NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

JOINT PROGRAM EXECUTIVE OFFICE FOR CHEMICAL AND BIOLOGICAL DEFENSE COLLABORATION STUDY

by

Andre T. Sadowski

March 2011

Thesis Co-Advisors: Daniel A. Nussbaum
Susan P. Hocevar

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
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** March 2011	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE Joint Program Executive Office for Chemical and Biological Defense Collaboration Study		**5. FUNDING NUMBERS**	
6. AUTHOR(S) Andre T. Sadowski			
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. IRB Protocol number _____N/A_____.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited		**12b. DISTRIBUTION CODE** A	

13. ABSTRACT (maximum 200 words)

The Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD) is interested in how it can achieve a higher success rate of fielded items with their nine subordinate Program Management Offices. The Joint Science and Technology Office (JSTO) is the research, development, and technology organization that assesses all the new technologies that may eventually become fielded. The JPEO-CBD organization suspects that many of the research projects funded by JSTO are rarely fielded into actual Chemical Biological Defense (CBD) systems used by the end user. This study analyzes the results of a JPEO-CBD Questionnaire and compares those results to applicable JPEO-CBD and JSTO technology statistics. The aim of this study is to analyze the quality of the agency relationships and how the relationships impact the probability of projects being fielded. This study shows a significant statistical relationship between the collaboration survey score of a JPM and its anticipated future transition to the warfighter. A similar result is true for the correlation between the historical percentage of technologies that transition to warfighter use and the JPM's collaboration survey score.

14. SUBJECT TERMS Technology Transition, Collaboration, Organizational Design Components, Chemical Biological Defense			**15. NUMBER OF PAGES** 87
			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

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

JOINT PROGRAM EXECUTIVE OFFICE FOR CHEMICAL AND BIOLOGICAL DEFENSE COLLABORATION STUDY

Andre T. Sadowski
Lieutenant Commander, Supply Corps, United States Navy
B.S., Charleston Southern University, 1998

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
March 2011

Author: Andre T. Sadowski

Approved by: Daniel A. Nussbaum
Thesis Co-Advisor

Susan P. Hocevar
Thesis Co-Advisor

Kevin J. Maher
Second Reader

Robert F. Dell
Chair, Department of Operations Research

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD) is interested in how it can achieve a higher success rate of fielded items with its nine subordinate Program Management Offices. The Joint Science and Technology Office (JSTO) is the research, development, and technology organization that assesses all the new technologies that may eventually become fielded. The JPEO-CBD organization suspects that many of the research projects funded by JSTO are rarely fielded into actual Chemical Biological Defense (CBD) systems used by the end user. This study analyzes the results of a JPEO-CBD Questionnaire and compares those results to applicable JPEO-CBD and JSTO technology statistics. The aim of this study is to analyze the quality of the agency relationships and how the relationships impact the probability of projects being fielded. This study shows a significant statistical relationship between the collaboration survey score of a JPM and its anticipated future transition to the warfighter. A similar result is true for the correlation between the historical percentage of technologies that transition to warfighter use and the JPM's collaboration survey score.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

The Joint Executive Program Office Chemical Biological Defense (JPEO-CBD) oversees nine Joint Program Manager Offices (JPM), which provide innovative services and products to the warfighter, Chemical Biological Defense (CBD), and to support homeland security. The Joint Science and Technology Office (JSTO), not a part of JPEO-CBD, provides the bulk of technology to meet the JPMs' missions.

JPEO-CBD requested help from the Naval Postgraduate School to improve the technology transfer process between JSTO and JPM, as well as the ultimate fielding of this technology to the warfighter. We created a collaboration survey with the intent of identifying a model to support the increase of technology transfer between JSTO and the JPMs and to the warfighter.

With data and opinions gathered from employees of all nine JPM offices, we developed several regression models.

This study shows a significant statistical relationship between the collaboration survey score of a particular JPM and its anticipated percentage of future technology transition to the warfighter. This is also true for the correlation between the collaboration survey score and the historical percentage of technology transition to warfighter. Specifically, if the collaboration, as measured by the collaboration survey score, between a JPM and its respective JSTO counterpart improves, then there is a higher probability that technology projects will successfully end up in the warfighter's hands.

Additionally, we report qualitative comments from the JPMs on steps to be taken to improve JSTO-JPM collaboration. JPEO-CBD managers can follow the recommendations in Chapter V of this study to pursue this goal.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

ASBRED	Armed Services Biomedical Research Evaluation and Management
AAE	Army Acquisition Executive
BW	Biological Warfare
CBD	Chemical Biological Defense
CBDP	Chemical Biological Defense Program
CBRN	Chemical Biological Radiological Nuclear Defense
COTS	Commercial Off The Shelf
DoD	Department of Defense
DoD CBRN	Department of Defense Chemical Biological Radiological Nuclear Defense
DHS	Department of Homeland Security
DARPA	Defense Advanced Research Projects Agency
DTRA	Defense Threat Reduction Agency
FDA	Federal Drug Administration
ICS	Interagency Collaboration Survey
IP	Intellectual Property
JPEO-CBD	Joint Program Executive Office for Chemical and Biological Defense
JPM	Joint Project Management Office
JPM BD	Joint Program Manager Biological Defense
JPM NBC CA	Joint Program Manager Nuclear Biological Chemical Contamination Avoidance
JPM CBMS	Joint Program Manager Chemical-Biological Medical Systems
JPM CP	Joint Program Manager Office-Collective Protection
JPM DECON	Joint Program Manager Decontamination
JPM GUARDIAN	Joint Program Manager Guardian
JPM IP	Joint Program Manager Office Individual Protection
JPM IS	Joint Program Manager Information Systems

JPM TMTI	Joint Program Manager Transformational Medical Technologies
JRO CBRN	Joint Requirements Office for Chemical Biological Radiological Nuclear Defense
JSTO	Joint Science and Technology Office
NPS	Naval Postgraduate School
OSD	Office of the Secretary of Defense
RFP	Request for Proposal
S&T	Science and Technology
TARA	Technology Area Review and Assessment
TQR	Transition Quarterly Reviews
TTA	Transition Technology Agreement

ACKNOWLEDGMENTS

I would like to thank Professor Daniel A. Nussbaum and Professor Susan P. Hocevar for their contribution to this thesis. Professor Nussbaum provided a wealth of knowledge on spreadsheet statistics, and Professor Hocevar provided a crucial link to the social science of collaboration.

Furthermore, I would like to thank Kevin J. Maher, CDR, SC, USN (Ret.) for his forthright tutelage, his candor, and many informative discussions over the course of my Operations Logistics curriculum. You were an inspiration to me and made me realize that there is light at the end of the tunnel.

Most importantly, I need to thank my wife, Janeska, and my son, Johann, for their constant support. The two of you are the focus of my life, while I continue to pursue this Naval career. Thank you all very much!

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. PROBLEM STATEMENT

The Joint Executive Program Office for Chemical and Biological Defense (JPEO-CBD) oversees nine Joint Program Manager Offices (JPM), which provide innovative services and products to the warfighter and CBD that can be used for Homeland Security. Seven of nine JPM offices receive their technology almost exclusively from the Joint Science and Technology Office (JSTO), which is not part of the JPEO; the other two JPM offices receive their technology either commercially or from another technology provider, with only a small percentage (less than 10%) coming from JSTO. JPEO-CBD contacted a Naval Postgraduate School (NPS) faculty member, Professor Nussbaum, from the NPS Operations Research Department, with the following concerns.

1. Technology Transition Percentages

Current chemical and biological threats are managed on the JPM requirements list. However, JPEO-CBD estimated that of all outstanding JPM requirements, only a small number are researched by JSTO. This is a concern because JSTO potentially fails to address some of JPEO's outstanding requirements. Of those few technologies that are researched, only a small fraction gets fielded in some form for delivery to the warfighter. JPEO-CBD estimated that fraction, referred to as a "transition percentage," at 5%.

JPEO-CBD requested NPS assess its pending Science and Technology (S&T) research requirements and its subsequent fielding from Fiscal Years 2005 to 2010 in order to give JPEO-CBD better insight into and management of the technology requester-and-provider relationship they have with JSTO. This study presents descriptive statistics for both a historical transition percentage, as well as for a future anticipated transition percentage. This historical percentage is important in order for JPEO-CBD to establish a baseline for future performance and studies.

2. Technology Transition Percentage Improvement

In line with the JPEO-CBD's estimated low technology transition percentage to the warfighter, it asked NPS to develop a survey and a model to improve their organization's overall performance in this area. To answer this question, a collaboration survey was constructed and administered to representatives from all nine JPM offices. This questionnaire is an adaptation of the Interagency Collaboration Survey (ICS), developed by Professor Hocevar, Professor Thomas, and Professor Jansen of NPS [1] and described in Chapter III.

3. Hypothesis

We hypothesize that the perception of past and current collaboration between two organizations is positively correlated with the transition percentage. We modeled the survey results to estimate the correlation between JSTO-JPM collaboration and technology transition. We also determine which factors have an impact in the historical technology transfer and which we predict will have an impact on future technology transitions.

4. Methodology

We evaluate the collaboration potential of JSTO and JPEO-CBD by drawing questions from three of the five Design Factors for Inter-Organizational Collaborative Capacity, described in Galbraith's study [2] and adapted by Hocevar et al. [1]. Our questionnaire uses a two-prong approach: (1) evaluate the numerical scores of the survey questions and then compare them to historical and future fielding percentages and (2) evaluate answers from the discussion questions of the questionnaire.

B. LIMITATIONS

1. Scope

JPEO-CBD is concerned with its technology transition percentage. It asserts, and we concur, that no other study has been done to examine this problem. Based on conversations with JPEO-CBD senior personnel, we learned that they were largely

unaware of their true technology transition percentage, but estimated it at 5%. This percentage is important in order for JPEO-CBD to establish a baseline for future performance and studies.

No study has been done to date for JPEO-CBD to address improvement of its technology transfer to the warfighter. Therefore, we have no baseline against which to measure our work. We created a JPM Questionnaire and traveled to each JPM location to administer it in person. Each interview took approximately two hours. Due to the logistical difficulties of traveling to JPMs on both coasts and funding constraints, we made only one visit to each JPM and administered only one questionnaire at each JPM. Follow-up e-mails were sent to interviewees to clarify certain information.

C. EXPLANATION OF KEY ORGANIZATIONAL RELATIONSHIPS, ROLES, AND RESPONSIBILITIES

1. Defense Threat Reduction Agency (DTRA) and Joint Science and Technology Office (JSTO)

DTRA is responsible for the consolidation of a variety of US Defense Department functions to deal more effectively with the threats posed by nuclear, chemical, or biological weapons. While the DTRA Chemical and Biological Technologies Directorate (DTRA CB) is not part of DARPA, it is DARPA's focal point for chemical and biological scientific and technical expertise. DTRA CB is also "dual-hatted" as the JSTO for Chemical and Biological Defense under the Department of Defense Chemical and Biological Defense Program (CBDP). In these roles, it seeks to provide cutting-edge technology solutions that reduce the threat from weapons of mass destruction and empower warfighters to achieve their missions in a chemical, biological or radiological environment [10]. DTRA CB serves two key roles in support of DoD CBDP: Funds Manager and Joint Science and Technology Manager. The funds management function is done under the oversight of the Assistant Secretary of Defense for Nuclear and Chemical and Biological Defense Programs. The joint S&T management responsibilities include:

- Development and integration of S&T programs in response to OSD and JRO-CBRN Defense guidance.

- Necessary programming, planning, and budgeting documentation for chemical and biological defense S&T programs.
- Working with the JPEO-CBD to ensure effective transition of S&T efforts to advanced development.
- Participating in Armed Services Biomedical Research Evaluation and Management (ASBRED) Committee meetings to ensure organizational coordination between medical and non-medical S&T liaisons, such as DARPA, industry, academia, and other government agencies.

JSTO-CBD also provides support for DoD CB defense S&T international programs and provides management and integration of CB defense Advanced Concept Technology Demonstrations [3].

More information is available in the Annual Department of Defense Chemical, Biological, Radiological, and Nuclear Defense Program Report to Congress [3] and the DTRA website at http://www.dtra.mil.

2. Defense Advanced Research Projects Agency's (DARPA) Biological Warfare Defense Program

DARPA is charged with seeking breakthrough concepts and technologies that will impact national security. DARPA's Biological Warfare (BW) Defense Program is intended to complement the DoD CBRN Defense Program by anticipating threats and developing novel defenses against them. The DARPA program is unique in that its focus is on the development of technologies with broad applicability against threats. DARPA invests primarily in the early technology development phases of programs and the demonstration of prototype systems.

In accordance with 50 USC 1522, the Director of DARPA avoids unnecessary duplication of DARPA's activities with the chemical and biological warfare defense activities of the military departments and defense agencies, and the Director also coordinates DARPA's activities with those of the military departments and defense agencies. The DARPA BW Defense Program coordinates its efforts with numerous

organizations, including the Deputy Assistant to the Secretary of Defense for CBD and DTRA Chemical & Biological Technologies Directorate (CB), as well as by participation in the Technology Area Review and Assessment (TARA) process. A panel of chemical and biological defense experts is routinely consulted by DARPA to evaluate programs and to ensure that National Institute of Health efforts are not being duplicated. DARPA also participates in the BW Seniors Group, which provides government coordination outside of DoD and works closely with the military services to ensure that technologies are effectively transitioned into the hands of the user community [3].

More information is available in the Annual Department of Defense Chemical, Biological, Radiological, and Nuclear Defense Program Report to Congress [3].

3. Joint Program Executive Office Chemical Biological Defense (JPEO-CBD)

JPEO-CBD provides research, development, acquisition fielding and life-cycle support of chemical, biological, radiological and nuclear defense equipment, medical countermeasures and installation and force protection capabilities supporting the national strategies. The JPEO-CBD reports to the Army Acquisition Executive (AAE) and serves as the CBDP Material Developer, overseeing Life Cycle Acquisition Management for assigned system acquisition programs within CBDP. The JPEO-CBD provides centralized program management and Joint Service acquisition program integration for all assigned nonmedical and medical chemical and biological defense programs. JPEO-CBD has nine subordinate Joint Project Managers (JPMs). They are JPM Biological Defense, JPM Collective Protection, JPM Nuclear Biological Chemical Contamination Avoidance, JPM Chemical Biological Defense, JPM Decontamination, JPM Guardian, JPM Individual Protection, JPM Information Systems, and JPM Transitional Medical Technology [4]. These JPM offices are further described below and in Appendix C.

a. Joint Project Manager Biological Defense (JPM BD)

JPM BD provides defensive equipment and technology to detect and identify biological threats in near real-time, and collects and assimilates data for commanders who require an understanding of the biological threat situation in their areas of operation [5].

b. Joint Project Manager Nuclear Biological Chemical Contamination Avoidance (JPM NBC CA)

The JPM NBC CA provides advanced detection, warning and identification of contamination of personnel and equipment; it monitors the presence of chemical warfare agent contamination. JPM NBC CA also provides the capability to detect and measure nuclear radiation from fallout and radioisotopes [5].

c. Joint Project Manager Chemical Biological Medical Systems (JPM CBMS)

JPM CBMS centrally manages and employs government and commercial pharmaceutical development best practices to oversee the Joint Vaccine Acquisition Program and Medical Identification and Treatment Systems [5].

d. Joint Project Manager Collective Protection (JPM CP)

JPM CP provides the warfighter with clean, breathable, toxic-free air and prevents particulates, liquids, and vapor contaminates from seeping into protected areas [5].

e. Joint Project Manager Decontamination (JPM DECON)

JPM DECON uses an evolutionary acquisition strategy to support the warfighter, providing a constant insertion of enhanced capabilities [5].

f. Joint Projects Manager Guardian (JPM GUARDIAN)

JPM GUARDIAN provides conventional and nonconventional detection, analysis, communications, protection, response and survey capabilities in support of

installation force protection, civil support teams, reserve reconnaissance and decontamination platoons, tactical units and civil authorities [5].

g. Joint Projects Manager Individual Protection (JPM IP)

JPM IP provides our Nation's warfighters Individual Protection Equipment (IPE) required to effectively conduct combat operations in a chemical-biological environment [5].

h. Joint Projects Manager Information Systems (JPM IS)

JPM IS supports the warfighter in the battle space by providing a modern joint services information system enterprise architecture and applications that shape the battle space against Chemical, Biological, Radiological, and Nuclear threats [5].

i. Joint Projects Manager Transitional Medical Technology (JPM TMTI)

JPM TMTI's mission is to protect the warfighter from conventional or genetically engineered biological threats, known or emerging, by accelerating the seamless discovery and development of broad-spectrum medical countermeasures through the use of novel technology platforms and innovative management approaches [5].

This is a basic overview of the individual JPM responsibilities. For more information, visit the JPEO-CBD website at www.jpeocbd.osd.mil.

D. METHODOLOGY

We evaluate the collaboration potential of JSTO and JPEO-CBD by drawing questions from three of the five Design Factors for Inter-Organizational Collaborative Capacity, described in Galbraith's study [2] and adapted by Hocevar et al. [1]. Our questionnaire uses a two-prong approach: (1) evaluate the numerical scores of the survey questions and then compare them to historical and future fielding percentages, in order to find one or more links between the outputs of the JPM questionnaire and (2) evaluate answers from the discussion questions of the questionnaire.

E. CONTENT OF THIS THESIS WORK

Chapter II discusses the literature review. Chapter III discusses the method used to develop the JPM Questionnaire. Chapter IV presents the results and analyses of the Questionnaire. Observations and recommendations from the analysis of the data are included in Chapter V.

II. LITERATURE REVIEW

While there is literature on technology transition, and literature on organizational collaboration, there is no literature that we could find on the topic of the influence of organizational collaboration on the level of technology transition.

We discuss below a particular model of organizational collaboration.

A. FIVE POINT STAR MODEL

1. Five Point Star Model Questionnaire Construct

Our collaboration questionnaire is directly derived from the Interorganizational Collaborative Capacity (ICC) survey constructed by Professor Susan Page Hocevar, Professor Gail Fann Thomas, and Professor Erik Jansen of the Naval Postgraduate School (NPS) in Monterey, CA [1]. They constructed this survey to study collaborative capacity of Department of Homeland Security (DHS) local, state, and federal agencies and other public organizations, as well as to identify capacities and barriers of collaboration. Once the findings of the survey are presented to the management of participating organizations, the agency can put plans into place, exactly where to improve their interagency collaboration [1]. Their diagnostic model builds on the "Star" model of organization design and development by Jay Galbraith [2].

B. FIVE ORGANIZATIONAL DESIGN COMPONENTS

Figure 1 shows the Hocevar et al. Collaboration model with its five organizational design components and their various sub-components. The Hocevar et al. Collaboration Model is a refinement of Galbraith's five point Star model [2]. The paragraphs that follow describe the five subsystems.

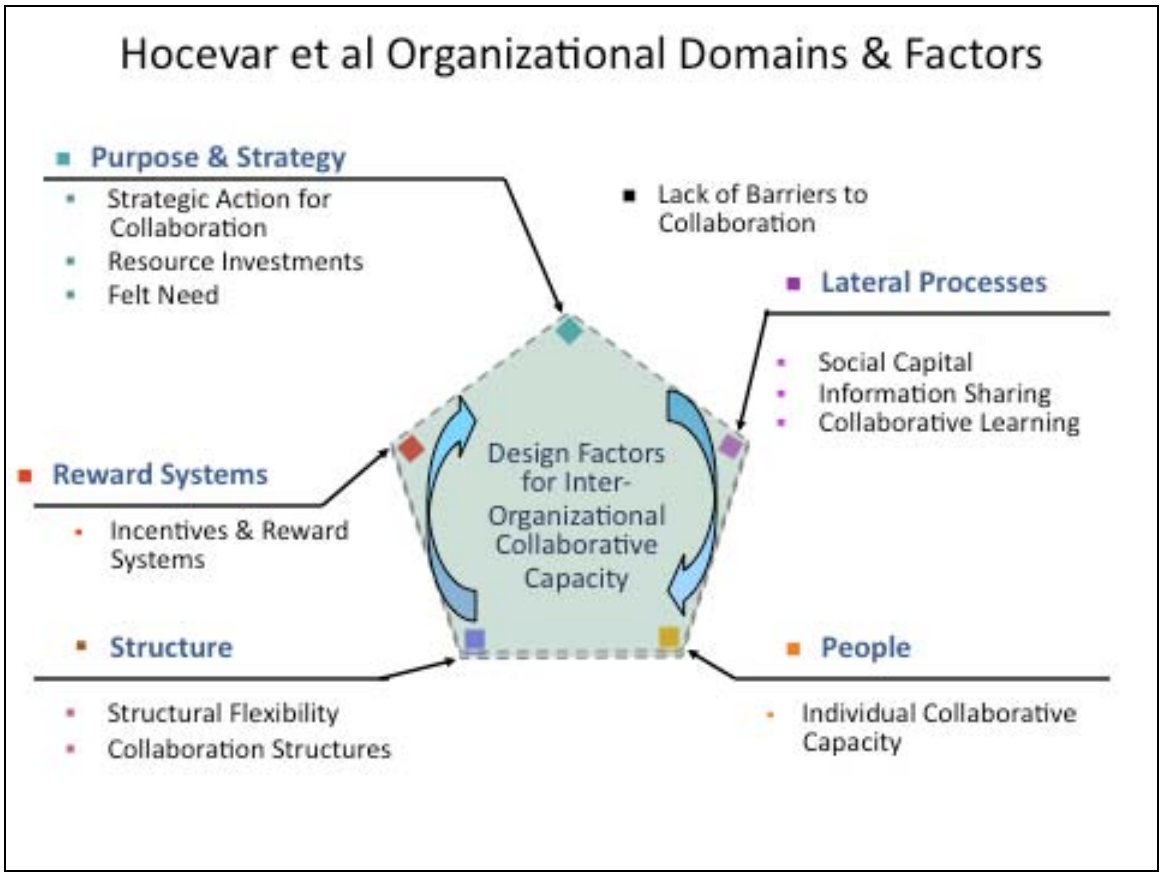

Figure 1. Hocevar et al. Collaboration Model [From 1]

1. People

Individual Collaborative Capacity questions focus on one organization's skills, capabilities and expertise, understanding and knowledge of other organizations' work and perspective, willingness to engage in shared decision-making, and seeking input from the other organization [6].

2. Reward Systems

Reward Systems "assess the individuals' perceptions of the consequences of their behavior in terms of their own personal payoffs. The items assess the degree to which collaborative work, collaborative activities, and collaborative talents result in rewards, career advancement, and promotion" [6, p. 16]. The JPM Questionnaire did not include

any questions regarding reward systems. The assessment was made that it didn't directly apply to technology transition. Future studies might include questions about reward systems.

3. Structure

Both subcategories of Structure, namely Structural Flexibility and Collaboration Structures, are relevant to this research. Each of these is described below.

a. Structural Flexibility

Structural Flexibility measures the degree to which respondents perceive that the organization is "flexible and responsive, quickly forming and modifying policies, processes, procedures, and partnerships" [6, p. 15].

b. Collaboration Structures

Collaboration Structures refers to the tools an organization has in place to improve the collaboration effort with another organization. These include interagency task forces and liaison roles to bring the two organizations together [2].

4. Purpose and Strategy

Purpose and Strategy should support the overall focus or mission of an organization. It describes its goals and, on a broad basis, how to achieve those goals. With respect to collaboration, this definition applies to how organization A's Purpose and Strategy applies to collaborating with another organization B to achieve organization A's goals. Purpose and Strategy contains three subcategories: (1) Felt Need, (2) Strategic Action for Collaboration, and (3) Resource Investments.

a. Felt Need

This is sometimes referred to as "Need to Collaborate," which assesses what motivates organizations to collaborate in achieving their respective missions. [6].

b. Strategic Action for Collaboration

Strategic Collaboration addresses whether two organizations are "pulling [together] in the same direction" or are trying to achieve a "common goal." It emphasizes establishing and addressing goals for collaboration and considering the interest of other agencies in decision making. In short, it is an emphasis on common goals, planning, and leadership of the different organizations [6].

c. Resource Investments

Resource Investment addresses whether the organizations are "putting their money where their mouth is." It is very easy to repeat the buzzwords of collaboration, but is the organization serious enough to allocate time, money, and personnel toward accomplishing these goals? This subcategory focuses on investment, assigning budgets and personnel to interorganizational collaboration [6].

5. Lateral Processes

Lateral Processes are processes designed to overcome barriers to collaboration caused by an organization's formal structure:

> An organization's lateral capability is the extent to which it can utilize these mechanisms to enhance its flexibility and leverage all its resources. Process and lateral capability allow the organization to bring together the right people, no matter where they sit in the structure, to solve problems, create opportunities, and respond to challenges. [2, p.19].

Subcategories of the Lateral Processes component contains are described below.

a. Social Capital

Social Capital assesses the degree to which organizational employees take the initiative to build relationships and know who to contact in the other organizations [6].

b. Information Sharing

Information Sharing assesses how well organizations share information, and measures how effective these communication policies are. Good information sharing

reduces the necessity of other collaborative mechanisms, such as liaisons, regular task force meetings, and joint exercises. However, these mechanisms can provide increased collaborative capacity [6].

c. Collaborative Learning

Sometimes an organization is faced with problems that can be best solved by good teamwork with another organization. Collaborative Learning questions assess the degree to which the organization might be regarded as a collaborative learning organization. These questions address the degree to which the organization commits resources to training, works with other organizations to identify lessons learned and develops strong norms for learning from the other organization [6].

6. Barriers to Collaboration

Barriers to Collaboration stand in the way of a good working relationship between two organizations. Barriers to Collaboration are part of the Hocevar et al. model, but blend into two other subcomponents of the model, namely Purpose & Strategy, and Lateral Processes [6].

C. TECHNOLOGY TRANSFER

1. Wahab Study

Although there are many studies completed in the field of technology transfer, none have been previously done on technology transfer and collaboration. Professor Sazali Wahab et al. of Universiti Putra Malaysia examined the effects of the degree of technology transfer on local firms' corporate and human resource performances. Their hypothesis was that human resource and corporate performance is limited by the age of the joint venture or working together. According to Professor Wahab, not many studies in both intra and interfirm technology transfer have focused on the degree of this transfer as either an independent or dependent variable. Rather, studies have addressed the technological knowledge and knowledge acquisition as dependent variables. The Wahab study concludes that technology transfer in itself will lead to a higher potential for innovation, increased technological capabilities, enhanced organizations' competitive

advantage, enhanced organizational learning effectiveness, improved productivity, increased technological development of local industry and improved economic growth of the host country [7].

2. Other Studies

The influence of collaboration and its influence on technology transfer has not been studied. The literature research indicates that there are no other studies other than [Wahab] that provide guidance for us in this research.

III. DATA AND METHODOLOGY

Table 1 shows the derivation of the JPM Questionnaire. For example, Question #1 on the JPM Questionnaire corresponds to Question #2 on the Hocevar et al. Questionnaire. The JPM Questionnaire is found in Appendix A; the Hocevar et al. Questionnaire is referenced in Appendix D.

DOMAIN	JPM QUESTIONNAIRE	HOCEVAR ET AL. QUESTIONNAIRE
STRATEGIC COLLABORATION	Q 1 Q 2	Q 2 Q 41
RESOURCE INVESTMENT	Q 3 Q 4	Q13 Question from [6]
SOCIAL CAPITAL	Q 5 Q6	Q 16 Q 17
BARRIERS TO COLLABORATION	Q 7 Q 8 Q 9 Q 10	Q 49 Q 7 Q11 Q 28
COLLABORATION STRUCTURE	Q 11 Q 17	Q 4 Q 44
STRUCTURAL FLEXIBILITY	Q 15	Q 47
NEED TO COLLABORATE	Q 18	Q51, but amended.

Table 1. Questionnaire Derivation and Comparison.

Additionally, we added questions # 12, 13, 16, 19, and 20, which are categorized as Collaboration Mechanisms To Improve Technology Transfer.

A. METHODOLOGY

1. Utilizing the Technology Organizational Domains and Factors

As stated before, the collaboration questionnaire used in this research project is derived from the Inter-Organizational Collaborative Capacity (ICC) survey constructed by professors Susan Page Hocevar, Gail Fann Thomas, and Erik Jansen of the Naval Postgraduate School (NPS) in Monterey, CA [6].

There are forty-three questions from the Hocevar et al. collaboration survey [6]. Based on conversations with our sponsor to assess the applicability of each question to the JPEO enterprise, we adopted fourteen of the questions for our questionnaire. These fourteen questions are associated with three of the five Organizational Design Components. It was determined that two of the Organizational Design Components do not apply to the JPEO-CBD's JPMs and their JSTO partners. After careful analysis of each question's applicability, we adapted only eleven of the forty-three questions from the Hocevar et al. collaboration survey [6]. We found these eleven questions to be a relevant subset of the collaboration diagnostic. We only have three of the five Organizational Design Components in our survey.

2. Constructing the Collaboration Questionnaire

Our questionnaire consists of twenty-five questions, which are in Appendix A. The questions are associated with the Domains from the Hocevar model, as indicated in TABLE 1. For the purpose of the JPM Questionnaire, we used only three of the five Technology Organizational Domains & Factors, namely Purpose and Strategy, Structure, and Lateral Mechanisms. Figure 2 shows the Organizational Domains & Factors Model adapted from [1]. Some questions related to Barriers were also included in our revised model. These questions are divided between Purpose and Strategy and the Lateral Processes Organizational Design Components, and, therefore, fall in between those categories on the model.

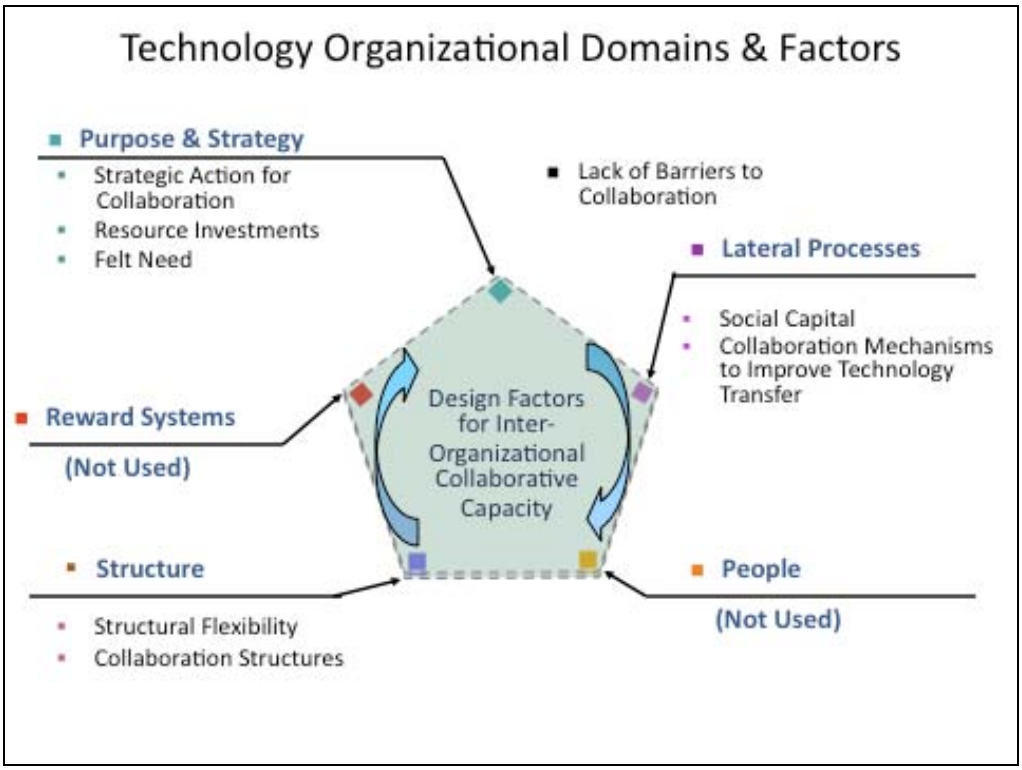

Figure 2. Technology Organizational Domains Factors [From 2]

Based on our understanding of the JPM and JSTO relationship and JPEO reviews of our questionnaire, we added eight questions that are indicative of technology transfer between these two organizations. In order to gain additional insights into the relationships between JPMs and JSTO, six "relationship" interview questions were added to the JPM Questionnaire, bringing the total questions in our survey to twenty-five. The full survey can be found in Appendix A.

Another consideration was the duration of the JPM employee interview. The sponsor insisted that we travel to each JPM location to administer these questionnaires face to face. We were informed by our sponsor that the managers and lead scientists of these JPM offices had extremely busy schedules and would not be available for more than a two-hour block of time. We structured the interview so that once the "numerical" questions were answered; additional time was available to address the discussion questions and whatever else the employees wanted to share with us during the interview.

Notwithstanding the sponsor's warnings about likely time limits, actual interview durations varied from ninety minutes to four hours, during which all required questions were satisfactorily answered.

3. Administering the Questionnaire

We administered JPM Questionnaire in interviews with employees at all nine JPM offices. We visited all nine JPM offices, interviewing two people at six locations and one person at three locations.

B. THREE APPLICABLE ORGANIZATIONAL DESIGN COMPONENTS FOR COLLABORATION IN TECHNOLOGY TRANSFER

Recall, from Chapter II, that the Hocevar et al. [2] collaboration survey consists of five Organizational Design Components: Purpose and Strategy, Structure, Lateral Mechanisms, Incentives, and People. The Hocevar et al. questionnaire was analyzed for applicability of the professional relationship between JPM and JSTO. The resulting JPM Questionnaire addressed three of the five Organizational Design Components. These questions were tailored so that they apply to the professional relationship between JPM and JSTO. For nineteen out of twenty-five questions, interviewees scored a particular area of collaboration utilizing a 6-point rating scale, with "1" representing "Strongly Disagree" (or "Never," or "Poor") and "6" being "Strongly Agree" (or "Always," or "Excellent.")

The paragraphs below provide details on the questions in each subcategory.

1. Structure

Structure is described in II.B.3. The subcategories of Structure, which apply to the JPM and JSTO relationships are: Structural Flexibility and Collaboration Structures.

a. Structural Flexibility

Structural Flexibility, measures the degree to which respondents perceive that the organization is flexible and responsive, quickly forming and modifying policies, processes, procedures, and partnerships [6]. The questions are related to the Structural

domain of the model. Question "15" is specifically about Structural Flexibility.. Interviewees were asked to rate this question on the 6-point scale.

Question #15: JSTO's organization's policies and procedures allow it to be responsive to the requirements of my JPM office.

b. Collaboration Structures

Collaboration Structures refer to the tools an organization has in place to improve the collaboration effort with another organization. These include interagency task forces and liaison roles to bring the two organizations together.

Question #11: My organization has adequate and appropriate structures (e.g., liaison roles, processes) for effective collaboration with JSTO.

Question #17: My organization gives members appropriate authority to collaborate with JSTO.

2. Lateral Processes

Lateral Processes are processes are described in II.B.5. The subcategories which apply to the JPM and JSTO relationship are: Social Capital and Collaboration Mechanisms to improve Technology Transfer.

a. Social Capital

The JPM Questionnaire asked interviewees to score the following statements addressing Social Capital:

Question #5: Members of my organization know who to contact at JSTO for information or decisions.

Question #6: Members of my organization take the initiative to build relationships with their counterparts in JSTO.

b. Collaboration Mechanisms to Improve Technology Transfer

These are additional questions that we added to our questionnaire. They were discussed in III.A.1.

Question #12: My organization has a history of working well with JSTO.

Question #13: It is possible for my organization to better integrate with JSTO.

Question #16: Our organization articulates requirements to JSTO.

Question #19: To what extent does your organization play an active or voting role in JSTO's research program?

Question #20: How would you rate the overall success of your organization in collaborating with JSTO?

3. Purpose and Strategy

Purpose and Strategy is described in II.B.4. The subcategories, which apply to the JPM and JSTO relationship are: Strategic Action for Collaboration, Resource Investment, and Felt Need.

a. Strategic Action for Collaboration

The JPM Questionnaire contained the following two statements in this category that the interviewee was asked to score from one to six:

Question #1: We have clearly established goals for interorganizational collaboration with JSTO.

Question #2: Leaders of my organization work productively with those of JSTO to improve our collaboration.

b. Resource Investment

Question #3: Our organization is willing to improve and invest how it does business with respect to a better relationship and transition strategy with JSTO.

Question #4: My organization commits adequate human and financial resources to improve collaboration and common practices with JSTO.

b. Need to Collaborate or Felt Need

In [6], John Kotter (A Professor of Leadership at Harvard Business school) asserts that a "felt need" or "sense of urgency" is a powerful factor that motivates individuals to make commitments to learning new skills and exploring new behaviors.

Question # 18 addresses whether the employee understands that there are possible benefits for accomplishing the organization's mission.

Question #18: To what extent does accomplishing your organization's mission require working with an S&T organization like JSTO?

4. Barriers to Collaboration

Barriers to Collaboration stand in the way of good working relationships between two organizations A key piece of information for the JPEO-CBD decision maker is whether or not these barriers exist in his/her organizations. For assessing Barriers to Collaboration, we added the following questions to the survey constructed in [6]. On the JPM Questionnaire, the interviewee was asked to score four Barrier questions from one to six. However, unlike the previous questions, the lower the numerical response on these questions, the better. For analyses that compared results across survey questions, these questions were recoded so that a "1" is transformed into a "6"; a "2" transformed into a "5"; etc. Here are the four barrier questions:

Question #7: My organization's unique requirements make collaboration with JSTO difficult.

Question #8: Conflicting organizational policies make collaboration with JSTO difficult.

Question #9: A history of competition and conflict affects our capability with JSTO.

Question #10: People in my organization tend to be suspicious and distrustful of their counterparts in JSTO.

C. OPEN-ENDED DISCUSSION QUESTIONS

We stated earlier that another focus of this study was to provide insight for the JPEO-CBD decision maker about qualitative ideas, comments, or suggestions, from the JPM interviewees, about the JPM and JSTO counterpart relationship. Therefore, the following open-ended discussion questions were added to record these qualitative comments

Question #25: What, if any, are the barriers which deter collaboration between JSTO and your program, and what are the things that facilitate or enable good collaboration?

Question #14: How is it possible for my organization to better integrate with JSTO?

D. OPERATIONS RESEARCH RELATED JPM QUESTIONNAIRE QUESTIONS

The collaboration component of this study is one prong of the two-pronged approach of this study. The other prong consists of questions to help us identify statistically valid success indicators between JPM offices and their JSTO counterparts that lead to fielding of technologies

1. Statistical Questions

The purpose of these statistical questions is to find one or more links between two outputs of the JPM Questionnaire:

a. The total quantitative collaboration questionnaire score, and
b. The transitional percentages from JSTO to JPM to warfighter.

As we stated earlier, the most important function of this study is to tie these two pieces of information together and provide the decision maker a predictive model to be used for enhancing the collaboration of their organization.

2. Transitioning Technology

The JPEO is trying to determine what percentage of technologies in development actually transition into a final product for the warfighter. One of the purposes of this research is to address the JPEO's concerns about the low percentage of projects that "transition," which refers to those technology products that end up in the hands of the end user (warfighter). A transition is defined as a technology that successfully moved through the R&D pipeline and is delivered to the warfighter.

During the discussions with the JPEO, we further refined that meaning by considering that if any part of a technology ends up with the end user, it is considered a successful transition. For example, if a circuit board or electronic component from a technology project ends up as a part of a larger electronic monitoring system, then that particular technology has "transitioned." Different JPMs have different definitions of a successful transition. For example, JPM TMTI and JPM CBMS deal with pharmaceutical products and their products require lengthy testing and, finally, Federal Drug Administration (FDA) approval. For these two JPMs, FDA approval of one of their drugs is considered a successful transition. For another JPM, JSTO's testing of a technology is considered a successful transition.

While a signed Technology Transition Agreement (TTA) often precedes a technology transition, other factors, such as lack of funding, or non-acceptance from the Military of the final product or service could still prevent it from ending up in the field.

The interviewees were asked for their estimate of the percentage of their technologies, which successfully transitioned. When they did not have these numbers available at the time of the interview, they provided them to us after further research into records and reports. We asked:

Question #21: What is your historical fielding track record (in percent) fiscal year 2005 to present? (5 YR Aggregate %)

Question #22: Has the collaboration between JSTO and your program increased/decreased/remained the same in the past 3 years?

Question #23: What percentage of capabilities in your fielded programs were provided by JSTO? (Down to the incremental level, where "incremental level" or "major release" refers to a requirement that is specified for a level of maturity as per DoD INST. 5200.02. When a requirement for an increment is not an off-the-shelf product, the JPM then requests the S&T community to develop the lowest component of the system being researched in time for increment build and delivery.)

Question #24: What percentage of capabilities of projects under your authority and funded by JSTO do you expect to be fielded in the future?

3. Funding Questions

There were no questions regarding funding on the JPM Questionnaire because JPEO-CBD does not provide funds to JSTO. Since JSTO is funded from DTRA, it makes the JPM-JSTO relationship unusual because the customer (JPEO-CBD) does not provide funding for the technology research service done by JSTO.

E. JPM QUESTIONNAIRE ASSESSMENT

Our questionnaire addresses collaboration potential, collaboration barriers, transition statistics, and the JPM - JSTO relationship. It provides a diagnostic tool for two organizations that are in a technology customer and technology provider relationship. These two organizations can use the results of the questionnaire to assess how to improve their relationship. The results and analysis of the JPM Questionnaire are presented in Chapter IV.

IV. RESULTS AND ANALYSIS

A. QUESTIONNAIRE RESULTS

1. Compiled Questionnaire Results and Statistics

For most of the questions, interviewees are asked to score a particular area of collaboration on a scale of "1" to "6," with "1" representing "Strongly Disagree," "Never," or "Poor," and "6" representing "Strongly Agree, Always, or Excellent." Due to the nature of collaboration barrier questions (Questions # 7,8,9,10, and 13), reverse scoring was required. For example Question #7 is "My organization's unique requirements make collaboration with JSTO difficult." For a scenario of optimal perceived collaboration, the respondent would have to choose to strongly disagree with this statement, and thereby choose "1" as his or her answer. However, since we want to capture a total collaboration score, a one-point score for the best possible answer would not be a good indicator of what we are trying to capture. Therefore, the Barriers are scored in reverse, so that a response of "1" or "Strongly Disagree" for the aforementioned questions will yield 6 points to the aggregate total, and vice versa. Table 2 shows some descriptive statistics from the survey.

Question	1	2	3	4	5	6	7	8	9	10
Mean	4.4	5.1	5.8	5.3	5.2	5.7	5.0**	4.3**	4.5**	4.1**
Std. Dev	1.1	1	0.3	0.8	0.6	0.7	1.6	1.6	1.5	1.8
Question	11	12	13	15	16	17	18	19	20	
Mean	4.5	4.4	2.6**	4.3	4.8	5.4	5.3	4	4.3	
Std. Dev	1.4	1.5	1.7	1.3	1.2	0.6	1.2	1.4	1.4	

Table 2. Numerical Results of Questionnaire.
(** Indicates Recoded Questions)

Appendix B contains the complete results, including descriptive statistics, of the questionnaire. This statistical summary consists of the mean, the standard deviation, the mode, and the variance for each question of the JPM Questionnaire. The discussion questions and percentages of fielding results are discussed later in this chapter.

There are no guidelines that determine whether a score is good or bad, as this depends on each organization's understanding. A score of four for a particular question may be good for one organization, and considered bad for another. The summary of the questions in Appendix B indicates which areas have higher scores than others, and a manager in any organization can then focus on any perceived weak areas. For example, Questions # 3, 6, and 17 have the highest numerical scores with the smallest standard deviation. The subject matter of these questions indicates the JPEO's strongest areas of collaboration are in the areas of "Resource Investment," "Social Capital," and "Collaboration Structures," respectively, and this will be detailed in the next paragraph. Conversely, Question # 13 has the lowest score and one of the highest standard deviations at 1.7, suggesting the weakest collaborative capacity is the fact that more improvement in collaboration is needed. Question #10 with a standard deviation of 1.8, indicates real differences of opinion on this subject matter.

The strength in the JPEO organization with regards to collaboration with JSTO is very good in the "Purpose and Strategy" subsystem, mixed in the "Lateral Processes" subsystem, and weak in the "Barriers to Collaboration" subsystem. In the "Lateral Processes" subsystem, the highest scores were achieved in "Social Capital," indicating that JPM employees are familiar with the JSTO organization and know who their counterparts are. However, in the "Collaboration Mechanisms to improve Technology Transfer" area, we recorded some of the lowest scores of the survey. Questions # 12, 13, 16, 19, and 20 refer to this area. This is where management should devote some attention for future improvement. "Purpose and Strategy" was the highest scoring subsystem of the survey. The "Resource Investment" and "Felt Need" areas scored high, indicating JPM's emphasis on wanting to improve collaboration with JSTO. The "Strategic Action for Collaboration" area scored about average on this survey, indicating improvement might be needed in the emphasis of establishing and addressing goals for collaboration, and considering the interest of other agencies in planning. The "Barriers to Collaboration" was the lowest scored subsystem. This indicates that barriers do still exist in the opinions of the JPM employees. The data of Questions #7–10, and most notably Question #10, indicate that some distrust between the organizations still exists and the

JPMs view JSTO as impeding better collaboration. Again, it is up to the management of the JPM organization to interpret their results for this questionnaire, and determine the levels at which corrective actions have to taken to improve in the respective subsystems.

B. ANALYSIS WITH FIELDING PERCENTAGES

We asked JPM employees to research both historical fielding percentages since fiscal year 2005 and the expected future fielding rate of projects that are already underway. As will be discussed in Chapter V of this study, lack of funding, loss of interest by the service, and other factors can also "kill" a technology project before it is fielded. The possibility of this kill factor was not addressed in this study.

There are a total of 19 questions in the survey with numerical results on the scale of "1" to "6". Therefore, the sum of the scores for each activity for this questionnaire can range between 19 and 114. It was requested that each JPM provide two interviewees. For reasons set forth in SECNAV 3900.39d and NAVPGSCOLINST 3900, the names of the participants and their JPM are confidential and cannot be legally disclosed. When two interviewees at a given JPM location had different scores, the two scores were averaged. This average score was the data point used in the analysis. When only one interviewee was encountered at a given JPM, his/her scores were used as that JPM office's data point.

Total survey scores ranged from 56.5 to 114. The JPM with 114 points on the survey indicates thereby that they perceive their collaboration with JSTO, as measured by our questionnaire, to be very good.

We plotted each JPM's survey total against: (1) the percentage of historically fielded items from JSTO (from 2005 to 2010); (2) the estimated percentage of future technologies that JSTO will likely field; and (3) the percentage of fielded technologies provided by JSTO, vice a different technology provider. We fitted the data with several regression models including linear, power, exponential, logarithmic, and polynomial models. Each of these models can be useful in describing trends in historical data and then forecasting from the data. We discarded the polynomial model because it included

too many peaks and valleys in the actual curve, for which we had neither sufficient points to get a good fit, nor, more importantly, an underlying theory to explain such a fit.

1. Regression Tools

In order to apply the various regression techniques, we built a table in Microsoft Excel with the relevant survey data, shown in Table 3.

Questionnaire Input data					
Survey Score	Future % From JSTO	Hist. % From JSTO	LN (Survey Score)	LN (Future %)	LN (Historical %)
95.6	36%	46	4.6	-1.012	-0.762
91.5	70	60	4.5	-0.357	-0.511
114.0	75	100.0	4.7	-0.288	0.000
96.8	85.7	85.0	4.6	-0.154	-0.163
83.0	50.0	90.0	4.4	-0.693	-0.105
56.5	6.0	5.0	4.0	-2.813	-2.996
85.0	71.3	50.0	4.4	-0.339	-0.693
106.8	50.0	6.8	4.7	-0.693	-2.686
70.0	16.0	0.1	4.2	-1.833	-6.908

Table 3. Questionnaire Data.

a. Power Regression

$Y = A * X^B$

$LN (Y) = LN (A) + B * LN (X)$

Regress LN (Y) against LN (X) for the Power Regression Trend Line.

b. Exponential Regression

$Y = A * e^{BX}$

$LN (Y) = LN (A) + B * X$

Regress LN (Y) against X for the Exponential Regression Trend Line.

c. Linear Regression

Y = A + B * X

Regress Y against X for the Linear Regression Trend Line.

2. JPM Collaboration Score Vs. Future Fielding Percentage

a. Power Regression

We did three regression models: linear, power, and exponential. The results are in the Table 4.

We assessed each model using the F test and a significance level of 0.10. All three models met the F significance, as seen in Table 4. Since all F values passed, we chose the power model, which has the highest R squared value. This model is the basis for asserting that the hypothesis of this study, namely that there is a positive correlation between the collaboration level of the various JPM offices and the expected percentage of technology transition, is correct. Figure 3 shows the data and the model.

JPM Questionnaire Score vs. Future Fielding			
Regression Type	F Significance	R Squared Value	Coefficient of Correlation
Linear	0.025	0.537	0.733
Power	0.003	0.744	0.863
Exponential	0.007	0.667	0.817

Table 4. Statistics for Future Fielding Percentage.

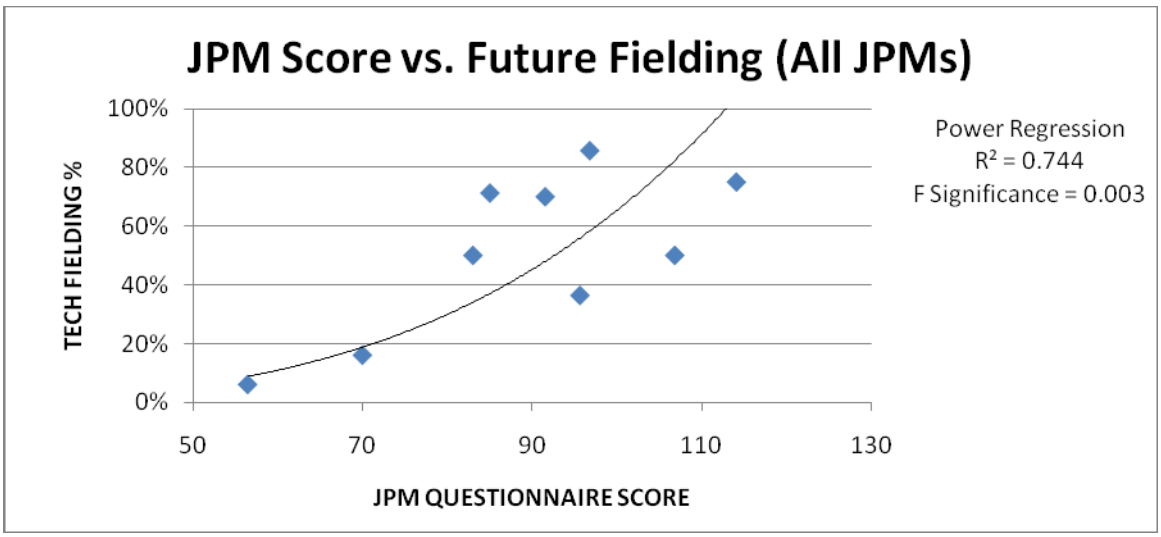

Figure 3. JPM Collaboration Score Vs. Future Fielding Percentage

The results of this Power Regression model are gratifying when compared to the results of the Wahab article on Inter-Firm Technology Transfer discussed in Chapter II of this study. The Wahab study achieved R squared values of 0.541 and 0.459, respectively. In the Wahab study, 0.541 represents the variance in the corporate performance explained by the degree of technology transfer; and 0.459 explains the variance of human resources performance by the degree of technology transfer and the age of the joint venture [7]. If we use those values as comparative industry standards for technology transfer, then our study makes a stronger argument for correlation in regards to technology transfer.

b. Exponential Regression

The Exponential Regression Model also indicates a positive correlation between the two variables, but has a lower R squared. Figure 4 shows the data and the exponential model. To the naked eye, the models in Figures 3 and 4 look identical, but as seen in table 4, the statistics are different.

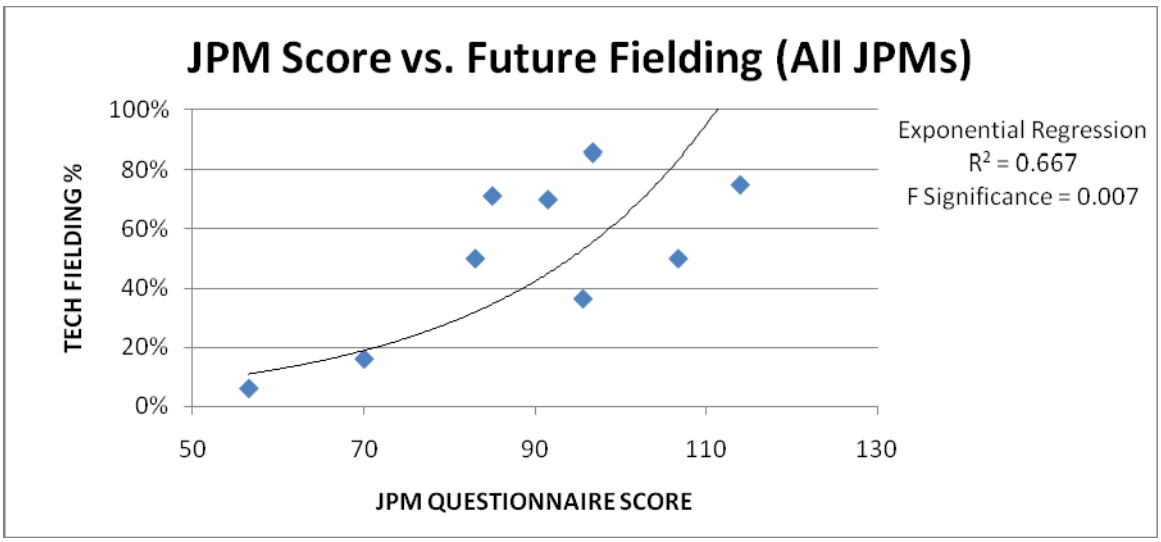

Figure 4. JPM Collaboration Score Vs. Future Fielding Percentage

c. Linear Regression

Linear Regression, as shown in Figure 5, also supports the hypothesis, that as collaboration increases, there is a higher probability of future technology transition.

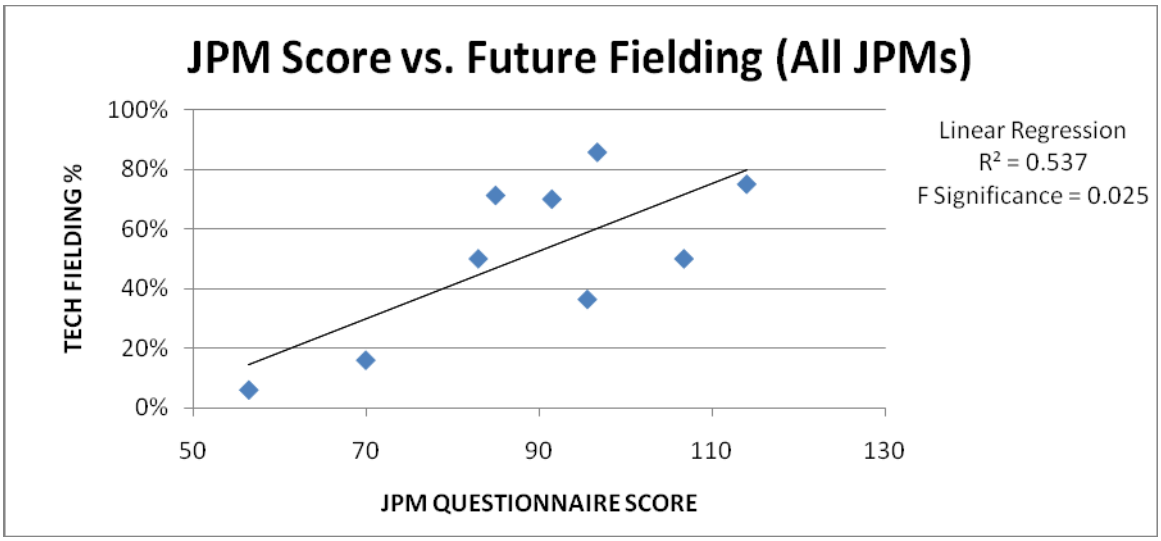

Figure 5. JPM Collaboration Score Vs. Future Fielding Percentage

3. JPM Collaboration Score Vs. Historical Fielding Percentage

a. Power Regression When Compared to Historical Fielding Percentage

In this section, we model the JPM Questionnaire Score vs. the Historical Fielding Percentage.

The models did not meet the F significance, as seen in Table 5. They range from 0.122 to 0.136. They have only moderate correlation. This moderate correlation is also seen in Table 4 in the Correlation Coefficient column. Table 5 shows that the Power Regression, with the R squared value of 0.306, is the highest in this category and therefore the best fit of these three regression models. Figure 6 shows the trend curve of the power regression model. The R squared values are low, but it still shows a moderate correlation between the collaboration score and the historical fielding percentage. Figures 7 and 8 also demonstrate moderate correlation between collaboration level of the various JPM offices and the percentage of historical transitions, with the same general finding that the JPM offices with higher collaboration scores also have an increased probability of having a better historical technology transition.

JPM Questionnaire Score vs. Historical Fielding			
Regression Type	F Significance	R Squared Value	Coefficient of Correlation
Linear	0.136	0.288	0.537
Power	0.122	0.306	0.553
Exponential	0.132	0.293	0.541

Table 5. Statistics for Historical Fielding Percentage.

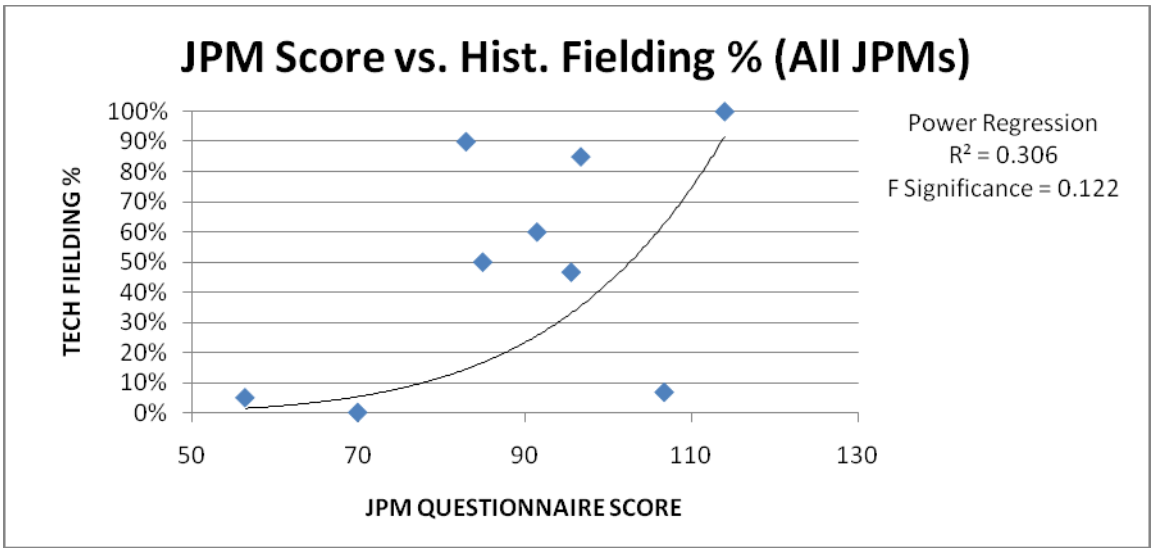

Figure 6. JPM Collaboration Score Vs. Historical Fielding Percentage Utilizing Power Regression

b. Exponential Regression

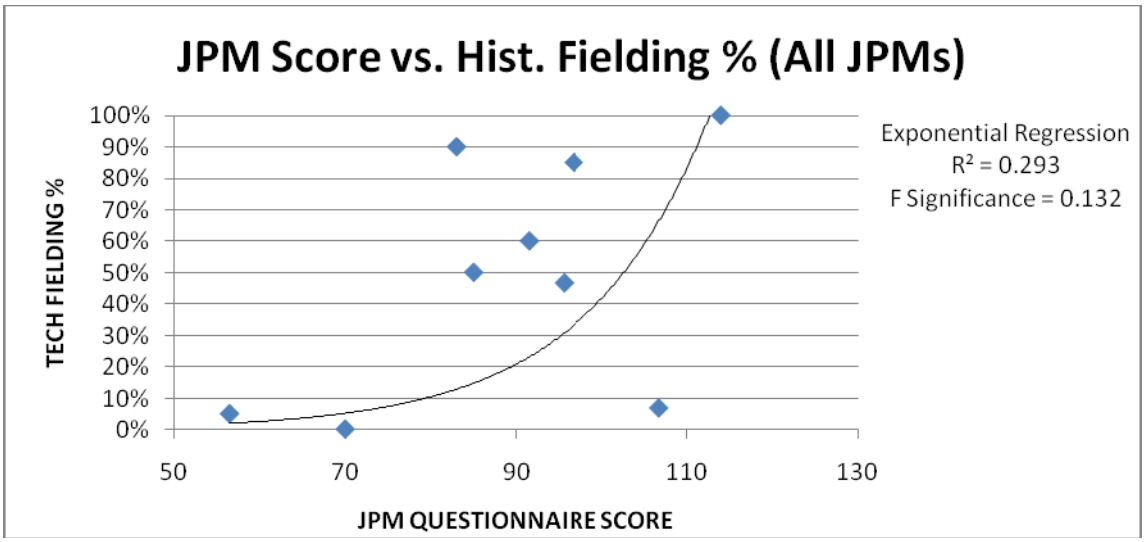

Figure 7. JPM Collaboration Score Vs. Historical Fielding Percentage Utilizing Exponential Regression

c. Linear Regression

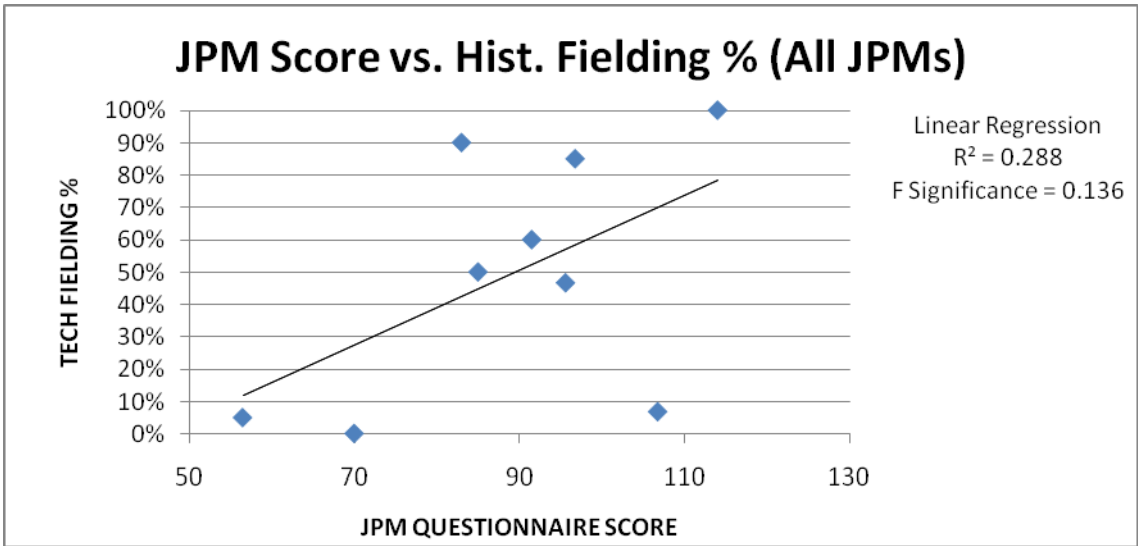

Figure 8. JPM Collaboration Score Vs. Historical Fielding Percentage Utilizing Linear Regression

4. Collaboration Question

We asked respondents one question that cannot be categorized anywhere else.

Question #22: Has the collaboration between JSTO and your program increased/decreased/remained the same in the past 3 years?

Eight of nine JPM offices responded with "increased," while one JPM responded with "remained the same." One respondent who indicated that collaboration increased said, "Collaboration between JSTO and our JPM has increased slightly over the past three years." Another JPM stated, "It has increased by orders of magnitude." Yet another JPM stated, "It has gotten better, but still not good. It's twice as good as before. We are talking more, but are we being listened to?"

In our survey we asked respondents to rate collaboration, but this particular question was asked to give JPEO-CBD management an indication of the collaboration trend over the past three years.

Question# 23: What Percentage of capabilities in your fielded programs were provided by JSTO? (Down to the Incremental Level, where the ”incremental level” or “major release” refers to a requirement that is specified for a level of maturity as per DoD INST. 5200.02. When a requirement for an increment is not an off-the-shelf product, the JPM then requests the S&T community to develop the lowest component of the system being researched in time for increment build and delivery.)

The responses to this question are in Table 6. The respondents provided a historical fielding percentage based on the fielded items from Fiscal Years 2005–2010 provided by JSTO. for the period Fiscal Years 2005-2010. The important result here is that the mean transition percentage is 49.3% with a standard deviation of 38.4%. This means that roughly 50% of all fielded systems come from JSTO. It is important because it refutes one of JPEO-CBD’s main concerns, namely that the technology transition percentage from JSTO was a low 5%.

Note, that JPM #9 was also included in this calculation, even though they did not receive technology from JSTO during Fiscal Years 2005–2010. A 0.1 was assigned to this value in order to permit calculation of the natural Log so that we could develop our regression models

JPM #	Hist. % From JSTO
1	46.7%
2	60.0%
3	100.0%
4	85.0%
5	90.0%
6	5.0%
7	50.0%
8	6.8%
9	0.1%
Mean	49.3%
SD	38.4%

Table 6. Historical Averaged Transition Percentages [From 10]

Question# 24: What percentage of capabilities of projects under your authority and funded by JSTO do you expect to be fielded in the future?

The responses to this question are in Table 7. The respondents estimated a future fielding percentage based on the items currently in various stages of development supported by JSTO, and their anticipated transition successes. The average expectation is for JSTO to continue to provide roughly 50% of the transitioning technologies to JPEO-CBD for the technologies currently being researched. Some JPMs anticipate a higher transition percentage in the future, and other JPMs anticipate a lower JSTO transition percentage. JPM #9, which goes from 0.1% Historical to 16% Future, is an example of the former; JPM #3, which goes from 100% Historical to 75% Future, is an example of the latter.

JPM #	Future % From JSTO
1	36.4%
2	70.0%
3	75.0%
4	85.7%
5	50.0%
6	6.0%
7	71.3%
8	50.0%
9	16.0%
Mean	51.1%
SD	27.4%

Table 7. Future Estimated Transition Percentages [From 10]

C. QUALITATIVE QUESTION DATA

1. Discussion Question

Our questionnaire has several open-ended questions. These questions were asked with no guidance from the interviewer to lead the responses into a specific direction. The interviewer just recorded the responses and asked the interviewees to elaborate on these discussion points from time to time. The responses recorded below represent the raw data only. The analysis and summary with documented recommendations are presented in Chapter V.

Here are the three questions asked in this category along with their qualitative responses:

Question# 14: How is it possible for my organization to better integrate with JSTO?

"As always, communication can be improved. We are not geographically co-located with JSTO, so we rely heavily on e-mail and phone communication. We do get together once a quarter for the TQRs, which is great, but there are so many projects to cover in such a short amount of time for all the JPMs. Access to information from JSTO is hard to access. For example, S&T portions."

"More time to work with JSTO Request for Proposal (RFP), input to RFP which JPM does not have now, and JPM does not sit on selection board. JSTO is integrated into JPM, but not vice versa."

"JSTO doesn't like to release details about early development programs and monthly/quarterly reports coming from principal investigators."

"More meetings."

"Relationships and communications are better at higher levels than at the working level."

"JSTO has a narrow view and not a broad view of the overall problem. JSTO is channeled on the big expensive piece of equipment. JSTO has different philosophies and is not set up to system of systems. JSTO to JPM is a nebulous relationship."

"JSTO needs to share processes like testing events. There needs to be more information/results sharing. TQRs should be disseminated to everyone. JSTO needs more funding in the biological and chemical area, as well as a better funding balance—more 6.1 and 6.2 monies. JSTO is too heavy in 6.3 funds. The more research conducted, the higher the probability of success."

"Inclusion in discussions of where S&T investments are planned prior to the capo's preparing the POM submits."

"Educating the JPM staff on how S&T investments work and the bigger points for moving a S&T effort forward or moving its funding onto an unfunded effort in the cue (when the primary S&T effort fails)."

Question# 22: Has collaboration between JSTO and your program increased/decreased/remained the same in the past 3 years?

Eight of nine JPM offices (88.9%) answered "increased," while one JPM office (11.1%) responded with "remained the same." These statistics were not used in any further analysis.

Question# 25: What, if any, are the barriers which deter collaboration between JSTO and your program, and what are the things that facilitate or enable good collaboration?

Barriers:

"It goes without saying that funding will continue to be a barrier for S&T projects. New technology is generally expected to be close to production ready in order to transition into the acquisition cycle. It can be challenging to align projects from the R&D side to current programs. Acquisition cycles tend to be schedule oriented, and it is hard to insert high-risk projects into a program."

"Too many JPEO taskers, as we had to hire and extra person just to process reports."

"More funding needed in advanced development, which would lead to more transitions. Projects fail due to funding, not technology. JSTO technology has only failed one in sixteen times. Handling of Intellectual Property (IP): (1) sold to one contractor and therefore sole source, which is not what you want; and (2) sold in a non-exclusive manner."

"Communications issues."

"JSTO needs to share transition targets and development environment."

"JSTO's non-accountability!"

"The pieces are not in place for JSTO to do more. JSTO has a different measure of success."

"There have to be open communications between JPEO-CBD, JSTO, and the JPMs."

"The JPM has to be able to talk to combat developers as well as JSTO."

"Timelines deter technology, causing them to transition too early."

"Expectation management deters collaboration."

"You can only push technologies so far."

"Lab vs. Field or PhD. vs. Soldier is not always compatible."

"Failure is required for progress or transition."

"Not anticipating user's need."

"No chemical or biological attacks in recent history. Therefore the threat is not defined, and the emphasis keeps changing."

"JSTO is not funded to properly test in a complicated environment and the new interpretation of the DoD 5000.02 (Milestone B) requires realistic testing."

Enablers:

"Funds will help, both to keep development of high-risk projects going, but also for personnel at JSTO. JSTO has to support many JPMs, which stretches them thin. Good, effective communication can really go a long way. Setting some time aside more than just at the TQRs is necessary for both JSTO and the JPM. Make a more formal forum for sharing information."

"Co-location and co-organization, involving the whole team. Each involved in the other's process of S&T and advanced development."

"Lean Six Sigma project of QDRs and TTAs. Integrated Product Team should meet bi-weekly with JSTO. Develop a Standard Operating Procedure (a formally documented process) for the TQR process."

"Summits improve collaboration"

"If we had more 6.4 and 6.5 monies, then we could leverage more technologies."

a. Other Recorded General Comments

"The following are product kills: (1) Intellectual Property (IP), (2) not being able to manufacture at full scale, (3) surgical implant products, (4) excess cooling requirements, (5) lack of funding, and (6) manufacturing problems."

"JSTO should go into analysis of future capabilities."

"A market survey should be conducted of what technologies are available."

"There is a conflict between JPEO and combat developers. They need to align to the program of record."

"Sometimes there is no benefit from research."

"TTAs define outcomes. They should not be signed for studies and enabling tasks. This causes too much administration. TTA's should be product oriented."

"We need to check for commercial off the shelf products (COTS)."

2. Summary

Both the historical estimated transition percentages and the future estimated transition percentages are approximately 50%, higher than the 5% JPEO-CBD anticipated. That is, of all fielded systems to the warfighter, roughly half contain JSTO technology. We expect no changes, unless JPEO-CBD can make policy changes to improve their collaboration with JSTO.

JPM employees, in anonymity, provided beneficial suggestions in response to Questions #22 and #25 to improve this collaboration, and JPEO-CBD should seriously consider their employees' responses, which provide insight and understanding of the JSTO-JPM relationship. Further conclusions and recommendations regarding these comments are provided in Chapter V.

THIS PAGE INTENTIONALLY LEFT BLANK

V. CONCLUSIONS

A. QUANTITATIVE CONCLUSIONS AND RECOMMENDATIONS

The strength in the JPEO organization, as measured by the questionnaire results, with regard to collaboration between JPMs and JSTO, is very good in the Purpose and Strategy subsystem, mixed in the Lateral Process subsystem, and weak in the Barriers to Collaboration subsytem. In the Lateral Process subsystem, the highest scores were achieved in Social Capital, indicating that JPM employees are familiar with the JSTO organization and know whom their counterparts are. However, in the Collaboration Mechanisms to Improve Technology area (Questions #12, 13, 16, 19, and 20), we recorded some of the lowest scores of this survey. This is an area where management should devote some attention for future improvement.

Purpose and Strategy was the strongest subsystem of the survey. The Resource investment and Felt Need areas scored high, indicating JPM's recognition of the importance of collaboration and an emphasis on wanting to improve collaboration with JSTO. The Strategic Action for Collaboration area scored about average on this survey, indicating improvement might be needed in the emphasis of establishing and addressing goals for collaboration, and considering the interest of other agencies in planning. The Barriers to Collaboration was the lowest scored subsystem.

Results from Questions #7–10 indicate that barriers do still exist in the opinions of the JPM employees. This indicates that some distrust between the organizations still exists and that JSTO is impeding better collaboration. Again, it is up to the management of the JPM organization to interpret their results for this questionnaire, and determine the levels at which corrective actions have to taken to improve in the respective subsystems.

1. Regression Models

This study successfully used three regression types, namely Power Regression, Exponential Regression, and Linear regression, to give statistical support to our hypothesis. Each regression type was utilized to try to correlate the JPM Questionnaire score to the historical and future fielding percentage. We built these models and they are

moderately good statistics. The best of the three results was achieved with the Power Regression model when comparing the JPM Questionnaire score to the future fielding percentage. The results from this regression are a value of 0.003 for F significance, a value of 0.744 for R squared, and a value of 0.863 for the Coefficient of Correlation. This is the best result of the six accepted models. This result and the result for the other 5 models make our hypothesis statistically significant. All six of these models are discussed in detail in Chapter IV.

B. QUALITATIVE CONCLUSIONS AND RECOMMENDATIONS

In this study, the hypothesis that the perception of collaboration between two organizations is correlated with the resulting anticipation of future technology transition has statistical support. Therefore, JPEO-CBD should strive to improve the collaboration between their JPMs and their respective JSTO counterparts. We anticipate this would lead to better working relationships, more trust, and more technology transitions for both organizations.

How can JPEO better encourage this collaboration and break down barriers to collaboration? In responses to our questions, interviewees provided insights on how to start improving this collaboration.

Some responses from the nine different JPM offices occurred more than once. For brevity, these recommendations are listed below only once.

Co-location and Co-organization of JPM and their perspective JSTO counterparts. Among those interviewed, there is a perceived advantage to co-location. Of all JPM offices, only JPM-TMTI is co-located with its respective JSTO, and they maxed out all possible points on the JPM Questionnaire. They also estimated that 75% of their technologies would be fielded in the future. In their opinion, they have perfect collaboration with their JSTO counterparts, and they think that co-location is the key factor to their success. They specifically responded that it is a strong advantage to sit across the table with your JSTO counterpart at all relevant meetings, and that this proximity allows workers from both offices to have a better professional relationship, and

permits them to align their organizations' priorities. There are also virtually no communication breakdowns, since they know their counterparts well and settle many issues face to face.

Without colocation, JPM employees rely largely on communications with JSTO by telephone and e-mail. It was also noted in some responses, but not with TMTI, that a few JPM employees do not always know their counterpart at JSTO. This is definitely a barrier to collaboration.

Wider dissemination of TQRs and other JSTO information. A recurring, major point of contention among the interviewees is the need for wider dissemination of TQRs and other JSTO information. Some of the interviewees noted that the TQRs are not disseminated to all employees, and doing this would add value. Furthermore, it was the opinion of some JPM employees that JSTO does not like to release details about either early development programs, or the monthly and quarterly reviews coming from CBD technology companies (which are called principal investigators or combat developers). Therefore, JPM interviewees felt left out of the loop, and wanted to be privy to the same information that JSTO has. Additionally, TQRs cover too many projects in too short a time and are tailored to address JSTO's concerns, and not JPM'.

Another related point brought up during the discussions was that sometimes JPEO-CBD asks JPM questions to which only JSTO has the answer. This makes it difficult for a JPM to answer JPEO demands.

One interviewee noted that JSTO does not share test reports. In the summary opinion of many interviewees, JSTO is playing a kind of "technology poker," where JPM is left guessing which cards JSTO holds. If JSTO could reverse this trend and openly share its information, then it would significantly improve collaboration between JSTO and the JPMs.

Philosophies between JSTO and JPM should be better aligned. Some interviewees stated that another barrier to collaboration is that JSTO and JPM have different philosophies. Specific comments included "JSTO is integrated into JPM, but

not vice versa," "JSTO has a narrow view, but not a broad view of the overall problem," and "JSTO is channeled on the big, expensive piece of equipment."

Funding. It was the opinion of some interviewees that better understanding of how JSTO prioritizes its funding will improve collaboration. JPM interviewees also wanted a better understanding of JSTO's internal process for funding. Several others indicated that more funds are needed to achieve more transitions. One interviewee said "projects fail due to lack of funding, not due to a lack of technology."

One interviewee said that JSTO is very heavy in 6.3 funds, but doesn't have enough 6.1 and 6.2 funds. If the funding ratios were changed to favor 6.1 and 6.2 funds, more advanced research would take place, thereby increasing the probability of 6.4 funds maturing the technology.

JSTO should have accountability to JPEO. It was the opinion of several interviewees that JSTO has absolutely no accountability to their JPM counterpart, and therefore JPMs couldn't influence JSTO to execute the JPMs' priorities.

Establish JPM employee temporary internships at JSTO. Another idea of a JPM employee was to send JPM employees to their respective JSTO office to participate in an internship to learn the inner workings and processes of their JSTO counterparts.

Expectation management should not drive technology projects. One interviewee was of the opinion that technologies can only be pushed so far. In other words, technologies mature and then they have reached their limit. Sometimes failure is required to make progress in a certain area of technology. And sometimes there is no benefit for a technology project whatsoever. There is a lack of understanding between the Ph.D. who develops the technology and the soldier in the field who uses it. PhDs have a research mentality and work in laboratory conditions, while the warfigher has a combat mentality and works in real word conditions, which are very different from the laboratory.

The term "product kill," as used by JPM employees, refers to funded technology projects, which, for whatever reasons, do not transition. The following are product kills unrelated to whether the technology works or not: Intellectual Property handling, not

manufacturing on a large enough scale, surgical implant products, excess cooling requirements due to a lack of refrigeration in the field, lack of funding, end user no longer supports the product, and manufacturing problems.

Increase the number of summits between JPM and JSTO. One interviewee suggested increasing the number of summits between JPM and JSTO in order to increase collaboration.

Improve TTA process. Some interviewees criticized the current TTA process and felt that it could and should be improved. TTAs in their current form define the outcomes, but the outcome could be different than the one initially defined. Furthermore, TTAs require too much administration and should be product oriented, rather than for studies and enabling tasks. JPM should hire personnel to work S&T issues. This has already occurred at some, but not at all, JPM offices

Give JPM more time to work with JSTO RFP. Some interviewees said that JPM does not have input into the RFPs that JSTO sends out to industry. JPMs do sit on the selection board that chooses the winning proposal but they feel that they need inputs to the RFP to help shape and guide the research and thereby increase the chances of successful technology transition.

Improve communications between JPM and JSTO and within JPM itself. Some interviewees noted that there is a lack of communication both between JPM and JSTO, as well as within their own JPM office. Top management at JPM has, in many cases, prioritized improving the working relationship between its office and JSTO. The trend is that it is improving. Question # 23 directly asks whether this trend is improving, to which eight of nine JPMs responded that it is improving, while only one of nine responded that their collaboration with JSTO has remained the same in the past three years. However, it was noted in the discussions that communication at higher levels of the JPM with JSTO is better than communications at lower levels. One interviewee also noted that team leaders need to be better briefed and that there exists a lack of understanding of how JPM investments and trigger points for S&T work.

Better handling of Intellectual Property (IP). One interviewee was of the opinion that IP was, improperly, repeatedly being sold to a single contractor, creating a sole source, or monopoly, situation. The lack of competition likely drive up acquisition costs.

The chemical and biological threat has to be better defined. Currently, the chemical and biological threat is not well defined, nor is its definition stable. Its emphasis seems to continuously change.

JSTO needs to better anticipate war fighter's needs. One interviewee felt that JSTO is not anticipating the war fighter's needs. If JSTO invests in a technology product that the warfighter no longer supports, then they are left hanging with funds spent on a useless technology. Better anticipation by JSTO of end user needs would lead to its funds being better spent.

If JPEO makes these suggested changes, it would improve future collaboration questionnaire scores, thereby improving perceived collaboration between the JPMs and JSTO. This may lead to achieving higher future technology transition percentages.

C. VALIDATION OF THIS STUDY

This study provides an improvement to the Wahab study as an industry standard for collaboration, and it "raises the bar" on those standards. Some comparisons between our work and Wahab et al. follow.

- The principal survey vehicle for the Wahab, as well as our study, was the questionnaire.
- Despite intensive follow-up, out of 850 possible interviewees, only 145, or 17%, returned the Wahab questionnaire; this number of respondents was considered adequate for the study. As a comparison, we achieved 100% participation of all nine JPMs by scheduling site visits and administering our questionnaire in person.

- The Wahab study achieved R squared values of 0.541 and 0.459 as a predictor of joint venture age [7]. As shown in Chapter IV of this study, our R squared values are higher in support of our hypothesis.
- The Wahab Study used a 10 point Likert scale. As a comparison, our JPEO-CBD study uses a 6-point Likert Scale.
- Here are the statistics for Wahab [F(2,125) = 53.186, p = .0001] and [F(2,125) = 73.710, p = .0001]. Both Wahab's models and ours are statistically significant.

D. RECOMMENDATIONS FOR FUTURE RESEARCH

This study has shown a positive correlation between perceived collaboration and technology transition results, as well as between perceived collaboration and technology transition expectations. This finding suggests the value of further research, using other pairs of organizations that work together and depend on each other for successful results. Future studies on this topic could experiment with more extensive surveys to improve the modeling statistics. Another goal of an extended survey should be to develop a type of standardized collaboration survey which could help to predict and improve organizational success within itself and while working hand in hand with other organizations on which it depends.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A

JPM QUESTIONNAIRE

JPM OFFICE:	

For each question below, circle the number to the right that best fits your opinion on the importance of the issue, or write your answer in the space provided. Use the scale above to match your opinion.

Question	Scale of Importance					
	Strongly Disagree					Strongly Agree
1) We have clearly established goals for inter-organizational collaboration with JSTO (Strategic Collaboration)	1	2	3	4	5	6
2) Leaders of my organization work productively with those of JSTO to improve our collaboration (Strategic Collaboration)	1	2	3	4	5	6
3) Our organization is willing to improve and invest how it does business with respect to a better relationship and transition strategy with JSTO (Resource Investment)	1	2	3	4	5	6
4) My organization commits adequate human and financial resources to improve collaboration and common practices with JSTO (Resource Investment)	1	2	3	4	5	6
5) Members of my organization know who to contact at JSTO for information or decisions (Social Capital)	1	2	3	4	5	6
6) Members of my organization take the initiative to build relationships with their counterparts in JSTO (Social Capital)	1	2	3	4	5	6
7) My organization's unique requirements make collaboration with JSTO difficult (Barrier to Collaboration)	1	2	3	4	5	6

8) Conflicting organizational policies make collaboration with JSTO difficult (Barrier to Collaboration)	1	2	3	4	5	6
9) A history of competition and conflict affects our capability with JSTO (Barrier to Collaboration)	1	2	3	4	5	6
10) People in my organization tend to be suspicious and distrustful of their counterparts in JSTO (Barrier to Collaboration)	1	2	3	4	5	6
11) My organization has adequate and appropriate structures (e.g., liaison roles, processes) for effective collaboration with JSTO	1	2	3	4	5	6
12) My organization has a history of working well with JSTO	1	2	3	4	5	6
13) It is possible for my organization to better integrate with JSTO	1	2	3	4	5	6
14) How is it possible for my organization to better integrate with JSTO?						

Question	Never					Always
15) JSTO's organization's policies and procedures allow it to be responsive to the requirements of my JPM office. (Structural Flexibility)	1	2	3	4	5	6
16) Our organization articulates requirements to JSTO.	1	2	3	4	5	6
17) My organization gives members appropriate authority to collaborate with JSTO. (Collaboration Structures)	1	2	3	4	5	6
18) To what extent does accomplishing your organization's mission require working with an S&T organization like JSTO?	1	2	3	4	5	6
19) To what extent does your organization play an active or voting	1	2	3	4	5	6

role in JSTO's research program?						
Question	Poor					Excellent
20) How would you rate the overall success of your organization in collaborating with JSTO?	1	2	3	4	5	6
Open Ended Questions						
21) What is your historical fielding track record?						
22) Has collaboration between JSTO and your program increased/decreased/remained the same in the past 3 years? Explain.						
23) What Percentage of capabilities in your fielded programs were provided by JSTO? (Down to the Incremental Level)						

24) What percentage of capabilities of projects under your authority and funded by JSTO do you expect to be fielded in the future?
25) What, if any, are the barriers which deter collaboration between JSTO and your program, and what are the things that facilitate or enable good collaboration?

APPENDIX B

QUESTIONNAIRE STATISTICS	RANGE (1-6)			
QUESTION	MEAN	SD	MODE	VAR
1) We have clearly established goals for inter-organizational collaboration with JSTO.	4.4	1.1	5	1.2
2) Leaders of my organization work productively with those of JSTO to improve our collaborations.	5.1	1.0	6	1.1
3) Our organization is willing to improve and invest how it does business with respect to a better relationship and transition strategy with JSTO.	5.8	0.3	6	0.1
4) My organization commits adequate human and financial resources to improve collaboration and common practices with JSTO.	5.3	0.8	6	0.6
5) Members of my organization know who to contact at JSTO for information or decisions.	5.2	0.6	5	0.4
6) Members of my organization take the initiative to build relationships with their counterparts in JSTO.	5.7	0.7	6	0.5
7) My organization's unique requirements make collaboration with JSTO difficult.	5.0**	1.6	6	2.6
8) Conflicting organizational policies make collaboration with JSTO difficult.	4.3**	1.6	6	2.7
9) A history of competition and conflict affects our capability with JSTO.	4.5**	1.5	6	2.3
10) People in my organization tend to be suspicious and distrustful of their counterparts in JSTO.	4.1**	1.8	6	3.3
11) My organization has adequate and appropriate structures (e.g., liaison roles, processes) for effective collaboration with JSTO.	4.5	1.4	6	2.0

12) My organization has a history of working well with JSTO.	4.4	1.5	6	2.3
13) It is possible for my organization to better integrate with JSTO.	2.6**	1.7	2	3.0
15) JSTO's organization's policies and procedures allow it to be responsive to the requirements of my JPM office.	4.3	1.3	5	1.6
16) Our organization articulates requirements to JSTO.	4.8	1.2	6	1.4
17) My organization gives members appropriate authority to collaborate with JSTO	5.4	0.6	5	0.4
18) To what extent does accomplishing your organization's mission require working with an S&T organization like JSTO?	5.3	1.2	6	1.4
19) To what extent does your organization play an active or voting role in JSTO's research program?	4.0	1.4	4	2.1
20) How would you rate the overall success of your organization in collaborating with JSTO?	4.3	1.4	4	1.8

** Indicates Recoded Questions

The means are based on response choices ranging from 1-6 with 1 being weak or negative on the item, and 6 being strong or positive on the item. Questions 7-10 and 13 were recoded in order to compare results and build accurate statistical relationships.

APPENDIX C

A. JOINT PROJECT MANAGER BIOLOGICAL DEFENSE (JPM BD)

JPM BD provides defensive equipment and technology to detect and identify biological threats in near real-time, and collects and assimilates data for commanders who require an understanding of the biological threat situation in their areas of operation. The biological defensive systems are characterized into groups called SENSE, SHIELD, and SUSTAIN, and meet the needs of the U.S. forces to warn personnel of imminent hazards (pre-attack) and aid in the treatment of personnel exposed to a biological hazard (post-attack) [4]. SENSE, SHIELD, and SUSTAIN are described, by operational attributes, below.

(1) SENSE

> The capability to continually provide the information about the CBRN situation at a time and place by detecting, identifying, and quantifying CBRN hazards in air, water, on land, on personnel, equipment of facilities. This capability includes detecting, identifying, and quantifying those CBRN hazards in all physical states (solid liquid, gas). [4, p. 1].

(2) SHIELD

> The capability to shield the force from harm caused by CBRN hazards by preventing or reducing individual and collective exposures, applying prophylaxis to prevent or mitigate negative physiological effects, and protecting critical equipment. [4, p. 1]

(3) SUSTAIN

> The ability to conduct decontamination and medical actions that enable the quick restoration of combat power, maintain/recover essential functions that are free from the effects of CBRN hazards, and facilitate the return to pre-incident operational capability as soon as possible. [4, p. 1]

For more information on SENSE, SHIELD, and SUSTAIN visit the JRO CBRN website at https://jro-cbrnd.cbiac.apgea.army.mil/SSSS.aspx.

B. JOINT PROJECT MANAGER NUCLEAR BIOLOGICAL CHEMICAL CONTAMINATION AVOIDANCE (JPM NBC CA)

The JPM NBC CA provides advanced detection, warning and identification of contamination of personnel and equipment; it monitors the presence of chemical warfare agent contamination. JPM NBC CA also provides the capability to detect and measure nuclear radiation from fallout and radioisotopes [5].

C. JOINT PROJECT MANAGER CHEMICAL BIOLOGICAL MEDICAL SYSTEMS (JPM CBMS)

JPM CBMS centrally manages and employs government and commercial pharmaceutical development best practices to oversee the Joint Vaccine Acquisition Program and Medical Identification and Treatment Systems. JPM CBMS provides safe, effective, and affordable CBRN medical countermeasures to the warfighter. This is accomplished by CBMS' expertise in Federal Drug Administration (FDA) regulatory compliance, product development, full life-cycle management, and partnering with other governmental agencies and nations [5].

D. JOINT PROJECT MANAGER COLLECTIVE PROTECTION (JPM CP)

JPM CP provides the warfighter with clean, breathable, toxic-free air and prevents particulates, liquids, and vapor contaminates from seeping into protected areas. This affords the warfighter the ability to sustain mission profiles without the encumbrance of individual protection equipment [5].

E. JOINT PROJECT MANAGER DECONTAMINATION (JPM DECON)

JPM DECON uses an evolutionary acquisition strategy to support the warfighter, providing a constant insertion of enhanced capabilities. In addition, JPM-DECON offers a family of systems inventory, consisting of decontaminant and applicator components that can be tailored into a desired configuration, and are specifically adapted to work together to decontaminate current and emerging threats. By tailoring the

Decontamination Family of Systems to fit the requirement, the warfighter is provided with enhanced decontamination capability that maximizes throughput and reduces the logistics footprint [5].

F. JOINT PROJECTS MANAGER GUARDIAN (JPM GUARDIAN)

JPM GUARDIAN provides conventional and non-conventional detection, analysis, communications, protection, response and survey capabilities in support of installation force protection, civil support teams, reserve reconnaissance and decontamination platoons, tactical units and civil authorities [5].

G. JOINT PROJECTS MANAGER INDIVIDUAL PROTECTION (JPM IP)

JPM IP provides our Nation's warfighters Individual Protection Equipment (IPE) required to effectively conduct combat operations in a chemical-biological environment. JPM IP pursues respiratory protection technologies that provide greater protection, reduces breathing resistance and ensures compatibility with current and future combat weapon systems. JPM IP also develops and procures suit technologies that will result in lighter, less cumbersome, but equally protective next generation suits for ground and aviation personnel [5].

H. JOINT PROJECTS MANAGER INFORMATION SYSTEMS (JPM IS)

JPM IS supports the warfighter in the battle space by providing a modern joint services information system enterprise architecture and applications that shape the battle space against Chemical, Biological, Radiological, and Nuclear threats [5].

I. JOINT PROJECTS MANAGER TRANSITIONAL MEDICAL TECHNOLOGY (JPM TMTI)

JPM TMTI's mission is to protect the warfighter from conventional or genetically engineered biological threats, known or emerging, by accelerating the seamless discovery and development of broad-spectrum medical countermeasures through the use of novel technology platforms and innovative management approaches. Technological advances in genetic manipulation, biotechnology and advanced biochemistry increase the possibility that future state or non-state adversaries could develop and deploy new genetically

engineered biological threats for which current countermeasures would be ineffective and the time needed to develop defense would be insufficient [5].

This is a basic overview of the individual JPM responsibilities. For more information, visit the JPEO-CBD website at www.jpeocbd.osd.mil.

APPENDIX D

INTER-ORGANIZATIONAL COLLABORATION SURVEY

Susan Page Hocevar, Erik Jansen & Gail Fann Thomas

This survey contains proprietary information and cannot be included with this thesis. For information concerning it you may contact Professor Susan P. Hocevar at

Graduate School of Business and Public Policy
555 Dyer Road, RM 211
Naval Postgraduate School
Monterey, CA 93943

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

[1] S. P. Hocevar, G.F. Thomas, and E. Jansen, "Interagency collaboration survey (ICS)," Naval Postgraduate School, Monterey, CA.

[2] J. Galbraith, *Designing Dynamic Organization: A Hands-on Guide for Leaders at All Levels*. Saranac Lake, NY, USA: AMACOM, 2001.

[3] Annual Department of Defense Chemical, Biological, Radiological, and Nuclear Defense Program Report to Congress available at http://www.defense.gov/pubs/chembio02012000.pdf

[4] Joint Requirements Office for Chemical Biological Radiological Nuclear Defense Website, "Joint CBRN Defense Functional Concept-Operational Attributes," https://jro-cbrnd.cbiac.apgea.army.mil/SSSS.aspx

[5] Joint Program Executive Office-Chemical Biological Defense Staff, *Full-Spectrum Chemical Biological Defense Capability.* Manassas, VA: Author.

[6] E. Jansen, S. P. Hocevar, R. G. Rendon, G. F. Thomas, "Interorganizational collaborative capacity: development of a database to refine instrumentation and explore patterns," NPS-AM-08-148, November 2008.*ies*, 2009.

[7] S. A. Wahab, H. Abdullah, J. Uli, R. C. Rose, "Age of joint venture, inter-firm technology transfer and local firms' performance," *International Journal of Business and Management*, vol. 5, no. 3, pp. 89–100, March 2010.

[8] United States Navy, Human Research Protection Program, 5200 SECNAV 3900.39d, November 2006.

[9] United States Navy, Human Research Protection Program, NAVPGSCOLINST 3900.4A, March 2010.

[10] Nano Science and Technology Institute website, "DTRA / JSTO," "http://www.nsti.org/Nanotech2008/sponsors.html?id=409

THI PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California

3. Kerry DeMarco
   Joint Program Executive Office for Chemical and Biological Defense
   Falls Church, Virginia