pp. 1–5).

The 1990s witnessed many companies adopting a new globalization trend. Organizations began to look within their structure to see how they could improve their business and process flows. Management within large companies wanted to eliminate costly inefficiencies in their traditional business practices. The functional business model led to top-heavy and overstaffed organizations incapable of reacting quickly to change

(Monk & Wagner, 2009, p. 22). The quest for increased efficiencies prompted the Gartner Group to coin the term *enterprise resource planning* (ERP). The definition of ERP included criteria for analyzing the extent that software was actually integrated both across and within the various functional silos (Jacobs & Weston, 2007, p. 361). It was an extension of MRP II, with added and enhanced functional capability. The goal for an integrated ERP was to replace blocks of information with cross-communication to ensure enterprise-wide coherence (LMI, 2006, pp. 1–5). When compared to MRP II, ERP offers broad functional coverage with much better capabilities. When combined with product enhancements, global support, and technology partners, ERP narrows the gap between desired and actual features (LMI, 2006, pp. 1–5).

The ERP industry was led by companies such as SAP, Baan, J. D. Edwards, PeopleSoft, and Oracle. In the late 1990s, these companies led the way for companies to move to ERP in order to address potential Y2K issues. As it became clear that the date turnover from December 31, 1999, to January 1, 2000, might wreak havoc on some information systems, companies searched for ways to consolidate data, and ERP systems provided one solution (Monk & Wagner, 2009, p. 25). These patterns of technological and operational progression from the past were revealed through the ERP evolution. The resulting pattern served as a basis for future trends and projections of this technology (Pairat & Jungthirapanich, 2005, p. 288). Figure 3 represents the development and progression of ERP through the years.

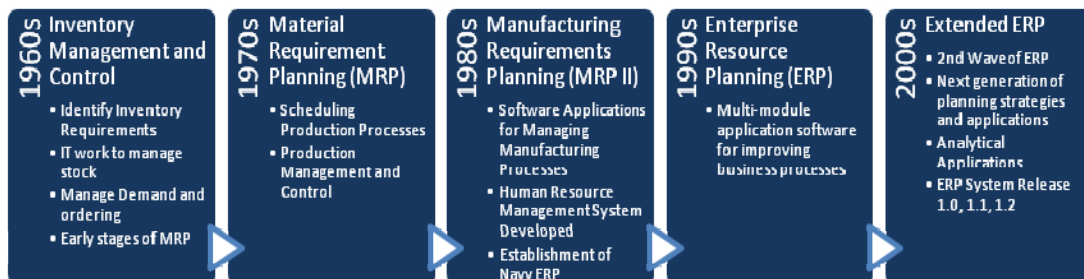


Figure 3. ERP Development and Progress Through the Years
(From Sysoptima, 2005)

C. NAVY ERP

The Navy ERP business management system combines the key operational components of an organization: supply chain, manufacturing/maintenance, finance, procurement, and human resources (Veit, 2005, p. 12). The Navy's ERP program dates back to 1988. The Assistant Secretary of Defense for Acquisition and Technology established the DoD's Commercial Business Practices Working Group in response to section 912(d) of the FY98 National Defense Authorization Act (Under Secretary of Defense for Acquisition, Technology, and Logistics [USD(AT&L)], 1998).

The goal of the working group was to minimize the differences the DoD paid for goods and services, compared to the private sector (Under Secretary of Defense for Acquisition, Technology, and Logistics [USD(AT&L)], 1998). The difference was minimized by implementing a number of strategies. The working group minimized the differences by implementing a number of strategies. One such tactic was to switch from a military specification to performance specifications. At this time, the Navy's Revolution in Business Affairs Commercial Business Practices Working Group used industry executives to help them search for business efficiencies. Industry executives attributed a successful ERP solution to business process re-engineering (Sysoptima, 2005).

In 1998, the DON authorized a limited production of ERP in four major system commands. The Navy ERP program grew from four pilots—which provided the basis for the convergence of capabilities into a single Navy solution—to be incrementally developed and deployed (Sysoptima, 2005). The pilots tested the application of a commercial off-the-shelf (COTS) ERP solution. Each of these pilots focused on different segments of ERP:

- Sigma Naval Air Systems Command (NAVAIR)—integrated financials, program management and budgeting, procurement, and human resources;
- Supply Maintenance Aviation Reengineering Team (SMART)—Naval Supply Systems Command (NAVSUP) and NAVAIR—maintenance planning and supply support processes, interface to Aviation Depots;
- Navy Enterprise Maintenance Automated Information System (NEMAIS)—Naval Sea Systems Command (NAVSEA) optimized intermediate-level maintenance, project systems, workforce management;

- Cabrillo—Space and Naval Warfare Command (SPAWAR)—Financial Management, Navy Working Capital Fund (NWCF) management.
(GAO, 2005, p. 13; Veit, 2005 p. 12)

All four of these limited-scope pilots have proven that the Navy can successfully do business in a COTS environment (Veit, 2005, p. 12). The cost of each pilot program is shown in Table 1. Some of the successes the pilots experienced were quicker financial statement availability and reduction in the total required legacy systems. NAVAIR shifted their financial system to Sigma, resulting in the reduction in assessment times and reduction in the requisition to orders, which provided significant time and resource savings for the Navy (Veit, 2005, p. 13). The next step involved bringing these pilot programs together into a standard solution for Navy business management, which will produce even greater mission support capabilities and efficiency (Veit, 2005, p. 13). Three out of the four pilot programs were retained and offered benefits to the Navy. “SMART’s timing versus the Navy ERP planning schedule resulted in its termination; however, its functionality has been included in the future converged program” (Veit, 2005, p. 13).

Table 1. Navy ERP Pilot Projects (in Millions) (From GAO, 2005, p. 13)

<i>Pilot</i>	<i>Organization</i>	<i>Initial Start</i>	<i>Costs through 2004</i>
Cabrillo	SPAWAR	Jun 00	\$67.4
SMART	NAVSUP	Aug 00	\$346.4
NEMAIS	NAVSEA	Jun 00	\$414.6
SIGMA	NAVAIR	May 01	\$215.9

In 2005, the decision to move forward with one integrated program involved the Navy’s plans to merge the four pilots into a single solution. Figure 4 displays the merger. As of September 2004, the Navy estimated that its total investment in these four pilots was approximately \$1 billion (GAO, 2005). The Navy plans for its ERP programs to encompass financial management, intermediate-level maintenance, plant supply, wholesale support, and program management and to provide the means for future

technology inclusion (Veit, 2005, p. 14). Furthermore, the Navy is continuing its effort to reduce legacy systems. Between 2001 and the end of 2011, the Navy plans to retire a total of 347 legacy systems.



Figure 4. Single ERP Solution As Evolved From Pilots
(From Veit, 2005, p. 13)

Although the Navy's ERP programs were making progress toward implementation, the September 2005 GAO report stated several problems that needed to be addressed. For example, there was not a centralized funding and control of each of the four pilots. The GAO saw growth in each of the four areas; however, the areas were growing on their own and not in coordination with one another. Furthermore, each of the pilot program offices configured its software differently, which caused integration and interoperability problems (GAO, 2005, p. 14). These pilot program offices configured the COTS software differently from each other in order to efficiently manage their own functional area of focus. The differences were allowed, even though the four pilot programs had many of the same business functions, such as financial management (GAO, 2005, p. 14).

Oversight was another issue that needed to be addressed. Because Navy leadership divided its ERP programs into four pilots, it did not assign the efforts as major automated information systems acquisitions, which limited departmental oversight (GAO, 2005, p. 17). In order for this oversight to take place, mission needs statements should be prepared to describe the framework of the relevant business needs. The Naval Audit Service was involved with identifying some of these oversights. They noted that the four ERP pilots were not assigned as major programs. Furthermore, the program managers did not get approval of the required documentation before proceeding to the next phase (GAO, 2005, p. 18). The DoD Chief Information Officer (CIO) is responsible

for the oversight of major automated information systems. Furthermore, an executive office is required for executive management. However, because the pilots were never designated as major programs, the oversight was at the command, or organizational level for funding of the pilots. Navy ERP officials said that, at the beginning of the pilots, investment authority was dispersed throughout the Navy, and there was no overall requirement within the Navy to address systems from a centralized Navy enterprise level (GAO, 2005, p. 18).

The Navy, in order to fully integrate all financial processes into its ERP program, started to work with the Defense Finance and Accounting Services (DFAS) and other process owners throughout the Navy and the OSD. The DON Office of Financial Operations also planned to review testing of its ERP financial software before making a final decision on approving the ERP software for use (Veit, 2005, p. 14). Furthermore, the Navy ERP Organizational Change Management team is looking into the ERP implementation plans and strategies for incorporating the business process changes. They also devised how it will monitor the transition from the old to the new system. Quality training associated with helping users understand the new process and the execution of each component of the process increases the users' ability to successfully implement change (Veit, 2005, p. 14).

Looking ahead, GAO recommended the Secretary of Defense direct the Secretary of the Navy to take action. In order to strengthen Navy ERP's management change and control processes, revisions to the Navy's ERP procedures for controlling system changes must be acknowledged by the program office (GAO, 2009, p. 23). Decisions about change requests will require a proposed change of life cycle cost impact estimation. The cost and schedule impacts of each proposed change in the Navy's ERP tracking pool must be captured. To increase the value of the Navy's ERP independent verification and validation (IV&V), GAO recommended to stop performance of the IV&V function under the existing contract and to engage the services of a new IV&V agent that is independent from all of the Navy ERP management, development, testing, and development activities that it may review (GAO, 2009, p. 23). In addition, reports of events should be directed to the oversight officials and program office (GAO, 2009, p. 23).

Although the four pilots were under different entities with different functional focuses, a pattern of problems emerged that provided the Navy with lessons learned that could be used in the future. By not meeting its requirement to reduce stove-piped systems, the Navy determined that the best way to move forward was to develop a new ERP system. New leadership of a central program office would emerge and lessons would be learned from the previous pilot projects. One of the most important lessons learned from the earlier pilot experiences was the need for disciplined processes in order to identify and manage requirements. An integral part of requirements identification is to have the system's users involved in the process to ensure that the system meets their needs (GAO, 2005, pp. 23–24). The current status of the Navy's ERP will be provided in Chapter III.

D. RETURN ON INVESTMENT (ROI)

The calculation of ROI shows the monetary benefits of the impact measures compared with the cost of the project (Phillips & Pulliam Phillips, 2007, p. 15). The ROI value is normally stated in terms of either a benefits/costs ratio, the ROI as a percentage, or the payback period (Phillips & Pulliam Phillips, 2007, pp. 15–16). Looking closer at the step-by-step process of calculating ROI, one should consider all objectives before concluding with the reporting of data. Figure 5 displays an ROI process model suggested by Phillips and Pulliam Phillips (2007) for organizations to conduct a proper analysis.

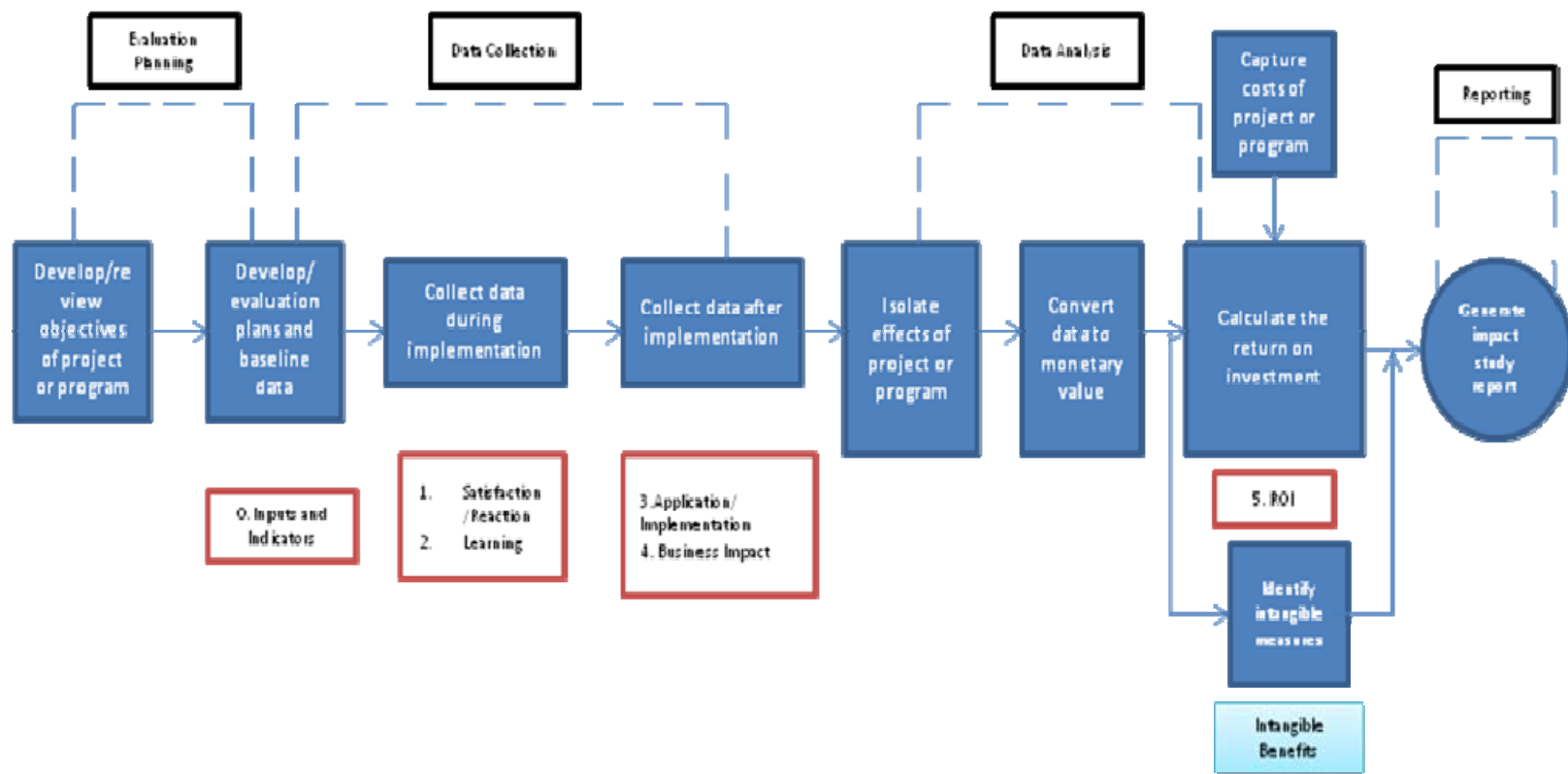


Figure 5. The ROI Process Model (From Phillips & Pulliam Phillips, 2007, p. 19)

Given the level of investment and the time needed to execute ERP systems, many companies plunged ahead without making ROI calculations (Stein, 1999, p. 1). Some wanted to integrate different business units; others wanted to consolidate redundant proprietary systems; and many used ERP systems to help solve their year 2000 problems (Stein, 1999, p. 1). Analysts say a successful ERP project can cut the fat out of operating costs, generate more accurate demand forecasts, speed up production cycles, and greatly enhance customer service (Stein, 1999, p. 1). All of these solutions can save an organization millions of dollars in the long run. However, the benefits can be costly. Not only do ERP systems take time and money to implement, but also they can disturb a company's culture, generate unnecessary training requirements, and even lead to productivity declines and mishandled customer orders that can cost millions (Stein, 1999, p. 1).

Frank O'Neil (2008), at Consona Corporation, identified what makes ERP worthwhile and looked at the ROI perspective. ROI allows the manufacturer to know if ERP implementation will add value to his company. ERP execution allows manufacturers to conveniently manage their businesses with advanced functionality (O'Neil, 2008, p. 19). According to O'Neil, (2008, p. 19), a successful ERP investment should provide the following:

- A modern, supportable operating environment with many enhancements and improved ease-of-use from the prior system
- Reduced inventory
- An improved ability to satisfy customer orders on time
- The ability to generate custom reports
- Increased data access

Mike Donovan, president of an international consulting firm, argued that ROI potential is present with ERP. He admitted that ERP must be "driven by the right strategic and tactical process improvement objectives, with documented assumptions and valid ROI expectations and metrics" (Donovan, n.d., p. 1). In order for ROI expectations to be met and to become positively measurable, the new processes and ERP must be implemented correctly and quickly (Donovan, n.d., p. 1).

According to the Dowlatshahi (2005), expected returns may not come as soon as desired after ERP implementation is complete. Several businesses chose not to perform an ROI analysis for different reasons. Some firms claimed that profitability had nothing to do with their reasons for implementing ERP (Dowlatshahi, 2005, p. 3752). Investors viewed this as a wise claim because most ERP systems show negative ROI for the first five years that they are in service (Dowlatshahi, 2005, p. 3753). After the first five years, companies can begin to expect steady returns, but not in the traditional form of revenue. Most companies that utilized an ERP system calculated their ROI as a result of expected savings in inventory and other costs compared with the total cost of implementation (Dowlatshahi, 2005, p. 3753). Effectively performing ERP systems reduced the cost of production and shipping, resulting in an average savings of \$1.5 million per year (Dowlatshahi, 2005, p. 3753). Many companies had a need to replace parts of existing systems, a fact that was included in cost savings. Some costs and conversion times (included in the ROI calculations) would have been incurred regardless of whether these organizations chose to execute an ERP system (Dowlatshahi, 2005, p. 3753).

Many of the costs of ERP are based on hardware, software, and overall installation cost. In Chapter III, we present the cost and benefit data, and in Chapter IV, we analyze the data. We then compare the ROI calculation of ERP within the Navy to that seen in the private sector. We also analyze and further discuss the measurement of tangible and intangible benefits when looking at the returns of ERP. We formulate cost avoidance, cost savings, inventory savings, and implementation costs to determine if there are any current savings with ERP or if a positive ROI can be forecasted through 2015.

III. DATA PRESENTATION

A. INITIAL AND REVISED ERP COST AND SCHEDULE

The Assistant Secretary of the Navy for Research, Development, and Acquisition directed the merger of the four pilot programs in July 2003. Integrating the four programs captured all the functionality of the stove-piped programs into one Navy program. The proposed benefit of the merger was to “standardize the Navy’s acquisition, financial, program management, plant and wholesale supply, and workforce management business processes across its dispersed organizational components, and support about 86,000 users when fully implemented” (GAO, September 2009, p. 3).

The Navy ERP Program office plans to release its ERP program in increments called templates. Each template is further broken down into releases. Template 1—presently, the only funded template—is broken into three releases. Releases 1.0, 1.1, and 1.2 are the three releases under Template 1. Release 1.0 is the largest release of the first template, incorporating financial management and acquisition. The purpose and design of 1.0 is to give Echelon II and Echelon III commands the information and data required to achieve their financial management and procurement functions. Release 1.0 is grouped into four categories: financial management—the General Fund & Navy Working Capital Fund, procurement, work force management, and program/project management (Veit, 2010, Slide 3).

Release 1.1 incorporates wholesale and retail supply. This solution was created to assist and support the Navy’s Single Supply Solution, and become the primary program for repairables and consumables. The principal inventory manager for the NWCF will be NAVICP by regulating allowances and balancing budgets. The five supply chain management processes include the following: planning, allowances, procurement, repair of repairables, and order fulfillment (Veit, 2010, Slide 3). Release 1.2 integrates intermediate-level maintenance. Table 2 provides further detail on the specifics of each release.

Table 2. Description of Functionality Added by Template 1’s Releases
(From GAO, 2009, p. 4)

Release	Functionality
1.0 Financial and Acquisition	<ul style="list-style-type: none"> - General Fund and Navy Working Capital Fund finance applications, such as billing, budgeting, and cost planning. - Acquisition applications, such as activity-based costing, contract awards, and budget exhibits. - Workforce management applications, such as personnel administration and training, as well as events management.
1.1 Wholesale and Retail Supply	<ul style="list-style-type: none"> - Wholesale applications, such as supply and demand planning, order fulfillment, and supply forecasting. - Retail supply applications, such as inventory management, supply and demand processing, and warehouse management.
1.2 Intermediate-Level Maintenance	<ul style="list-style-type: none"> - Maintenance applications, such as maintenance management, quality management, and calibration management.

The program office, in 2005, expected its ERP system to be fully operational in FY11. At this same time, the total cost of the system for its anticipated 20-year life cycle was \$1.87 billion, and was expected to manage a projected 80% of the Navy’s appropriated funds. The percent of appropriated funds was determined after the Marine Corps’ funding and military personnel and pay were removed (GAO, 2005).

The above estimates were revised. In 2007, the ERP Program had slipped behind schedule two years and was now expected to be fully operational in FY13. The total cost of the system was now estimated to be \$2.4 billion over its useful life (2004–2023), an increase of roughly 30%. The percentage of the Navy’s appropriated funds managed when fully operational has also been revised, which is currently expected to be 50%. The Marine Corps’ funding and military personnel and pay were removed prior to this estimate (GAO, 2009).

B. CURRENT HISTORY OF ERP

Figure 6 depicts the deployment plan for the DON’s ERP Program. Release 1.0 was implemented in three phases. NAVAIR deployed ERP Release 1.0 in October 2007. A total of 15,000 users were included by this release. A geographically diverse command, NAVAIR is spread out over four states and two countries. In May 2008, ERP achieved

Initial Operational Capability (IOC) at NAVAIR. The IOC was 22 months behind the 2004 schedule and four months later than the new 2007 plan. Data conversion and institutionalizing new business processes were two main reasons the IOC was delayed. The above delays had a ripple effect on the scheduled deployment of follow-on phases (GAO, 2009).

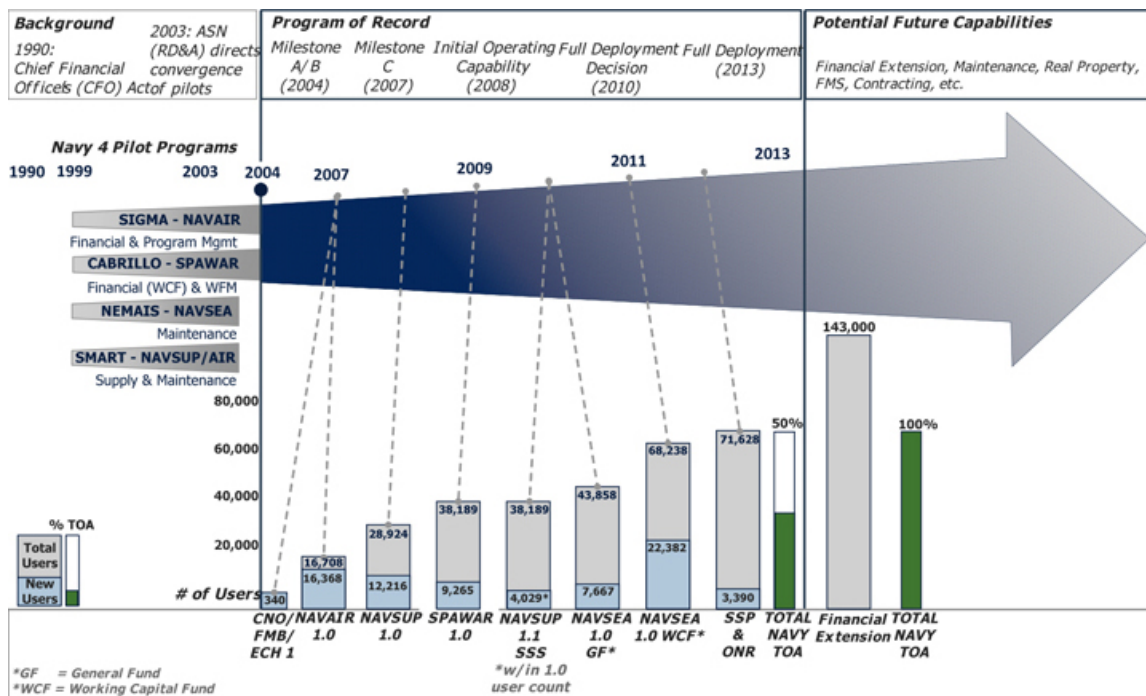


Figure 6. ERP Deployment Timeline (Carter, 2010, Slide 3)

As part of the same phase, the Defense Finance and Accounting Service (DFAS) received Release 1.0 in the same month. The DFAS is less geographically diverse, as it is located in two Ohio towns. The DFAS release added 350 users, bringing the total number of users to 15,350. In October 2008, Release 1.0 was deployed at NAVSUP, adding 9,500 users. As of October 2008, the total number of users was 24,850. Release 1.0 was implemented at SPAWAR 18 months behind schedule in October 2009. SPAWAR brought in 9,265 users, bringing the total to 34,115. The final phase of Release 1.0 was deployed at NAVSEA’s General Fund in October 2010 and its Working Capital Fund (WCF) planned for October 2011 deployment. The General Fund added 7,667 users,

while the WCF added 22,382. These two additions brought the total number of users to 64,164. Both of these releases were 12 months behind schedule (Veit, 2010).

Currently, Release 1.1's implementation plan has been achieved over a period of one year, in three phases. Material Group 1 was put into service in March 2010, followed by Material Group 2 in August 2010, and ended with Material Group 3 in February 2011. No new users were added by this release because they had been included in Release 1.0. Release 1.1 is currently being implemented at the DON's Fleet and Industrial Supply Centers (FISCs). This portion of Release 1.1 is planned to take 17 months. Release 1.2, for intermediate-level maintenance, was removed and may be added at a later date.

C. ERP COST AND BENEFIT DATA

A few definitions will make the data that follow more understandable. For the purpose of this study we will use the following definitions. The Secretary of the Navy is currently updating the instruction that defines cost savings and cost avoidance. Once the updated instruction is signed, cost savings will be defined "as an actual reduction in the number of dollars needed to meet a customer requirement by improving a process or function. Dollars **can** be removed from a Budget Line Item (BLI)" (SECNAVINST, 2007). Cost avoidance will be defined "as a reduction in the number of dollars needed to meet a customer requirement by improving a process or function. Dollars **cannot** be removed from a BLI because they have been previously removed or do not exist in the budget. Cost avoidances can also result from process improvements that prevent a future or unbudgeted cost" (SECNAVINST, 2007). So, for instance, when NAVAIR implemented SIGMA, it retired all of its legacy financial management systems. By retiring these legacy systems, NAVAIR generated both cost savings and cost avoidance by not having to pay for these systems now and in the future.

The cost data presented in Tables 3 and 4 were received from Herren Associates, the company contracted by the Office of the Chief of Naval Operations (OPNAV) and the Deputy Chiefs of Naval Operations for Fleet Readiness and Logistics (N4) to collect current and projected costs for deploying ERP. Herren Associates specializes in providing systems acquisition, program analysis, cost engineering, and transformation.

The ERP program's deployment costs are fully funded and include the following: Deployment Management Support, Training Delivery Support, User Management Support, On-Site Support (OSS), Navy ERP Train-the-Trainer Instructors, Business Process Team Support, and Data Management Support (Carter, 2010, Slide 14). The data presented in Figures 3 and 4 display the total actual and projected costs from FY04 to FY15. The data are normalized so all dollars are presented in base year FY04 dollars.

Table 3. Actual ERP Deployment Costs (From Herren Associates, personal communication, January 12, 2011)

In \$K	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total Cost
In fiscal year indicated	\$44,319	\$65,888	\$115,283	\$173,122	\$202,523	\$221,743	\$207,033	
Normalization Factor	1.0	.9728	.9435	.9187	.8972	.8839	.8769	
In FY04 \$	\$44,319	\$64,093.4	\$108,771.1	\$159,048.7	\$181,698.8	\$196,002.5	\$181,547.7	\$935,481.2

Table 4. Projected ERP Deployment Costs (From Herren Associates, personal communication, January 12, 2011)

In \$K	FY11	FY12	FY13	FY14	FY15	Total Cost
In fiscal year indicated	\$214,574	\$131,468	\$92,043	\$76,042	\$71,977	
Normalization Factor	.8656	.8537	.8403	.8262	.8124	
In FY04 \$	\$185,735.3	\$112,234.2	\$77,343.7	\$62,825.9	\$58,474.1	\$496,613.2

The benefit data presented in Tables 5–10 were received from two sources. The data in Tables 5–8 were received from the Office of the Assistant Secretary of the Navy (Financial Management and Comptroller), Office of Financial Operations. The data in Tables 9–10 were received from LMI, a private research institute. LMI was hired by OPNAV N4 to conduct a study on the DON’s ERP. Tables 5–7 identify the cost savings and avoidance benefits of legacy systems in both actual and projected numbers. All data have been normalized into FY04 dollars. Table 8 represents the projected cost savings benefits of standardizing inventories. Lastly, Tables 9 and 10 recognize the actual and projected cost savings from the benefits of labor.

Table 5. Projected Cost Savings From Legacy System Retirement
(From Ingram & Jordan, 2010 Slide 8)

In \$K	FY12	FY13	FY14	FY15	Total Benefit
In fiscal year indicated	\$47,400	\$47,400	\$63,700	\$63,700	
Normalization Factor	.8537	.8406	.8262	.8124	
In FY04 \$	\$40,465.4	\$39,844.4	\$52,628.9	\$51,749.9	\$184,688.6

Note. There were no cost savings in FY11.

Table 6. Actual Cost Avoidance From Legacy System Retirement
(From Ingram & Jordan, 2010 Slide 7)

In \$K	FY08	FY09	FY10	Total Benefit
In fiscal year indicated	\$18,500	\$43,800	\$53,700	
Normalization Factor	.8972	.8839	.8769	
In FY04 \$	\$16,597.8	\$38,715.6	\$47,089.7	\$102,403.1

Table 7. Projected Cost Avoidance From Legacy System Retirement (From Ingram & Jordan, 2010 Slide 7)

In \$K	FY11	FY12	FY13	FY14	FY15	Total Benefit
In fiscal year indicated	\$65,500	\$91,100	\$100,800	\$102,800	\$103,100	
Normalization Factor	.8656	.8537	.8403	.8262	.8124	
In FY04 \$	\$56,700	\$77,771.8	\$84,697.5	\$84,934.1	\$83,758.1	\$387,861.5

Table 8. Projected Inventory Cost Savings (From Ingram & Jordan, 2010 Slide 9)

In \$K	FY13	FY14	FY15	Total Benefit
In fiscal year indicated	\$10,000	\$38,000	\$76,000	
Normalization Factor	.8403	.8262	.8124	
In FY04 \$	8,402.5	31,395.9	\$61,742.2	\$101,540.6

Table 9. Actual Labor Savings (From Keller et al., 2006, pp. 6–15)

In \$K	FY10	Total Benefit
In fiscal year indicated	\$49,000	
Normalization Factor	.8769	
In FY04 \$	\$42,968.2	\$42,968.2

Table 10. Projected Labor Savings (From Keller et al., 2006, pp. 6–15)

In \$K	FY11	FY12	FY13	FY14	FY15	Total Benefit
In fiscal year indicated	\$166,000	\$181,000	\$186,000	\$219,000	\$265,000	
Normalization Factor	.8656	.8537	.8403	.8262	.8124	
In FY04 \$	\$143,697.7	\$154,519.2	156,287.1	\$180,939.5	\$215,285.2	\$850,728.7

Figures 7 and 8 represent the costs and benefits of deploying ERP. These costs (in thousands) differentiate between actual and projected figures.

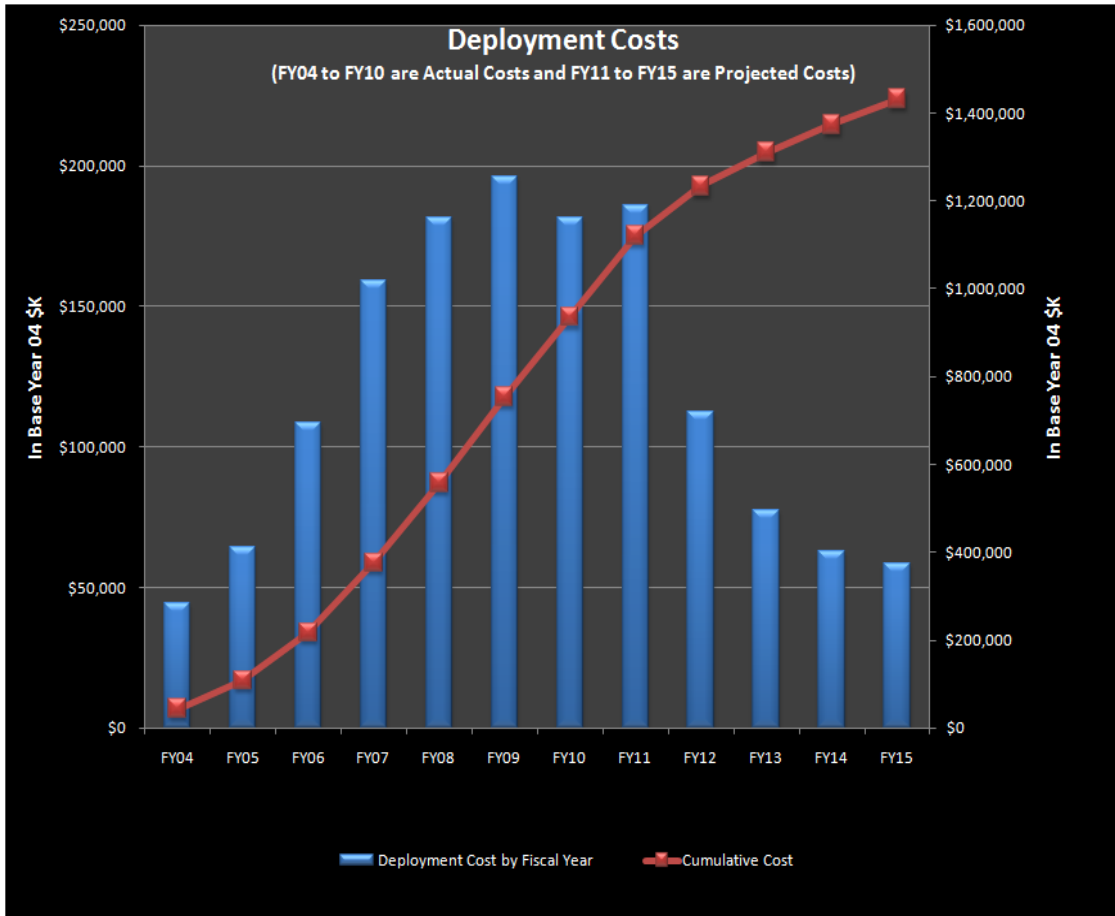


Figure 7. Total Deployment Costs (Actual and Projected) (From Herren Associates, Economic Analysis, January 12, 2011)

The ROI is closely looked at in Figures 8–13. We analyzed the total costs versus benefits (actual and projected). Using the ROI calculations, which will be explained in further detail in Chapter IV, we identified the ROI experienced by implementing the DON’s ERP Program and compared them to those ROIs experienced by private firms that implemented ERP Programs.

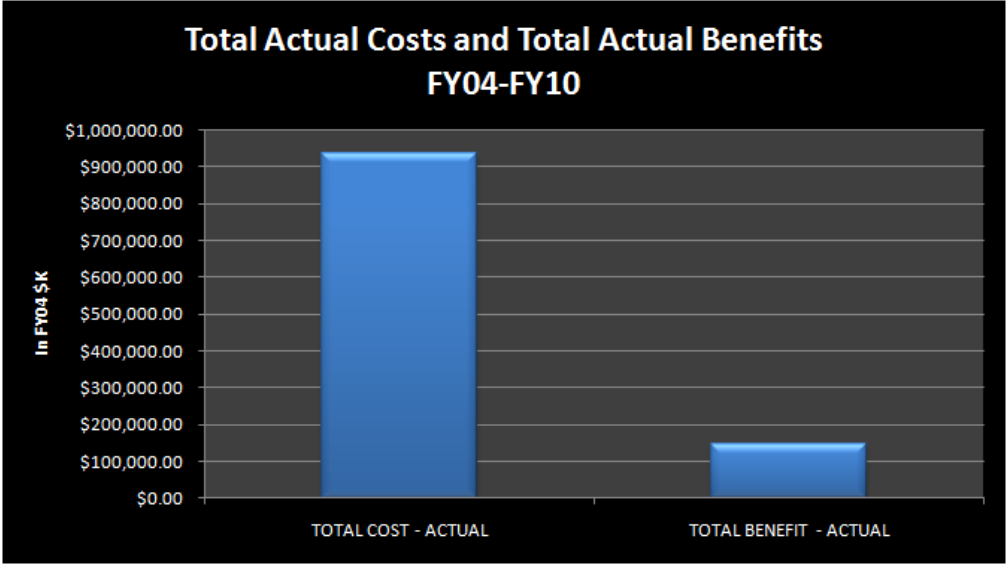


Figure 8. Actual Costs and Benefits FY04–FY10 (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan 2010, Slides 7–9; Keller et al., 2006, pp. 6–15)

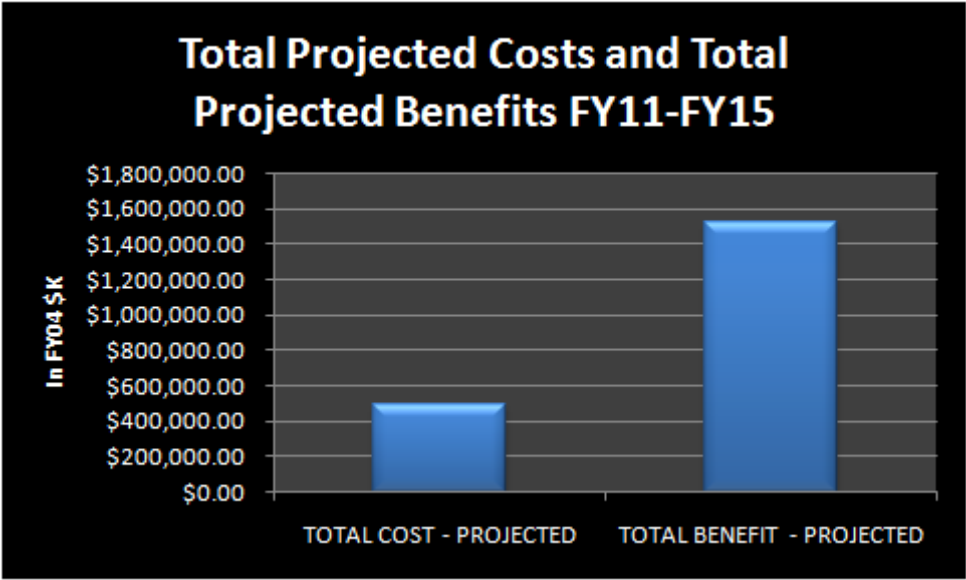


Figure 9. Projected Costs and Benefits FY11-FY15 (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan, 2010 Slides 7–9; Keller et al., 2006, pp. 6–15)

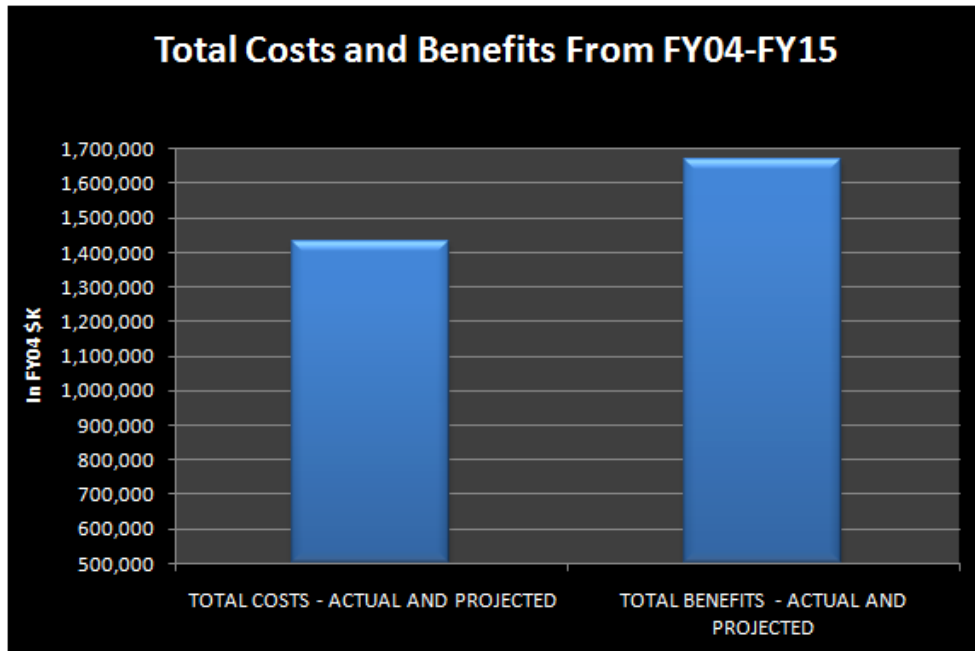


Figure 10. Total Costs and Benefits FY04–FY15 (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan 2010 Slides 7–9; Keller et al., 2006, pp. 6–15)

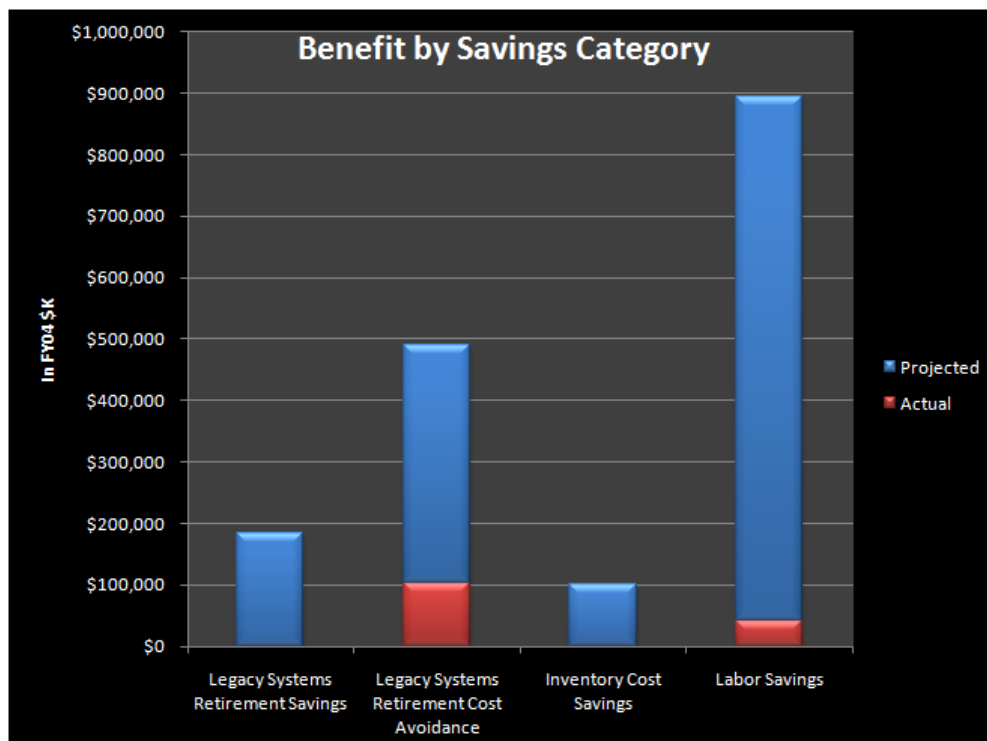


Figure 11. Benefit by Savings Category (From Ingram & Jordan, 2010, Slides 7–9)

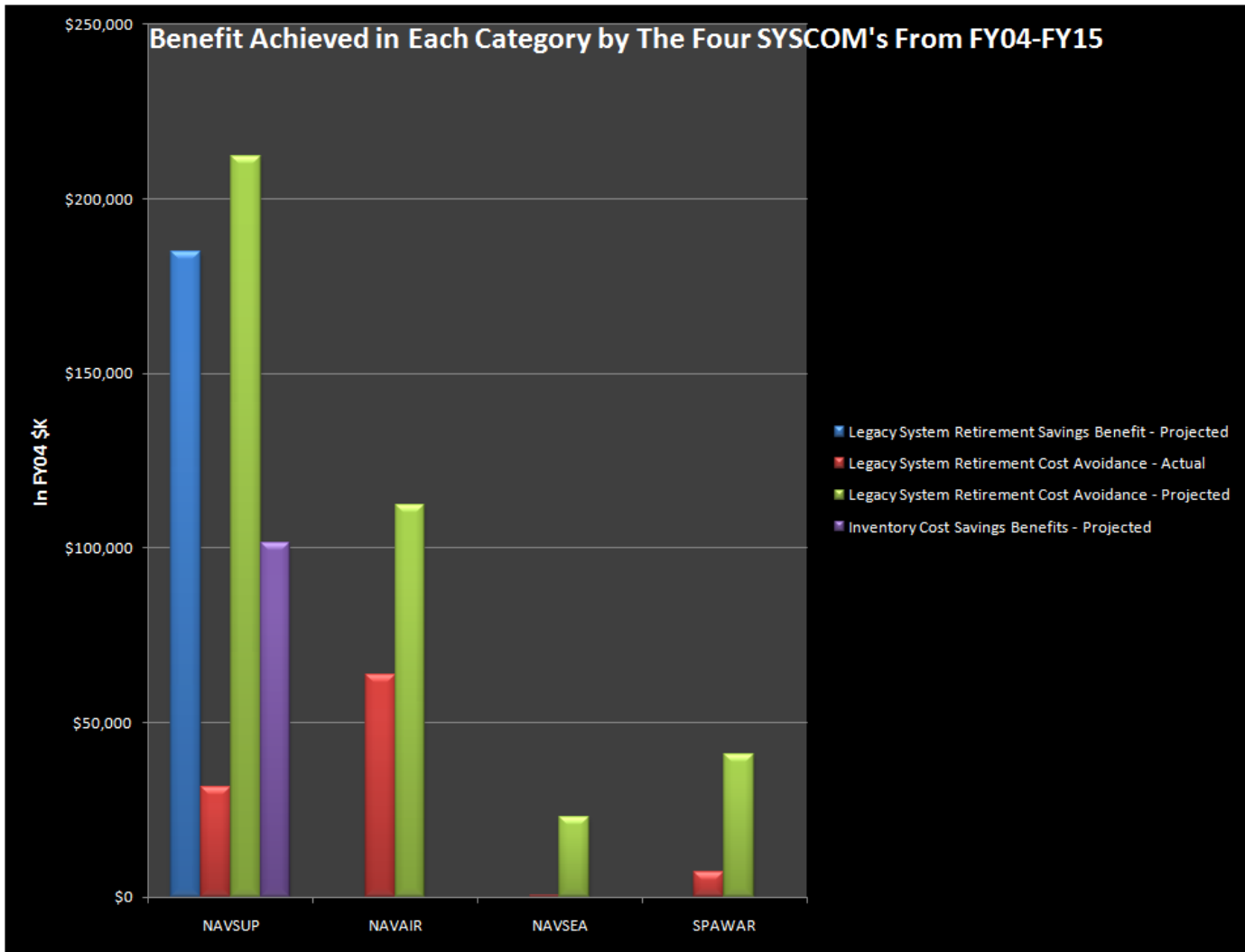


Figure 12. Actual and Projected Benefit Achieved by Each SYSCOM (From Ingram & Jordan, 2010 Slides 7–9)

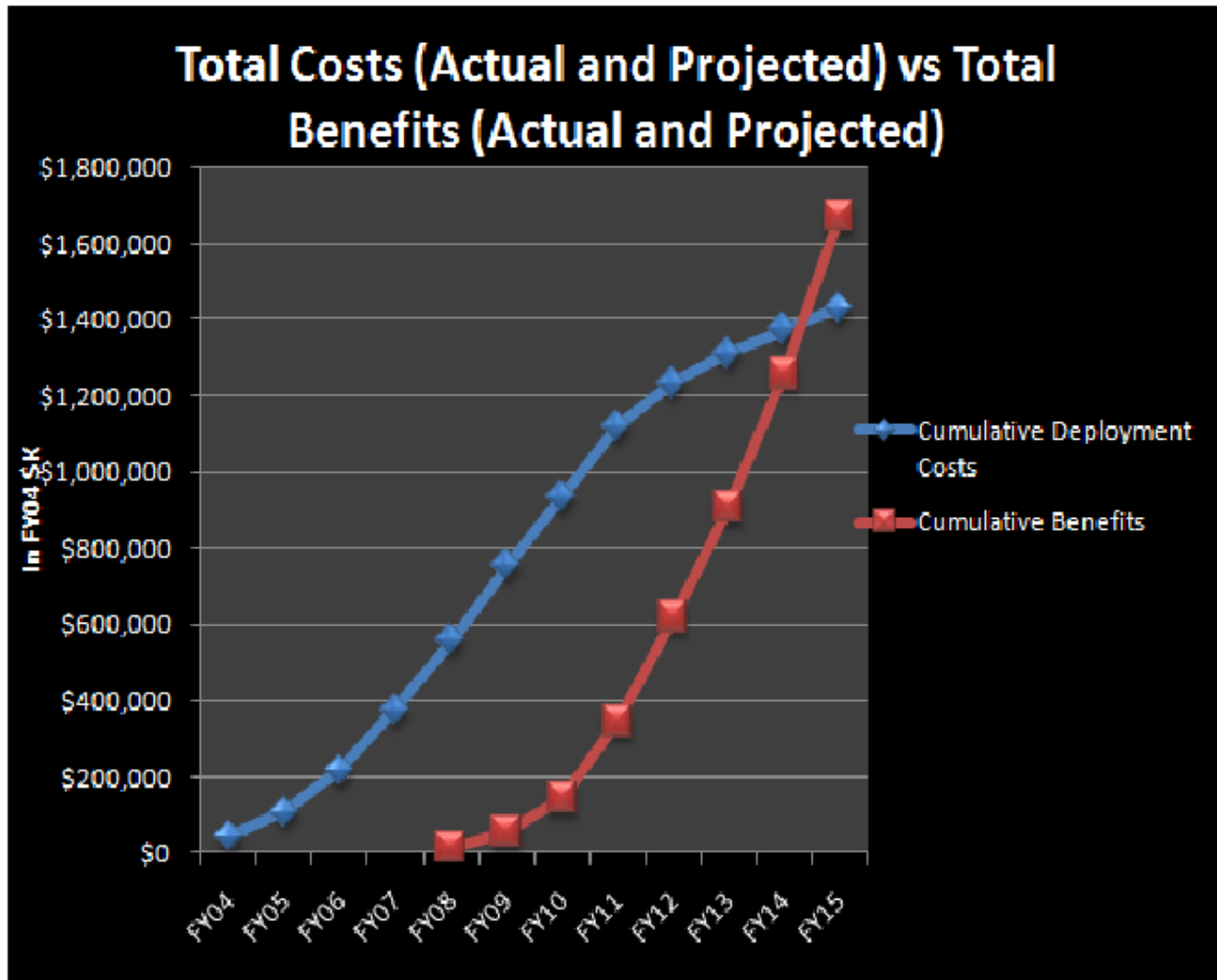


Figure 13. Total Costs (Actual and Projected) vs. Total Benefits (Actual and Projected) (From Herren Associates, Economic Analysis, January 12, 2011; Ingram & Jordan, 2010 Slides 7-9)

IV. ANALYSIS

A. INTRODUCTION

This chapter provides an analysis of the DON's ERP Program from the data presented in Chapter II. As discussed in the previous chapters, the ERP program began in FY04 and was first implemented at NAVAIR in October 2007. The DON's ERP Program has not completed its life cycle. As a result, not all costs and benefits are known. Actual costs are known for FY04 to FY10. The DON, with the help of Herren Associates, has developed a projected cost for deploying and maintaining the DON's ERP Program.

The same is true for the benefits. Only actual benefits are known for FY04 to FY10. The DON, with the help of LMI, developed projected benefits from implementing the DON's ERP program from FY11 to FY15. Benefits are derived from one of three sources: the retirement of legacy systems, reduction in the required inventory held by the DON, and labor reductions. The legacy system retirement savings is the most accurate estimate, as it is based on known costs.

There is more risk in assessing the inventory and labor savings. The DON, with the help of Deloitte Consulting, benchmarked 10 aerospace and defense companies that employed an ERP system. They found that these companies had experienced a 15–20% savings in required inventory. Based on this benchmarking, the DON estimated a reduction in inventory that equated to 7.5% of its procurement dollars. The DON also estimated that the reduction in required inventory would also lead to a 2.5% reduction in inventory carrying costs. LMI rated the DON's inventory savings estimate as reasonable (Keller et al., 2006).

The labor benefits calculation is a little more complex than the inventory savings. First, the DON analyzed industry labor savings. Industry realized a reduction in labor requirements of 5% to 18% by implementing an ERP. The low end of 5% was seen in personnel functions. The high end of 18% was observed in the financial sector. The financial sector included financial accounting, cost controlling, and asset accounting. The

DON chose the low end of 5%. These improvements did not occur immediately upon implementing an ERP. Instead, the improvements were seen over time (Keller et al., 2006).

As a result of the time required to see the improvements, the DON developed a ramp to calculate the labor savings. A different ramp was applied to each functional area impacted by the DON's ERP. LMI found the ramp used by the Navy to be too optimistic. The ramp should have been a little flatter and increased at a slower rate. Although there may be a reduction in required labor, it does not mean the DON will immediately separate personnel. However, the fact that actual labor savings were seen in FY10 leads one to believe that, in the future, the DON will act similarly and reduce the labor force (Keller et al., 2006).

B. CHART ANALYSIS

1. Deployment Costs

Figure 7 depicts the DON's ERP Program deployment costs. The costs indicated from FY04 to FY10 are the actual costs the program obligated. The costs indicated from FY11 to FY15 are projections for the Program's expected requirements. One can see from this chart that the Program's costs ramp up from its outset to FY11. ERP's single largest appropriation from FY04 to FY07 is research, development, test, and evaluation (RDT&E). RDT&E is the biggest appropriation during this time frame due to the fact that the COTS software needs to be modified to meet the needs of the DON. From FY08 to FY11, the largest appropriation is Operation, and Maintenance Navy (OM&N). OM&N replaced RDT&E as the largest appropriation due to the fact that the system was being deployed during these years.

2. Costs and Benefits

Figures 8–10 depict the costs and benefits of the Program. Figure 8 depicts the actual costs and benefits from FY04 to FY10, while Figure 9 shows projected costs and benefits from FY11 to FY15. Figure 10 is a combination of the previous two figures and

shows the total costs FY04 to FY15 (actual and projected) and total benefits FY04 to FY15 (actual and projected). Comparing Figure 8, the total actual costs FY04 to FY10, to Figure 10, the total costs FY04 to FY15, reveals that the Program's costs during the first seven years is 65.3% of all costs over this entire time frame. The benefits are the exact opposite. Comparing the same two figures reveals that 87.0% of all benefits are expected to be achieved from FY11 to FY15. An accurate ROI calculation can be performed on each individual time period. However, an ERP system requires time to recoup the cost of implementation, and the DON's ERP Program has not yet reached full operational capabilities. To achieve a fair ROI, one must look at the ERP Program over a longer period of time.

3. Benefits by Savings Category

Figure 11 portrays the cost savings/avoidance by the four categories. The projected labor savings is the single biggest category. The DON and LMI predict roughly 3,451 full-time equivalent (FTE) employees will be separated. The 3,451 FTE breaks down to 2,569 civilians, 862 contractors, and 20 military personnel (Keller et al., 2006). The second biggest category of savings is legacy systems retirement cost avoidance. ERP is predicted to retire 347 systems (Veit, 2005).

4. Benefits by SYSCOM

Figure 12 renders the benefits achieved by each SYSCOM. If the projections hold true, then the Navy Supply Systems Command (NAVSUP) will have achieved 68.2% of the total benefits from FY04 to FY15. This should not be surprising, given they are the only SYSCOM with a projected inventory savings, and that 296 of the 347 systems expected to be retired by the DON's ERP Program are either acquisition, financial management, or logistics. NAVSUP is the SYSCOM responsible for these systems and, therefore, takes credit for these savings/avoidances.

C. RETURN ON INVESTMENT CALCULATION

Our research performed three ROI calculations. The first is based on actual costs and benefits. The second uses projected costs and benefits. The third is a compilation of the first two, total costs (actual and projected) and total benefits (actual and projected).

1. Return on Investment Using Actual Cost and Benefit Data

$$\text{ROI (actual)} = \{[\text{legacy system retirement cost avoidance benefits (FY08 to FY10)} + \text{labor cost savings benefit (FY10)}] - \text{costs (FY04 to FY10)}\} / \text{costs (FY04 to FY10)} \times 100$$
$$\text{ROI (actual)} = \{[\$102,403,100 + \$42,968,200] - \$935,481,200\} / \$935,481,200$$
$$\text{ROI (actual)} = \$-790,109,900 / \$935,481,200 \times 100$$
$$\text{ROI (actual)} = -0.8446 \times 100$$
$$\text{ROI (actual)} = -84.46$$

2. Return on Investment Using Projected Cost and Benefit Data

$$\text{ROI (projected)} = \{[\text{legacy system retirement savings benefits (FY12 to FY15)} + \text{legacy system retirement cost avoidance benefits (FY11 to FY15)} + \text{inventory cost savings benefit (FY13 to FY15)} + \text{labor cost savings benefit (FY11 to FY15)}] - \text{costs (FY11 to FY15)}\} / \text{costs (FY11 to FY15)} \times 100$$
$$\text{ROI (projected)} = \{[\$184,688,600 + \$387,861,500 + \$101,540,600 + \$850,728,700] - \$494,613,200\} / \$494,613,200 \times 100$$
$$\text{ROI (projected)} = \$1,030,206,200 / \$494,613,200 \times 100$$
$$\text{ROI (projected)} = 2.0829 \times 100$$
$$\text{ROI (projected)} = 208.29$$

3. Return on Investment Using Total Cost and Benefit Data

ROI (total) = {[legacy system retirement savings benefits (FY12 to FY15) + actual legacy system retirement cost avoidance benefits (FY08 to FY10) + projected legacy system retirement cost avoidance benefits (FY11 to FY15) + inventory cost savings benefit (FY13 to FY15) + actual labor cost savings benefit (FY10) + projected labor cost savings benefit (FY11 to FY15)] – (actual costs (FY04 to FY10) + projected costs (FY11 to FY15))} / actual costs (FY04 to FY10) + projected costs (FY11 to FY15) X 100

ROI (total) = {[\$184,688,600 + \$102,403,100 + \$387,861,500 + \$101,540,600 + \$42,968,200 + \$850,728,700] – (\$935,481,200 + \$494,613,200)} / \$935,481,200 + \$494,613,200 X 100

ROI (total) = [\$240,096,300 / \$1,432,094,400] X 100

ROI (total) = 0.1677 X 100

ROI (total) = 16.77

D. ANALYSIS OF RETURN ON INVESTMENT CALCULATION

Our intent was to compare the ROI achieved by the DON's ERP Program with the ROI private sector firms realized by implementing ERPs. However, an exhaustive search failed to uncover sufficient private sector ERP-specific ROI data to make the desired direct comparison. Therefore, in an attempt to present a suitable proxy for comparison, we reference a study by Hunton, Lippincott, and Reck, which compared the overall financial performance of companies that adopted ERP to the overall financial performance of companies that did not adopt ERP.

The Hunton et al. study looked at four measures of a firm's performance: return on assets, return on sales, asset turnover and ROI. The authors define ROI as "income before extraordinary items (available for common stockholders), divided by the sum of total long-term debt, preferred stock, minority interest and total common equity. Compustat then multiplies the ratio by 100" (Hunton et al., 2003, p. 176).

The actual ROI for the Navy's ERP Program from FY04 to FY10 is -84.46; the projected ROI for the Navy's ERP Program from FY11 to FY15 is 208.29; and the combined ROI for the Navy's ERP Program from FY04 to FY15 is 16.77. All of the Navy's ROIs, with the exception of the actual, are better than those seen in the private sector.

Hunton, Lippincott, and Reck (2003) conducted a study of 126 companies, representing 23 different industries. The companies ranged in size from small to large. ERP adopters included 63 companies, while nonadopters included 63 companies. The average total asset for the 63 ERP adopting businesses was \$10,861,000, the median was \$3,654,000, and the standard deviation was \$17,448,000. For the 63 non-adopting ERP firms, the average total assets were \$9,195,000, the median was \$3,003,000, and the standard deviation was \$13,161,000 (Hunton et al., 2003, p. 176).

Their study followed the 126 companies over four time periods. The first period is an average of the three years prior to adopting the ERP system. The second is one year after adoption; the third is two years after adoption; and the final is three years after adoption.

Hunton, Lippincott, and Reck studied firms that had adopted ERPs and firms that had not. For the 63 firms that adopted ERP systems, there was no significant change in ROI over the six years of the study. The average ROI for the three years prior to ERP adoption was 8.576 and the median was 8.614. One year after adoption of the ERP system, the average dropped to 7.691 and the median went to 8.957. Two years after adoption of the ERP system, the average dropped to 7.533 and the median went to 8.411. In the last period, the average ROI for ERP adopters increased to 8.002 and the median rose to 8.395 (Hunton et al., 2003, p. 177).

For the 63 firms that had not adopted ERP systems, there was a significant change in ROI. The average ROI for the three years prior to non-ERP adoption was 8.498 and the median was 7.861. One year after not adopting an ERP system, the average dropped to 5.804 and the median went to 5.462. Two years after not adopting an ERP system, the

average dropped to 4.649 and the median went to 5.153. In the last period, the average ROI for non-ERP adopters increased to 5.457 and the median rose to 5.731 (Hunton et al., p. 177).

Table 11. ROI Performance Comparison Between ERP Adopters and Non-ERP Adopters (Hunton et al., p. 177).

	Pre-Adoption	Post 1 Year	Post 2 Years	Post 3 Years
ERP Adopters	8.579	7.691	7.533	8.002
Non-ERP Adopters	8.498	5.804	4.649	5.457

The above study leads to the following conclusions: (a) One may not see the results of implementing an ERP system for several years; (b) Coordination of new methods and control functions may be one reason it takes several years to see the results; and (c). Their study also lends credibility to the fact that there are efficiencies to be gained by implementing an ERP system. However, once implemented and employees are fully trained, the ERP system has a positive impact on a firm's ability to utilize its assets (Hunton et al., 2003, p. 177).

E. LIMITATIONS OF ROI CALCULATION

When looking at the gains involved in an ERP process, it becomes difficult to factor in these intangible assets. Intangible can be defined as “an identifiable nonmonetary asset without physical substance held for use in the production or supply of goods or services, for rental to others or for administrative purposes” according to the new International Accounting Standard (Murphy & Simon, 2002, p. 303). Tangible assets differ in definition as a value is applied in a monetary approach. If a price is able to be placed on an object, function, or benefit, then it can be labeled as tangible. In the IT industry, intangibles can be broken down into ongoing and future benefits. Ongoing would be the more tangible of the two, dealing with internal improvement of an

organization. The customer service is the toughest to measure, as it deals with customer satisfaction and sales volumes (Murphy & Simon, 2002, p. 304). Figure 14 breaks down the intangible benefits and what they mean to the IT industry.

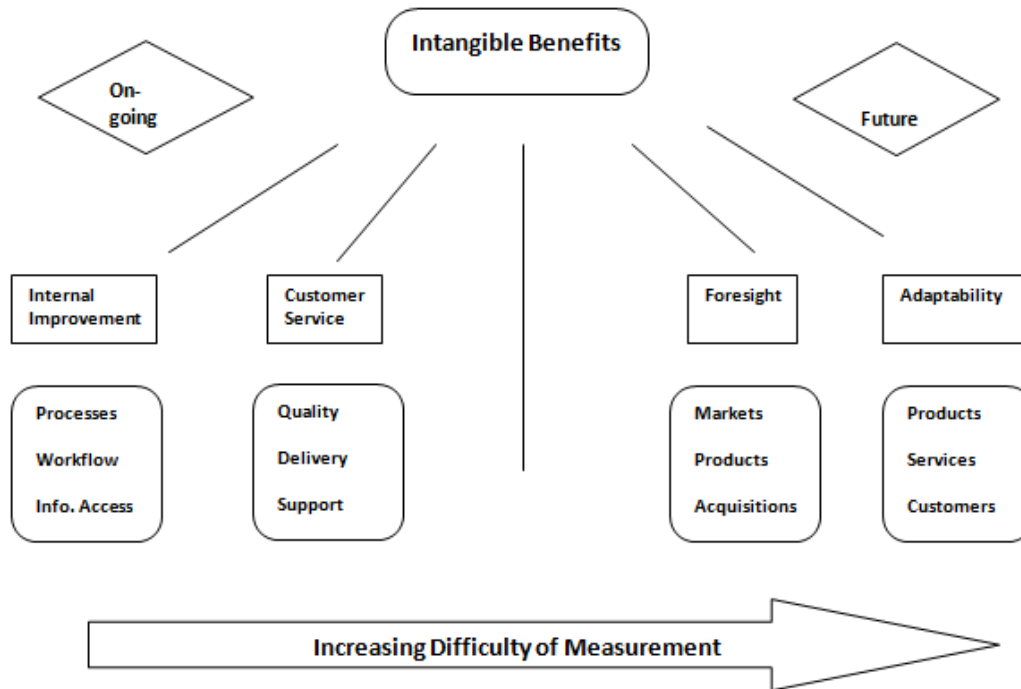


Figure 14. Intangible Benefits (Murphy & Simon, 2002, p. 306)

In 1998, a survey was taken of 62 Fortune 500 companies by Benchmarking Partners, Inc. for Deloitte Consulting LLC. In interviews with client firms, the question was asked which tangible and intangible benefits were realized in their ERP process. Figure 15 displays the outcome and percentages of these intangible benefits. In this survey, the categories that classify an intangible asset include: information visibility, new improved processes, customer responsiveness, integration, standardization, cost reduction, flexibility, globalization, Y2K, business performance, and supply/demand chain performance improvement.

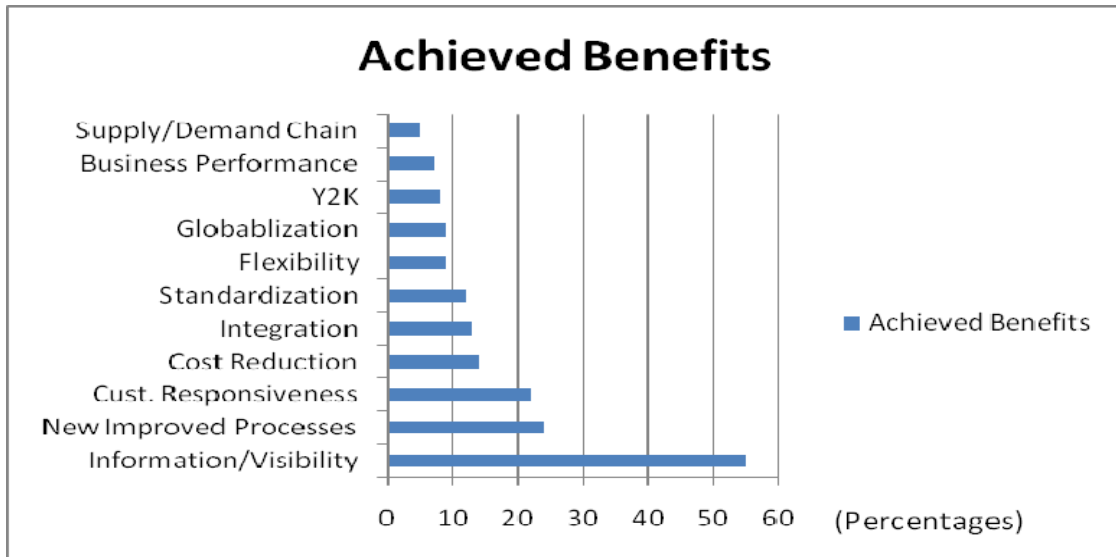


Figure 15. Intangible Benefits Realized (From O’Leary, 2004, p. 65)

In a measure of intangible anticipated versus achieved benefits, the achieved benefits do not match what is anticipated (Norback & Akerblom, 2003, p. 23). In our research, it was found that placing a price tag on intangible returns and benefits is a difficult task. Many nonmonetary benefits can correlate to hard numbers if those analyzing the numbers can do some “imaginative number-crunching” (Fryer, 1999, p. 88).

The ROI calculation is an excellent tool for analyzing whether a company should or should not make an investment. It is not a perfect tool, however. Since ROI is an imperfect analytical tool, one should know its limitations. The ROI calculation does not include any nonmonetary or intangible elements. There are many nonmonetary elements that are not accounted for by the above ROI calculation. These nonmonetary elements need to be considered along with the ROI calculation and should inform one’s decision.

This project received its data from the ERP Program Management Team and from contractors they hired. No attempt was made to independently verify the data that were received. The authors believe the data fairly represent the cost and benefits associated with the DON’s ERP Program. The data provided are the only data known to be available.

THIS PAGE INTENTIONALLY LEFT BLANK

V. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

There is a tremendous cost associated with trying to implement ERP within an organization. ERP was first developed by private industries. The DON did not begin looking at ERP until the late 1980s, as it began learning from commercial business practices. The approximately \$2 billion spent by the DON was intended to save millions of dollars from FY04–FY15. Although the evolution of ERP and development within the DON has met its many challenges, analyzing the return on investment involved with its implementation could potentially save billions of dollars over the life of the program.. By making efforts to coordinate data and information across every area of their organization, the DON aimed its resources at the four major Systems Commands (SYSCOM): NAVAIR, NAVSUP, NAVSEA, and SPAWAR.

The streamlining of Navy business practices emerged from a commercial working group adopted in the late 1980s, which eventually led to a large-scale ERP implementation at the start of the 21st century. Four initial pilot programs merged into one solution, and GAO recommended a more in-depth oversight of ERP by DON Leadership. Some in Congress say the pilot programs failed; however, research suggests that ERP would not be where it is today without the lessons learned from these pilot programs. In 2007, ERP was broken down by templates, giving each release number a functionality to be responsible for. With each new release, new users were added with the implementation process. Projections were made for the cost of implementation with estimates totaling \$2.4 billion over a 20-year period (FY04–FY23). Projections such as this ignite questions as to whether the Navy will see a return on its \$2.4 billion investment. This project examined the DON's expected ROI from its original ERP implementation. Comparisons were made between the DON's ROI and that of the private sector to analyze the degrees of success between the two entities.

B. PRIMARY RESEARCH QUESTIONS

Has implementing ERP provided the DON with a current positive ROI at the end of FY10? If not, will the ERP provide the DON with a positive forecasted ROI by the end of FY15?

ERP is still in the stages of development and deployment within the DON. After collecting the data, the actual benefits and actual costs to date were normalized to FY04 dollars. The forecasted benefits and costs were normalized to the same base year. Through ROI calculations of one actual and one forecasted ROI, it was determined that the actual ROI for the Navy's ERP program from FY04 to FY10 is -84.46. The forecasted ROI for the Navy's ERP Program from FY11 to FY15 is 208.29, and the combined ROI for the Navy's ERP Program from FY04 to FY15 is 16.77. The benefits were derived from legacy system retirement, inventory reductions held by the DON, and labor reductions. All of the Navy's ROIs are better than those seen in the private sector. Calculations were made for actual, forecasted and combined. Three calculations were performed because most of the costs to implement an ERP are upfront, and most benefits are not realized for years to come. Each calculation shows how the ROI changes over time.

C. SECONDARY RESEARCH QUESTIONS

How do the actual ROI and the forecasted ROI compare to those of private sectors? Were there any nonmonetary benefits not considered in the calculation?

After researching and analyzing the ROI of private sector firms' ERPs, it was discovered that the Navy produced a better return overall. The companies we examined that had adopted ERP had an ROI of 8.576 over the average of three years. We concluded that ERP implementation provides managers the ability to look into their companies' progress or declination. ERP adoption gives managers the opportunity to make better decisions through analysis of alternatives. Once ERP is implemented and employees are trained on the system, it has a positive impact on an organization's utilization of assets.

The intangible benefits of ROI were difficult to measure. ERP nonmonetary assets, such as information visibility, improved processes, customer responsiveness, integration, standardization, globalization, flexibility, and responsiveness, were not calculated in the ROI. These elements are not accounted for, but we believe they should be considered a valuable asset in the ERP process.

D. CONCLUSION

Our thesis conducted research of the evolution of ERP, provided a thorough literature review, developed a definition of ROI used by technology projects, and presented the ROI experienced by private companies implementing ERP systems. We collected data from members of the ERP Program Office and analyzed the cost and benefit data of implementing the DON's ERP. Our intention was to normalize the data and convert all financial information to FY04 dollars, the year the program began. Converting the financial cost and benefit data to a common base year was required in our work. Our analysis compared the DON actual and projected ROI achieved from FY04 to FY15 to that of the commercial sectors. The positive ROI potential from the DON's ERP Program could potentially save the Navy millions of dollars in the long term. There is a value in proceeding with the DON's ERP Program. The majority of the benefits are in the future, so a delay of any type, or program termination, will risk losing this future return.

E. IMPLICATIONS OF THESIS

After conducting our research on the history of DON'S ERP and its implementation, our questions led us to ask why this program is so important and what kind of return can be expected from investments in ERPs. There is plenty of information surrounding ERP and what it is capable of producing; however, there are also many observations on companies losing money with implementation of ERPs. Therefore, the question "why would one want to invest in such a program?" is inevitable. Our conclusions consistently point to the need for persistence. ERP success requires long-term resolve. If organizations, such as DON, are willing to invest and endure the challenges of applying this program, the payoffs and benefits could have tremendous

value. Even if the benefits of Navy ERP reached 50% of their projected target from 2004–2015, they would still achieve significant long-term benefits. Stretching these benefits out to 2023 could potentially increase these figures.

F. RECOMMENDATIONS FOR FUTURE STUDY

This report was limited by the data available. Currently, only cost and benefit data for FY04 to FY10 are available. Nonmonetary benefits were not included. Future studies could build on this report by examining the nonmonetary benefits associated with the DON's ERP Program and devising a method of conversion to a monetary figure that could be included in the ROI equation. This report was also limited by the fact that the DON's ERP Program is not fully implemented. We recommend repeating this study after the ERP Program has been fully deployed for three years. Doing this would allow for a direct comparison of the private sector ROIs the Hunton, Lippincott, and Reck study discussed. An ROI for the DON's ERP program should also be calculated at the end of FY23, so a return for the entire program can be determined. All of the data would be useful to determine whether the DON's ERP Program was a success.

LIST OF REFERENCES

- Aladwani, A. M. (2001). Change management strategies for successful ERP implementation. *Business Process Management Journal*, 7, 266–274.
- Baatz, E., Koch, C., & Slater, D. (1999, December 22). The ABCs of ERP. Retrieved from http://www.uncg.edu/bae/people/holderness/readings/The_ABCs_of_ERP.pdf
- Brook, D. A., & Candreva, P. J. (2007). Business management reform in the Department of Defense in anticipation of declining budgets. *Public Budgeting and Finance*, 27(3), 50–70.
- Carter, J. L. (2010). *Navy ERP Program*. Powerpoint presentation. PEO EIS.
- Donovan, R. M. (n.d.). Why the controversy over ROI from ERP? *Performance Improvement*. Retrieved from <http://www.bettermanagement.com/library/library.aspx?l=13288>
- Dowlatshahi, S. (2005). Strategic success factors in enterprise resource-planning, design, and implementation: A case-study approach. *International Journal of Production Research*, 42, 3745–3771.
- ERPandMore.com. (2007, February 7). ERP history [Web log post]. Retrieved from <http://www.erpandmore.com/erp-reference/erp-history/>
- Fryer, B. (1999). The ROI challenge. *CFO Magazine*. 85–90.
- General Accounting Office (GAO). (1991, September). *The Chief Financial Officer Act: A mandate for federal financial management reform* (GAO/AFMD-12.19.4 CFO Act). Retrieved from <http://www.gao.gov/special.pubs/af12194.pdf>
- Government Accountability Office (GAO). (2005, September). *DOD business systems modernization: Navy ERP adherence to best business practices critical to avoid past failures* (GAO 05-858). Retrieved from <http://www.gao.gov/new.items/d05858.pdf>
- Government Accountability Office (GAO). (2009, September). *Navy implementing a number of key management controls on enterprise resource planning system, but improvements still needed* (GAO 09-841). Retrieved from <http://www.gao.gov/new.items/d09841.pdf>
- Hunton, J., Lippincott, B., & Reck, J. (2003). Enterprise resource planning systems: Comparing firm performance of adopters and nonadopters. *International Journal of Accounting Information Systems*, 4, 165–184.

- Ingram, P., & Jordan, S. (2010). *Navy ERP Benefits Working Group Report To NESIB* [Presentation slides]. Data Analysis Presented to the Navy Enterprise Resource Planning Board, August 23, 2007.
- Jacobs, R., & Weston, T., Jr. (2007). Enterprise resource planning (ERP)—A brief history. *Journal of Operations Management*, 25, 357–363.
- Kampf, R. (2006). *ERP systems—Situation and future development*. Retrieved from http://www.ebz-beratungszentrum.de/pps_seiten/sonstiges/erp_engl.htm
- Keller, D., Kolachina, R., Mattern, V., Mittal, M., Raymond, P., Stimatze, G., & Zimmerman, D. (2006). *Navy enterprise resource planning study report (NA509T2)*. Washington, DC: LMI Government Consulting.
- Monk, E., & Wagner, B. (2009). *Concepts in enterprise resource planning* (3rd ed.). Boston: Course Technology.
- Murphy, K., & Simon, S. (2002). Intangible benefits valuation in ERP projects. *Information Systems Journal*, 12, 301–320.
- Norback, M., & Akerblom, J. (2003). *Taking ERP to ROI*. Lund, Sweden: Lund Institute of Technology.
- O’Leary, D. (2004). Enterprise resource planning (ERP) systems: An empirical analysis of benefits. *Journal of Emerging Technologies in Accounting*, 1, 63–72.
- O’Neill, F. (2008). Supply management: The ROI in ERP. *SMT Magazine*. Retrieved from <http://www.smtonline.com>
- Pairat, R., & Jungthirapanich, C. (2005). A chronological review of ERP research: An analysis of ERP inception, evolution, and direction. Proceedings of the IEEE International Engineering Management Conference (288–292). Thailand.
- Peeters, J. (2009). Early MRP systems at Royal Philips Electronics in the 1960s and 1970s. *IEEE Annals of the History of Computing*, 31, 56–69.
- Phillips, J. J., & Pulliam Phillips, P. (2007). *Show me the money: How to determine ROI in people, projects, and programs*. Williston, VT: Barrett-Koehler.
- Secretary of the Navy Instruction. (2007). *Validating and Leveraging Financial Benefits Associated with Lean Six Sigma for Continuous Process Improvement (SECNAVINST 5220.13)*. Washington, DC: Government Printing Office.
- Sheldon, D. H. (2005). *Class A ERP implementation: Integrating Lean and Six Sigma* [Ebrary Reader e-book]. Retrieved from <http://site.ebrary.com.libproxy.nps.edu/lib/nps/docDetail.action?docID=10124738>

- Stein, T. (1999). Making ERP add up. *InformationWeek: The Business Value of Technology*, 1–4.
- Sysoptima. (2005). *History and evolution of ERP*. Retrieved from http://www.sysoptima.com/erp/history_of_erp.php
- Under Secretary of Defense (AT&L). (1998, October 15). *Establishment of a study group to analyze implementation of price-based acquisition within the Department of Defense* [Memorandum]. Retrieved from https://acquisition.navy.mil/content/download/2118/.../file/abm98_46a.pdf
- Veit, B. (2005). Department of the Navy Converged Enterprise Resource Planning Program. *Armed Forces Comptroller*, 50(4), 11–15.
- Veit, B. (2010). *Navy ERP: Where we've been—Where we're going*. [Presentation slides]. Office of the Assistant Secretary of the Navy (FM & C), Office of Financial Operations. Retrieved from www.asmconline.org/wp-content/.../N-ERP%20Been%20-%20Going.ppt

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California