Maintaining the U.S. Army Research, Development and Engineering Command Prototype Integration Facilities

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Abstract

It is well recognized that the U.S. Army Research, Development and Engineering Command (RDECOM) Prototype Integration Facilities (PIFs) provide an unmatched and critical capability, supporting RDECOM's overarching science and technology (S&T) strategic goal of transitioning technology to the warfighter. Since their inception they have provided a rapid method to field urgently needed products directly to the warfighter and played a vital role in bridging the gap between S&T and the user community. They provide the agility necessary to rapidly upgrade current systems to counter urgent threats and to develop, apply and evaluate leap-ahead technology for future systems.

As fiscal resources become increasingly constrained in this new era of reduced defense budgets and loss of Overseas Contingency Operations (OCO) funding, one can assume that the collective prototyping and integration capacity within RDECOM may become unsustainable. These PIFs are largely funded through customer reimbursable funding, much of which has been resourced through OCO funding for the last decade. The changing fiscal environment may require a rightsizing of PIF capacity or novel new opportunities to leverage their unique capabilities. Given the right Army and RDECOM management and budget support, all of the PIF managers surveyed strongly felt that their facilities can play a larger role in tightening the linkages between RDECOM's S&T efforts and the Army's materiel acquisition community.

Chapter 1 – Introduction

The final report of the 2012 Army Science Board (ASB) study on Army science and technology (S&T) recommended that S&T prototyping and integration capabilities be used as a method for bridging S&T to the acquisition community (U.S. Army Science Board, 2013). Over the preceding decade at war, the Prototype Integration Facilities (PIFs) validated much of the ASB's study by leveraging ongoing S&T programs to deliver rapid capability in response to urgent needs via Joint Urgent Operational Needs and Rapid Equipping Force requirements. New PIF S&T bridging mechanisms could take several different paths. Some of these paths represent opportunities that have yet to be fully explored. These include meeting the goals of the Weapon Systems Acquisition Reform Act of 2009 (WSARA), building Small Business Innovation Research (SBIR) contractor prototypes, providing new manufacturing technologies to support depots and industry, or by developing prototypes to support advanced S&T concept development.

This paper documents the perspectives and thoughts of senior government civilian subject matter experts who work within the U.S. Army Research, Development and Engineering Command (RDECOM) PIFs to identify some of the PIF strengths, weaknesses, opportunities, and threats. These opinions were then used to help assess the impact that the anticipated Department of Defense (DoD) budget decreases will have on the facilities that currently depend on customer reimbursable funding and have grown in capacity to support the last decade of war. Since the September 11, 2001, terrorist attacks, the DoD has been engaged in domestic and overseas military operations in support of Overseas Contingency Operations (OCO), and the PIFs have played a major role in supporting these operations by rapidly integrating engineered solutions in response to warfighter/acquisition customer requirements. It is generally understood

that the DoD budget will decline in the future and support for Operation Enduring Freedom (OEF) will be significantly reduced or terminated. This will have a major impact on the RDECOM PIFs which are primarily supported through OCO-funded customer-reimbursable programs.

Since the military drawdown in Iraq, the PIFs have already seen a reduction in customer funding, which will continue with the drawdown in Afghanistan during 2014 (see PIF FY11–FY13 Customer and Funding Data in Chapter 4). The amendment to the President's fiscal year 2014 (FY14) budget includes $79.4 billion for OCO to support OEF (U.S. Department of Defense, Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer, 2013). If we look at the OCO funding levels from FY08 through FY143 (as shown in Figure 1), we see a general decrease in OCO funding: in FY08 the amount was $187 billion; in FY09, $146 billion; FY10, $162 billion; FY11, $159 billion; FY12, $115 billion; and FY13, $87 billion; FY14, $80 billion. DoD plans to continue requesting OCO funds for several more years, even as combat operations in Afghanistan come to a close, to reset the equipment retrograded from Afghanistan rather than support to Urgent Needs from warfighters, which has been a key source of PIF funding.

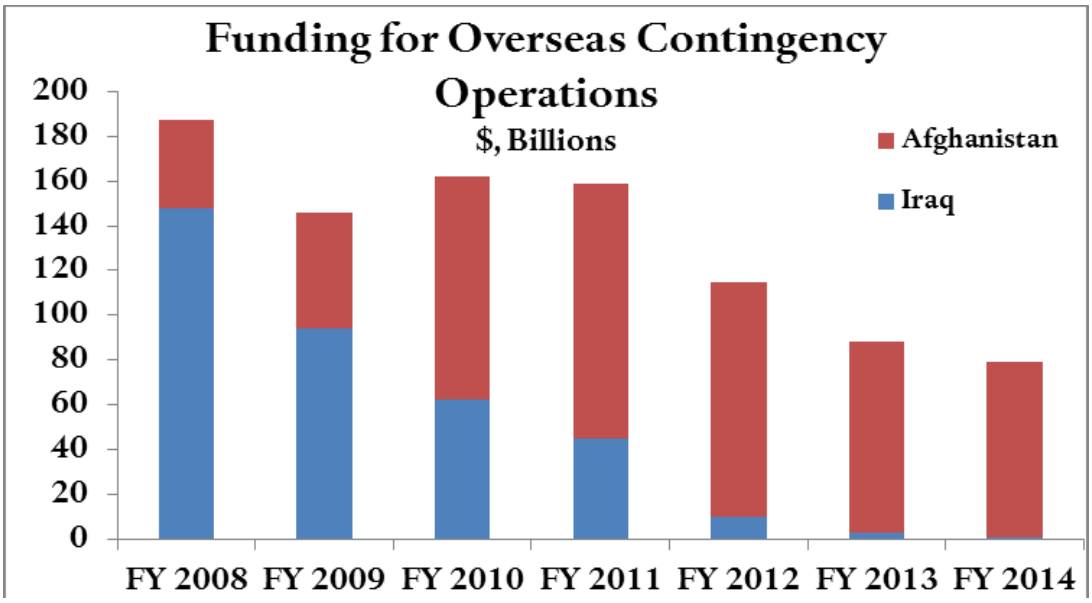


Figure 1 – OCO Funding by Military Operation (Source: DoD)

(Note: FY 2014 is a funding request)

For all of RDECOM's PIFs, reimbursable and supplemental funding has increased significantly during Operation Iraqi Freedom and OEF. However, when the war ends and supplemental funds are discontinued, PIF funding will decrease and the focus will shift from quick-reaction customer work back to supporting traditional mission-technology base programs. Sudden customer funding cuts and an unstable DoD budget could damage the critical piece that the PIFs provide in the defense industrial base. The combined potential cuts in customer funding could be so large the PIFs may see reductions, delays, and cancellations in work orders. These reductions have begun this year and are anticipated into the next fiscal year and beyond. In response, RDECOM will need to manage the existing funded PIF workload to mitigate harmful effects on PIF capabilities and the workforce.

Plans need to be made now in anticipation of this funding decrease and shift. RDECOM must keep these facilities warm to be able to quickly surge for the next conflict and to continue

to develop and advance state-of-the-art technology for future systems. Strategy initiatives are needed to mitigate the impact of this anticipated funding decrease and to maintain and even advance PIF capabilities throughout RDECOM. PIFs are currently self-sustaining, with 85–100% funded directly by customers (Quinn-Doggett, 2008).

Problem Statement

As fiscal resources become increasingly constrained in this new era of reduced defense budgets and loss of OCO funding, will the collective prototyping and integration capacity within RDECOM be unsustainable?

Purpose of This Study

This paper assesses the impact that anticipated funding decreases will have on the PIFs and identify potential new PIF opportunities. Opportunities are based on the key aspects of the PIFs' ability to provide near-term insertion of technologies directly to theater operations, far-term insertion of technologies to programs of record, and their ability to support RDECOM's S&T mission. This study asked the PIF managers questions about the current PIF functions listed below, to gain insights about workload trends over the past 5 years, and asked their opinions on future opportunities and current operations (Rogers, 2013).

Current PIF functions:

- Develop competitive prototypes in accordance with the Weapon Systems Acquisition Reform Act
- Integrate solutions to address "rapid response" customer requirements
- Develop S&T prototypes to support Advanced Concept Development
- Provide program manager support
- Perform temporary manufacturing

- Perform reverse engineering
- Perform conceptual modeling and animation
- Develop training devices/aids/software applications (apps)
- Develop technical data packages

Background

The PIFs are the essence of RDECOM, serving a vital role in bridging the gap between S&T and the user community (U.S. RDECOM Public Affairs Office, 2014). They provide the agility necessary to rapidly upgrade current systems to counter urgent, asymmetric threats on the battlefield, as well as the agility to develop, apply, and evaluate leap-ahead technology for future combat systems. RDECOM's PIFs provide high fidelity prototypes for concept development and system evaluations, risk reduction, and manufacturing optimization (U.S. Army Science Board, 2013). RDECOM's PIFs support current operations as well as their parent organizations and associated Program Executive Offices (PEOs), program managers (PMs) and Life Cycle Management Commands (LCMCs; U.S. Army RDECOM Public Affairs Office, 2014). As the war winds down, with its attendant budget reductions and operational changes, RDECOM PIFs will need to leverage each other and adapt to and develop new mission areas. This paper focuses on identifying PIF strengths and opportunities in light of the anticipated funding decreases.

During the past 10 years of war, S&T has become a priority to address the current threat. The PIFs provide a method to bridge the technology chasm from the laboratory to the field (as illustrated in Figure 2), but as PoR reimbursable and supplemental funding shrinks, can all the PIFs survive the shift from a quick-reaction mission to supporting a traditional mission-technology base program? Promoting and expanding PIF capabilities to validate engineered solutions during design and development with hardware, performing WSARA performance

assessments throughout the life cycle, investigating new manufacturing technologies, developing competitive prototypes, and integrating engineered solutions rapidly in response to warfighter/acquisition customer requirements are all keys to bridging the chasm. WSARA recommends conducting competitive prototyping early in the acquisition process to help define technical risk and anticipate cost drivers for desired capability. Key elements of WSARA 2009 include

- Competitive prototyping
- Dual-sourcing
- Unbundling of contracts
- Funding of next-generation prototype systems or subsystems
- Use of modular, open architectures to enable competition for upgrades
- Use of build-to-print approaches to enable production through multiple sources
- Acquisition of complete technical data packages
- Periodic competitions for subsystem upgrades
- Licensing of additional suppliers
- Periodic system or program reviews to address long-term competitive effects of program decisions

RDECOM leadership is interested in expanding the PIFs' roles in several of these areas, including government competitive prototyping, as well as developing a strategy where PM/S&T/industry teams can work in collaboration to reduce PEO/PM technical, schedule, cost, and performance risks and to support manufacturing technology efforts.

Figure 2 shows that S&T can deliver technology only at Technology Readiness Level (TRL) 6, but to bridge S&T to a program of record (PoR) you need to prototype a technology to a TRL 7 (see Figure 6). Adapted from U.S. Army Science Board, 2013, p. 43. Distribution Statement A: Approved for public release; distribution is unlimited.

Figure 2 – S&T-to-Acquisition Bridge Depiction

One major benefit to government involvement in these efforts is the government's ability to maintain ownership of technical data for use throughout the acquisition life cycle. RDECOM leadership is also interested in investigating the concept of a new, mobile, expeditionary PIF that can be scalable and tailored to missions, with design, engineering, and fabrication capabilities, as well as reach-back capabilities to the RDEC PIFs to support rapid equipping of the force and special operation forces.

RDECOM Prototyping Enterprise

PIF capabilities are unique at each RDECOM Center (RDEC). They are aligned with core RDEC mission areas and are customer focused (see Appendix C for RDECOM RDEC

Missions). Once technology solutions have matured, they enter an advanced development stage and transition to one of RDECOM's six research centers (see Figure 3). The centers cover all areas, with research in lethality, Soldier systems, ground vehicles, chemical-biological, aviation and missile, and communications-electronics. Researchers and engineers work with PEOs and PMs to move technology solutions to the engineering and production phase (RDECOM, 2013a).

Adapted from RDECOM, 2013a, p. 19. Cleared for public release by the RDECOM Public Affairs Office.

Figure 3 – RDECOM Organization Chart

The U.S. Army Armament Research, Development and Engineering Center (ARDEC) PIF, part of the Materials, Manufacturing and Prototype Technology Division, focuses on maturing manufacturing readiness by developing, demonstrating, and transitioning affordable manufacturing processes. The ARDEC PIF also conducts rapid response prototyping in support of ARDEC's mission of providing innovative armaments solutions to the warfighter (see Figure 4). ARDEC's PIF contains a pilot manufacturing facility that provides the capabilities to

synthesize, characterize, and consolidate nano-materials into functional materials on a pilot scale. This PIF can fabricate up to one kilogram an hour of nano-scale powder of virtually any metal or oxide/non-oxide ceramic (the largest capability in DoD). It also can rapidly produce prototypes very close to the final (net) shape, reducing the need for surface finishing using bulk nano-structured materials. This ARDEC PIF is also unique because of its ability to work with energetic materials (explosives, gun propellants, pyrotechnic) for both munitions and missile applications (U.S. Army RDECOM, 2013b, 2013e).

The Aviation and Missile Research, Development and Engineering Center (AMRDEC) PIF focuses on rapidly equipping the warfighter in support of current operations, prototype development, modifications and upgrades, sustainment, and bridging technology gaps in DoD requirements (see Figure 4). The product offerings include design solutions, mechanical piece parts, circuit card assemblies, cable harnesses, electromechanical devices, platform integration of complex systems, kitting operations, re-set and refurbishments, field support, trade studies, logistics support, and drafting of Modification Work Orders. A Modification Work Order is the official publication that authorizes and contains instructions for any alteration, conversion, or modernization of an Army end item or component of an end item, which in any way changes or improves the original purpose or operational capacity in relation to effectiveness, efficiency, reliability, or safety of that item, and new source qualifications (Defense Acquisition University [DAU], 2014). The AMRDEC PIF contains advanced aviation crew stations (cockpits) for technology assessment, requirement verification/validation, early user demonstrations, preliminary airworthiness assessments and pilot-vehicle-interface human factors analyses.

Adapted from Perich (2014b), pp. 14-15

Figure 4 – Examples of PIF Rapid Response Projects

AMRDEC's PIF also contains dedicated clean rooms, to allow for the prototyping of devices for both aviation and missile applications (U.S. Army RDECOM, 2013b).

The Communications-Electronics Research, Development and Engineering Center (CERDEC) PIF is part of the Power and Integration Directorate, in the Prototyping, Integration and Testing Division. It provides engineering design, development, fabrication, installation, integration, testing, and fielding of shelter, vehicular, aircraft, watercraft, and soldier prototype C4ISR systems (see Figure 4; U.S. Army RDECOM, 2013b).

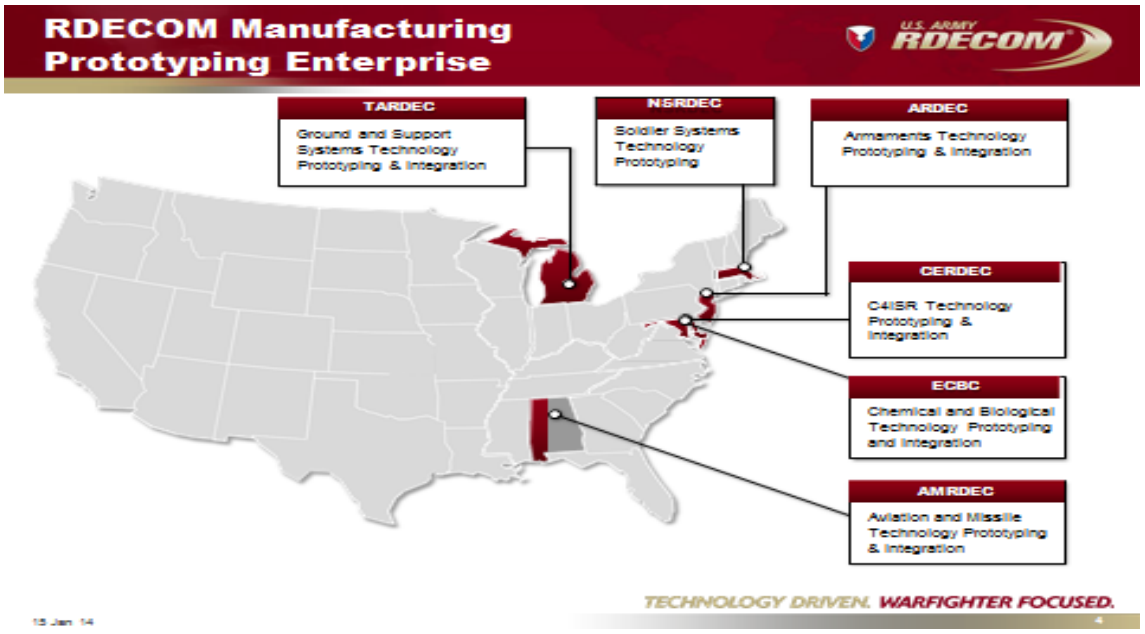
The Edgewood Chemical Biological Center (ECBC) PIF, part of the Advanced Manufacturing and Design Division, performs design, development, testing, production, fielding, engineering sustainment, and disposal of chemical and biological defense systems (see Figure 4); possesses a computer animation capability; and uses nine different prototyping machines. It can produce functional parts within hours of design concept. This PIF also has the capability to create precise virtual model renderings and realistic animations of complex organic, chemical and microbiological systems. ECBC's PIF also provides design and development services for robotic, unmanned vehicles and hazardous-material-handling manipulator systems, specializing in sensor integration (U.S. Army RDECOM, 2013b).

The Tank Automotive Research, Development and Engineering Center (TARDEC) PIF, part of the Center for Systems Integration Division, develops, fabricates and integrates advanced solutions into current and future ground systems. The TARDEC PIF is the single entry point to RDECOM for ground vehicle system integration projects. This includes development of ground vehicle electronics and architectures, power and mobility systems, intelligent ground systems, sustainment, and survivability (see Figure 4). This PIF specializes in metal working, coating, and

ground vehicle assembly. The shop develops system and subsystem designs and prototypes and integrates advanced technology into current and future ground systems (Williams, 2009).

The Natick Soldier Center Research, Development and Engineering (NSRDEC) PIF, part of the Shelters Technology and Fabrication Directorate, fabricates prototypes and conducts small-run production for items to support soldier systems in the areas of soldier pack systems, rigid wall shelters, tents and fabric covers, mechanical aerial delivery parts and components, kitchens, and combat feeding items (see Figure 4). NSRDEC's PIF is also equipped to design and develop various prototype airdrop items through the use of lightweight to heavyweight sewing machines (U.S. Army RDECOM, 2013b).

Figure 5 illustrates the locations of the PIFs.



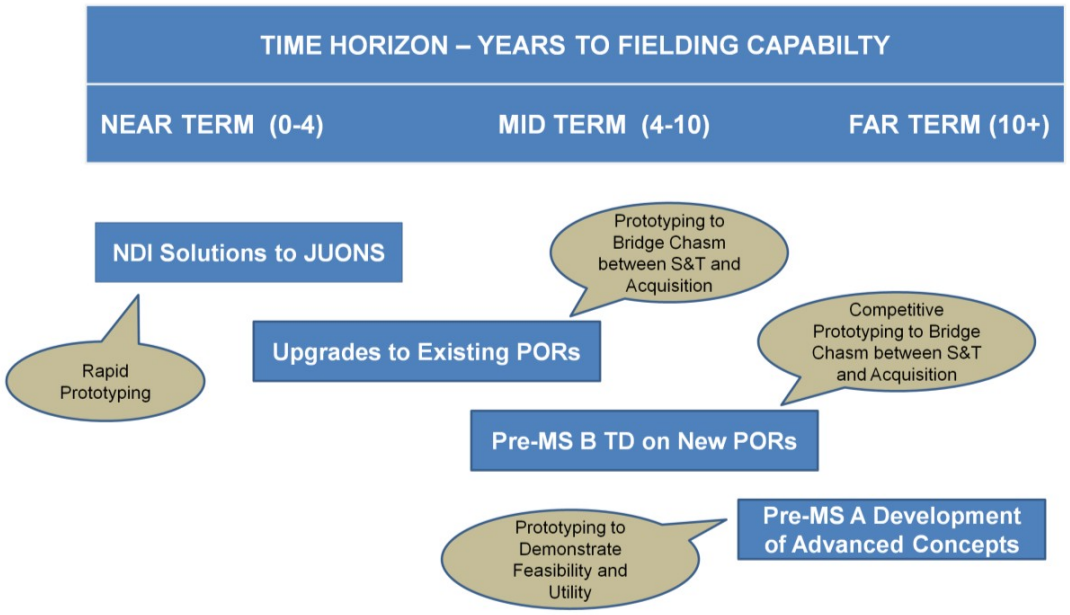
Adapted from Rogers (2013), p. 6.

Figure 5 – RDECOM PIF Locations

Significance of the Research

It is important to recognize that prototyping is a means for bringing technology from development to acquisition, especially to meet PEO/PM PoR technology-maturity requirements. This paper examines existing PIFs within RDECOM and discusses feedback from the various RDEC PIF leaders on facility utilization and other opportunities in the face of reduced PIF budgets. The U.S. Army Science Board (2013) recommended the use of prototyping and systems integration as one method for bridging science and technology to the acquisition community in the areas of rapid prototyping, upgrades to existing programs, competitive prototyping pre-Milestone B, and prototyping to demonstrate the feasibility of advanced concepts pre-Milestone A.

Figure 6 illustrates that the type of prototyping is not the same for near-, mid-, and far-term programs, and the efforts must be tailored to the unique time-frame needs. For near-term insertion of technologies directly to theater operations, rapid prototyping is required. At the other end of the time spectrum, advanced concept prototyping should focus on demonstration of the feasibility and utility of technology-enabled systems that satisfy the operational capability needs of the concepts.



Adapted from U.S. Army Science Board (2013), p. 44

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Figure 6 – Type of Prototyping Varies Across Time Horizon

Overview of the Research Methodology

This research effort used a structured survey involving numerical representation and subjective responses received from the target population described below. Data were collected to test the hypothesis and investigate the perceptions of the RDECOM PIF community with regard to shrinking customer reimbursable and supplemental funding. The target population was management personnel from the six RDECOM PIFs. The process used for this study included the following steps:

- Conduct a literature review
- Define the issue

- Formulate the issue hypotheses
- Collect Data
- Analyze Data
- Draw conclusions and confirm or disconfirm the hypotheses

Research Questions

This research assessed the collective prototyping and integration capacity within RDECOM and the potential for a shift in focus for the RDECOM PIFs from a mostly customer-focused operation supporting the war effort to one that supports a more traditional technology base mission program. The research questions add to the knowledge on potential inefficiencies within the PIF domain and investigate PIF workload trends in light of declining OCO funding.

Key research questions that were posed to the respondents of the survey included:

- What will be the biggest impact to your PIF as customer funding decreases?
- Has there been a shift in services that the PIF provides over the past 5 years?
- What PIF services are not currently provided or could be better utilized that would help your PIF generate additional business to offset diminishing supplemental funding?
- What percentage of the PIF's products/services is used by RDECOM's core Army mission science and technology programs (Budget Activity 6.2: Applied Research or Budget Activity 6.3: Advanced Technology Demonstration)?

Research Hypotheses

H_1: The PIF leadership predicts that PIFs can shift from OCO customer-funded work to supporting more Army S&T mission-funded technology programs.

H_0: The PIF leadership does not feel that the PIFs will be able to successfully shift from customer-funded work to supporting more Army S&T mission-funded technology programs.

Objectives and Outcomes

The objective of this study was to highlight feedback from the RDECOM PIF leadership on the impact that customer-funding decreases will have on the PIFs and to make recommendations regarding how to use current capabilities better and keep the RDECOM PIF facilities open to be able to quickly surge for the next conflict. The outcome of this study identifies initiatives to help mitigate the impact of anticipated funding decreases and maintain or advance PIF capabilities throughout RDECOM. Plans need to be made now in anticipation of customer-funding decreases regarding how to shift the PIFs' customer-focused mission. PIFs are currently self-sustaining, with 85%–100% customer reimbursable funding (Quinn-Doggett, 2008), and they will require mission funding or other customer sources to be maintained.

Limitations of the Study

The survey tool was administered to the PIF management leadership in February 2014. A total of 17 surveys were completed, covering all six of the RDECOM RDECs. The principle limitation of this study was the small sample size; ideally the study should be expanded to a larger target population that includes PIF customers and Army leadership, to gain opinions from external stakeholders on their future vision for the PIFs. Opinions could also be solicited from RDECOM technical directors, Headquarters AMC chief technology officer, Department of the Army G-3 (Operations) and G-4, (Logistics), PEOs and deputy PEOs, PMs, and external agencies such as OSD, the Defense Threat Reduction Agency and the Defense Logistics Agency.

Recommendations outlined in this paper, if deemed feasible, would have to be researched to assess current regulation limitations before implementation. Additional data could also be tapped on the PIF budgets and unique facility capabilities, to fully analyze the current PIF enterprise. Current sources of data for PIF funding were not available from the RDECOM G-8 at

the time of this study. With this data it would be possible to break out each PIF's annual funding for the last 5 years in terms of S&T; customer Research, Development, Test and Evaluation (RDT&E), Other Procurement Army, Operations and Maintenance (O&M), and OCO funding. This information would allow an analysis to connect the relevancy of the funding assumptions (Quinn-Doggett, 2008) from 6 years ago to today's situation. Additional customer-funding information could also be used to assess RDEC PIF prototyping efforts against assigned RDEC mission areas.

Validity of the Research

Due to the limited number of survey responses, this research should be considered a pilot study. Drawing strategic conclusions from a survey of 17 responses can certainly lead to excessive inference. But I feel the survey is a valid pilot study, which can lead to follow-up efforts that can inform and guide senior leaders. The survey was reviewed by a project advisor for clarity, content, and validity. Additionally, a select group of PIF managers who are very familiar with PIF practices reviewed the survey for clarity, content, and validity. Their recommendations and comments were included in the survey. All comments were administrative and clarifying in nature.

Reliability of the Responses

The survey interview questionnaire was the critical data source of this research project. The survey was designed to take the pulse of the current PIF leadership about the impact that customer-funding decreases will have on the PIFs. The survey was designed to accommodate input from each PIF across RDECOM respondents, but it represents only a select sample of all those involved with PIF services.

Chapter 2 – Literature Review

This chapter provides an overview of the publications that were reviewed relative to the research question. I have grouped the articles into DoD literature and literature from commercial sources related to defining the current DoD S&T and acquisition environment, the role of the PIFs, and use of prototyping to transition technology.

Department of Defense Literature

1. RDECOM (2013c). This RDECOM document is used to communicate RDECOM's core technical competencies and S&T strategic direction to Army leadership, stakeholders, customers, partners, and RDECOM's internal workforce. This living document articulates RDECOM's leadership commitment to conducting and providing state-of-the-art S&T products and engineering services to support PEOs, PMs and LCMCs.

Rapid prototyping is highlighted as one engineering service that RDECOM provides through the PIFs, and this document states RDECOM's commitment to provide concepts and engineering designs for rapid conversion into prototypes for immediate use by the warfighter or for transition to depots and arsenals for full-scale production. It is clear from this document that RDECOM leadership fully supports the mission of the PIFs, recognizes their importance to the organization and the Army, and is committed to maintaining their capabilities to support transition of technology to the warfighter and other customers.

2. Stadterman (2012). This report provides insights into the WSARA of 2009. The U.S. Congress passed WSARA in 2009, and it significantly changed the way the DoD procures weapon systems. One key point to WSARA is the requirement to have an acquisition strategy that ensures competition. WSARA states that an acquisition strategy should include the use of competitive prototypes before Milestone (MS) B approval, unless the Milestone Decision

Authority waives the requirement. The PIFs have the ability to perform WSARA performance assessments throughout the life cycle and, when requested, develop competitive prototypes, but the PIF workload in this area, to date, has not grown. A previous commanding general of RDECOM had a desire to have RDECOM build government competitive prototypes with RDECOM S&T products as an alternative for the PM to consider or allow for transition of government S&T into industry prototypes. To my knowledge the government has never built a competitive prototype under WSARA.

Potential elements that the PIFs can address in compliance with WSARA may include:

- Competitive prototyping
- Dual-sourcing
- Funding of next-generation prototypes or subsystems
- Built-to-print approaches
- Acquisition of complete Technical Data Package
- Competition for subsystem upgrades
- Licensing of additional suppliers
- Program reviews to address competitive long-term effects of program decisions

3. U.S. Department of the Army (2013). This describes the Small Business Innovation Research (SBIR) program, a congressionally mandated program to increase the participation of small businesses in federal research and development. The goal of the SBIR program is to tap into the innovativeness of the small business community to help meet government research and development objectives. One possible new role that the PIFs could play is to assist small companies, which might lack a prototyping capability, to build their prototypes. Congressional SBIR reauthorization in FY12 mandated the following percentage of the RDT&E line item to

fund the SBIR program each year: FY14: 2.8%, FY15: 2.9%, FY16: 3.0%, and FY17: 3.2%. The FY13 budget is $149 million, coming mostly from the PEOs. RDECOM's taxation is approximately $40 million, yet RDECOM receives approximately $90 million in SBIR investments in the form of new topics, Phase I, and Phase II projects (M. Smith, RDECOM, personal communication, 2014, March 3).

Successful Phase I companies may submit a Phase II proposal to continue working on the concept, with a maximum dollar amount of $1 million. Phase IIs are a substantial 2-year research and development effort intended to produce a prototype meeting the requirements of the original solicitation topic and that can be made commercially viable. In addition to the PIF fabricating the prototype at cost, the SBIR contractor using a PIF would have protection of proprietary information, including technical data rights, and could gain valuable insights into potential military applications from the RDECs. Many Phase II contracts address RDECOM-solicited research and development topics being technically managed by the RDECs. The RDECs are allowed to provide technical assistance services to small businesses engaged in SBIR projects. The objective of this effort is to increase Army SBIR technology transition and commercialization success, thereby accelerating the fielding of capabilities to soldiers and to improve manufacturing capability.

4. Muzzelo (2013). This report was used as a reference to enhance my understanding of technical data rights. The objective of this research paper was to improve the government understanding of the relationship between government ownership of Technical Data Rights (TDR) and the transition of technology from the S&T community into PoR. Survey questionnaires were used to solicit feedback from PEOs and PMs on Advanced Technology Development (ATD) projects to ascertain whether the ATDs transitioned technology products as

well as the associated TDRs of the transitioned technology. Through an analysis of survey responses, this research indicates that government ownership of TDRs makes a statistical difference in the successful transition of technologies from the Science and Technology community to PMs for use in PoRs.

RDECOM PIFs can play an important role in maintaining government ownership of technical data throughout the life cycle for customers, depots, arsenals, industry and the Army as a whole.

5. Quinn-Doggett (2008). In this report to RDECOM leadership, a PIF study team was established to analyze and assess the current posture of existing PIFs within RDECOM and to develop a comprehensive business strategy for utilization, growth, and optimization of PIF capabilities in support of the overall RDECOM mission. This report supported the RDECOM strategic planning goal to exploit rapid prototyping capabilities to expedite solutions to the field, establish command policy on quantity and location of special facilities such as quick-reaction prototyping facilities, modeling and simulation centers, and software engineering centers. This report stressed the need to reduce redundancies in the PIFs across RDECOM and recommended that the RDECs focus on core competencies within their mission areas and leverage one another's capabilities for complementary technologies where appropriate. With customer funding decreasing, RDECOM might be forced to consolidate PIFs. From the survey data it is clear that the PIFs do not want to be merged or eliminated.

6. RDECOM (2013b). This Memorandum of Understanding (MOU) represents an outstanding step toward the PIFs working together as an enterprise with full support of RDECOM leadership, including the technical directors. It describes the partnering relationship between the RDECOM PIF organizations and establishes a framework for cooperative efforts

among the PIFs in order to forge an alliance that will result in mutually acceptable decisions to fully leverage the experience, expertise, and technological capabilities of each. The intent of this MOU is to maintain and enhance the mission capabilities and performance of the PIFs through a teaming approach to develop and accomplish common goals and coordinated projects. I feel this MOU is the first step in allowing the PIFs to collaborate as a community, rather than compete with one another.

7. U.S. Army Science Board (2013). This study provides an excellent overview of RDECOM, S&T planning, technology transition, and the role of prototyping. The study found that the Army lacks an S&T strategy and investment plan to meet likely future challenges. It stated that improvements must be made to the transition of technology and advanced capabilities to acquisition programs.

The study also highlighted the need for technology upgrades to existing acquisition programs or insertion into new acquisition programs and how prototyping opportunities must focus on maturing technologies and reduce system integration risk for these programs. For new PoRs, during the Technology Development phase before MS B, prototyping should be conducted competitively to the maximum extent possible within time and resource constraints to allow for alternative approaches to be tested and matured. As stated earlier, competitive prototyping before MS B is required by statute (WSARA) unless a waiver can be justified. In my survey I was interested to learn whether the RDECOM PIFs have been asked to provide competitive prototypes before MS B. The PIFs could play a major role in competitive prototyping, technology maturation, improving program cost estimates, providing design validation, and realistic requirements refinement for program offices. The report summarizes some key prototyping observations that deserve to be highlighted (pp. 46–47):

- S&T funded development generally cannot satisfy the technology maturity levels required by acquisition programs because of the program manager's risk-averse focus on contract execution. To remedy this issue, a prototyping environment funded via dedicated program elements is needed to take selected technologies from TRL 6 to TRL 7. The TRL scale is a metric for describing the maturity of a technology. The scale consists of nine levels. Each level characterizes the progress in the development of a technology, from the idea (level 1) to the full deployment of the product in the marketplace (level 9). These levels are detailed in Figure 7.

Adapted from Innovationseeds (2014)

Figure 7 – Technology Readiness Levels

- Systems integration maturity is as important as technology maturity to the PoR PM. The lack of a systems integration mindset and skill set within S&T contributes to lack of acceptance of an S&T technology by the PoR. The prototyping environment must require collaboration between S&T and acquisition communities to ensure that all critical system interfaces are understood and exercised. One approach to accomplishing this is for the dedicated program-elements funding to be allocated on the basis of competitive proposals from PM/S&T/industry teams.

- The tight interdependent relationship between a PM and his or her prime contractor may inhibit the inclusion of RDECOM innovative technologies or other sources outside the PM team.

- A focus on PoR transition only can result in the prototyping environment being too focused on the midterm. The prototyping environment should include opportunities across the entire time horizon, including rapid prototyping of near-term technologies for direct fielding and far-term prototyping of advanced concepts that can lead to disruptive capabilities.

The ASB study team highlighted that prototyping is widely recognized as an essential means for bridging the Army S&T technology transition chasm. Prototyping directly addresses bringing a technology to a TRL 7 level.

8. U.S. Department of Defense (2013a). This document was used as a reference to verify OCO funding levels, which have provided the PIFs' major source of customer funding for the past 10 years. This document is an amendment to the FY14 President's budget for OCO to support Operation Enduring Freedom. This budget request reflects the President's drawdown of troop levels and reductions in OCO funding.

9. Institute of Land Warfare (2011). This document was also used as a reference to verify OCO funding levels. This analysis was completed by the Association of the United States Army, and it reviews the federal, Department of Defense, and Army budget requests for FY12. This was the last year this report was written.

This budget analysis included summary information on each DoD department and OCO funding levels. The FY12 budget proposal had 93% of OCO funding going to DoD. The DoD OCO budget decreased by $3.2 billion, or 2%, between FY10 and FY11 and by $41.5 billion, or 26%, between FY11 and FY12. This document confirmed that OCO budgets are decreasing due to the drawdown of forces in Iraq and Afghanistan.

In FY01, before OCO, the Army budget was $78 billion. Between FY01 and the FY12 request, the base budget had grown by 86%. A comparison of the FY12 budget request with the FY10 experience reveals a $26 billion reduction in OCO. FY12 reductions in OCO had a significant impact on various contractors because the procurement accounts decreased by 33%.

Commercial Sources Literature

1. Booz Allen Hamilton (2013). This report assessed the perceptions of government defense employees regarding the use of prototyping in the defense procurement process. The study was supported by research including interviews with prototyping experts. The following was taken from the study's executive summary (p. 3):

> In order to assess the state of the defense acquisitions process, the Government Business Council, with sponsorship from Booz Allen Hamilton, undertook a comprehensive research project that surveyed defense managers about the current acquisition process and how it has been improved since the Weapon Acquisition Reform Act of 2009 (Reform Act). Rapid prototyping and platform modernization, important parts of the Reform Act,

has been shown to be an effective way to make the procurement of complicated defense systems faster and within budget. A total of 474 federal managers, from GS-11 to Senior Executive Service or equivalent grade levels completed the survey. Nearly a third of all respondents (29 percent) have been involved in the use of rapid prototyping for a defense system. Of those managers, 93 percent note that rapid prototyping positively impacted their program in some way. The most common benefits were refined requirements (54 percent) and reduced technical risks (53 percent), while 50 percent note rapid prototyping helped validate designs for their defense system.

2. RAND Corporation (2014). This study examines how the Army can better manage systems acquired through nontraditional means (i.e., outside the process defined by DoD 5000.02 [U.S. Department of Defense, 2013b]), focusing on command and control (C2) systems. The research identifies issues, challenges, and problems associated with nontraditional rapid acquisition processes and recommends ways for the DoD acquisition system to develop, procure, and field effective C2 systems more rapidly within the framework of current policies and processes. The study points out that wartime operational pressures revealed gaps in the Army's capabilities and spurred an urgent drive from both the Army and the DoD to fill those gaps with new technology solutions. What followed was a period of organizational creativity within the Army, where decisionmakers responding to the urgent operational needs from the field were also equipped in an unprecedented manner with a source of immediate flexible funding to respond to those needs: congressionally allocated supplemental funding. One of the most actionable recommendations in the report is that the Army should document its recent experiences in rapid acquisition, to capture lessons learned and best practices, and develop metrics for program

managers while the difficult-to-replenish reservoir of talent experienced in rapid acquisition expertise is still accessible and remembers much of what it has accomplished.

3. Coffey (2013). This paper focused on the DoD in-house science and engineer workforce, which plays a large part in maintaining the technical competence of the PIF and RDEC workforce. The discussion on the oscillation in DoD expenditures gave me an understanding of what the PIFs are facing and why, based on historic DoD budget trends. The paper stated that DoD expenditures started a cycle of ups and downs after World War II. These swings can be seen after the Korean War, the Vietnam War, the Reagan buildup, and most recently the Afghanistan and Iraq wars. Each upswing during these periods has been followed by a nearly equal downswing. Following this historical trend, the PIFs funding upswing will now be followed by a significant downswing.

The author states that major acquisition programs should be very conservative regarding the introduction of new technologies until the uncertainties associated with them are understood or reduced. He also states that major acquisition programs and S&T programs should be managed as separate tracks. The thought is that acquisition programs have a high expectation for success, while S&T needs to take more risks, having a lower expectation for transition. As technologies mature, the connection between S&T and acquisition programs can then be made. It can be argued that if a large portion of RDECOM's S&T programs transition to acquisition programs, either the S&T program is too conservative (risk averse) or not mature enough (high risk). In the second scenario, the technical uncertainties must be resolved during the acquisition program, which would cause program costs to increase. The final point the author makes is that government S&T must provide the hands-on experience needed to maintain in-house

competence in science and engineering to identify promising technologies and guide technical directions.

As the PIFs provide engineering services to the PMs, they also provide systems engineering training to the RDEC workforce.

4. National Research Council, Committee on Accelerating Technology Transition (2004). This report focuses on accelerating technology transition, based on a workshop that examined industry lessons learned on how material and production technologies are transitioned. They examined how new high-risk materials and production technologies are adopted by design and manufacturing groups in aerospace (such as Boeing's Phantom Works and Lockheed Martin's Skunk Works) and racing sport industries (such as America's Cup sailboats). The committee concluded that there are common characteristics of successful technology transition: (1) the establishment of enterprises similar to Skunk Works, that is, committed multidisciplinary teams led by champions who inspire and motivate the teams toward specific goals; (2) team determination to make the technology succeed and be profitable, including convincing the customers that they need the technology; (3) mechanisms of open, free communication of knowledge and problems in meeting goals; and (4) a willingness of the champion to take personal risk, which leads to a willingness of the organization to take risks at the enterprise level.

The paper presented three best practices found in industry for the accelerated transition from concept to implementation, which it felt the DoD should adopt (p. 32):

- Develop a viral process, one that is infectious and self-propagating, for technology development through the quick, iterative prototyping of materials and products, with free and open communication and an agile manufacturing processes and effective modeling
- Work to functional requirements rather than to specifications

- Develop a flexible mechanism for creating and recreating successful teams

I believe that the PIFs have demonstrated these best practices through their support of the warfighter in Afghanistan and Iraq. RDECOM's rapid prototyping capabilities have provided support in many initiatives with a blend of engineering, prototyping, and manufacturing expertise. In most cases these efforts culminated in fielded solutions within developmental cycles measured in days, weeks, or months. RDECOM's PIF flexibility has allowed the facilities to adapt to suit different system needs.

Chapter 3 – Research Methodology

This chapter describes the research perspective, research design, research questions and hypotheses involved in this study. Information concerning participation, population, sample size, research instrument, data collection procedures, data collection and analysis are also presented in this chapter.

This survey was designed to ask senior government civilian subject matter experts who work within the RDECOM PIFs to assess the impact that the anticipated funding decreases will have at each PIF and identify some of the PIF strengths, weaknesses, opportunities, and threats.

When answering the questions, participants were asked to use generic terms and refrain from revealing confidential or classified information.

Research hypotheses are as follows:

H_1: The PIF leadership predicts that PIFs can shift from OCO customer-funded work to supporting more Army S&T mission-funded technology programs.

H_0: The PIF leadership does not feel that the PIFs will be able to successfully shift from customer-funded work to supporting more Army S&T mission-funded technology programs.

Research Perspective

Descriptive questions were asked via survey to the PIF managers for this study. The initial questions identified the demographics of the survey participants. Further questions asked the type of technology transition performed by the PIF and determination of the PIF disposition. Finally, questions were asked about the funding, process, and challenges.

The research for this paper was mostly qualitative, seeking an understanding of current practices, requirements, and policies. The survey was sent to RDECOM PIF managers, including those from ARDEC, AMRDEC, ECBC, TARDEC, NSRDEC, and CERDEC, to gather their

opinions on the challenges facing the PIFs. Seventeen responses were received. This research sought to assess the current workload and challenges of the RDECOM PIFs with the war winding down.

Surveys were administered anonymously using SurveyMonkey (surveymonkey.com) as the principle data-collection method. The scope of this study was purposely focused on this population, considered subject matter experts.

Research Design

The principle method chosen for this project was a survey instrument (see Appendix A). The survey consisted of 33 questions and was qualitative in design, focusing on identifying inefficiencies within the PIF domain and investigating PIF workload trends. The survey also included demographic questions related to the respondents and PIF location. In addition, quantitative data was collected from a data call request sent to the RDECs requesting customer-reimbursable funding and work that that RDECs are receiving from PEOs and any direct O&M, Army (OMA) dollars funded to support PIF efforts during the period FY11–FY13.

O&M appropriations are used to finance “expenses” not related to military personnel or RDT&E, and they include DoD civilian salaries, supplies and materials, maintenance of equipment, certain equipment items, real property maintenance, rental of equipment and facilities, food, clothing, and fuel (DAU, 2014). RDT&E program costs are primarily associated with research and development efforts, including the development of a new or improved capability to the level where it is appropriate for operational use. These costs are funded under the RDT&E appropriation (DAU, 2014).

The survey data were received and managed by a commercial, online product that provided cross-tabulation capabilities. The quantitative data were received and managed by the

RDECOM headquarters G-8 budget office (L. Ryan, RDECOM, personal communication, February 4, 2014).

Participants, Population and Sample

The survey's target population was the RDECOM PIF management workforce. Participants included supervisory personnel (GS-14 to GS-15), which represent a small sample of RDECOM personnel. The survey data show almost all of the participants have engineering degrees and have worked in the PIF for more than 10 years. This study is considered a pilot study due to the small sample size. All participants were asked to identify what PIF they worked in, the role they fulfill within the PIF, and their government job series. The survey was sent to ARDEC, CERDEC, AMRDEC, TARDEC, ECBC, and NSRDEC.

Senior managers within each PIF were asked to respond individually, or the PIF had the option to respond as a group and submit one RDEC PIF survey.

Setting and Environment of the Target Population

The Army established RDECOM 10 years ago to reduce the time for technology to transition from laboratories to soldiers (U.S. Army RDECOM, 2014a). Prototyping is an engineering service provided by RDECOM for rapid conversion of concepts into prototypes for immediate use by soldiers. All of the RDECOM research centers have a special facility that is designated as a PIF. As stated earlier, they are predominately funded by customer-reimbursable dollars, with the goal to produce results as quickly as possible at the lowest possible cost. The PIFs have evolved in response to needs with regard to personnel, (including government employees and contractors), facility size, and capability. They are very customer focused, and all have a strong desire to continue growing their capability and customer base in order to survive.

Bias and Errors

Only a small sampling of the entire PIF community was included in this research. PIF customers and RDECOM senior management may have a different view of future directions for the PIFs; had they been included in the study, different results might have been found. The sample population for this research does represent input from all six RDECOM PIFs. All survey participants provided input voluntarily, and most questions were designed to gain subjective opinions. Participants' responses could be based on personality, their PIF experiences, and work environment or experiences working cooperatively through RDECOM headquarters. Reduction of bias and error in future research could be controlled through interviews in which the researcher asks clarifying questions. Individual and group responses were given equal weight in this study. The time constraints of this project did not allow for interview of respondents to determine variations in opinion within a PIF.

Data Collection and Analysis

The survey data were collected as responses submitted by individuals and groups. SurveyMonkey provides consolidation of the results from the survey and includes a data analysis section that can present the data in table or figure formats. Many of the questions included the option to provide a free-text written response to the question. These responses were collected by SurveyMonkey and presented as a list of comments. I have included all of the comments relevant to the study question (see Appendix B) in this research paper.

Summary

The methods used for this study included a literature review, analysis of PIF customer funding trends, and development of a survey intended to address the research questions and hypotheses concerning the issues and challenges of the RDECOM PIF facilities. The survey

questions asked the PIF management workforce to suggest PIF initiatives to help to mitigate the impact of funding decreases and what they felt was needed to maintain and advance PIF capabilities throughout RDECOM.

Chapter 4 – Findings

This chapter provides the results of the RDECOM PIF survey. The first section of the survey described the target population, including the respondents' PIF, their current position, and the number of years working in the PIF. The survey was designed to ask senior government civilian subject matter experts who work within the RDECOM PIFs to identify some of the PIF strengths, weaknesses, opportunities, and threats, to help assess the impact that the anticipated funding decreases will have at each PIF. The full survey instrument appears in Appendix A.

Survey Results

Question 1: *Do you currently work in an RDECOM Prototype Integration Facility (PIF) as a Government employee?* All 17 participants responded that they currently work in a PIF.

Question 2: *In which Prototyping Integration Facility do you work?* Employees from all six RDECOM RDEC PIFs responded to the survey, as shown in Table 1. Two of the RDECs filled out the survey as a group (ARDEC and CERDEC).

Table 1 – RDECOM PIF Survey Respondents

RDECOM RDEC PIF Respondents	Number of Responses
Armament RDEC	1
Aviation and Missile RDEC	5
Communications Electronics RDEC	1
Edgewood Chemical Biological Center	4
Tank Automotive RDEC	4
Natick Soldier RDEC	2
Total Responses to the Survey	**17**

Question 3: *Is your PIF embedded within one or more of your Research, Development and Engineering Center (RDEC) mission directorates or is it a dedicated stand-alone PIF?* All of the PIFs responded that they have embedded prototyping integration capabilities within one of their mission directorates. All of the RDECs have a special facility designated as a PIF.

Question 4: *What is your position title and job series?* See Table 2.

Table 2 – Respondents' Position Title and Job Series

Number of Respondents	Job Title and Series
1	Electrical Engineer - 0850
1	Mechanical Engineer - 0830
1	Industrial Engineer - 0896
1	Program Manager - 0301
2	Senior Engineering Technician - 0802
11	General Engineer - 0801

Question 5: *What is your role in the Prototyping Integration Facility?* All of the participants were managers or supervisors within the PIF.

Question 6: *How many years of experience do you have working in the PIF?* Over 70% of the participants had more than 11 years of experience working within the PIF, with a high percentage (41%) having over 15 years of experience (Table 3).

Table 3 – PIF Respondents' Years of Experience

Years of Experience	Percentage
<1 year	0.0%
1-5 years	17.6%
6-10 years	11.8%
11-15 years	29.4%
> 15 years	41.2%

Question 7*:* *Rank-order the services your PIF performs **CURRENTLY**, from most work (1) to least work (10).* In order to understand better the current PIF service workload, respondents were asked to rank order their PIF services, from most to least workload for each of the PIF services listed. Respondents could also enter free text for services not listed. Table 4 shows the total number of ranking responses for each PIF service. Total responses vary due to incomplete surveys or because the PIF does not perform that service. The shaded blocks highlight the highest number of responses for each PIF service in order to assess where most of the respondents felt their PIF service ranked in workload. In addition to the services listed, the PIFs also reported performing other services over the past 5 years including:

- electrical integration support
- support manufacturing readiness reviews
- additive manufacturing
- model making
- engineering analysis studies
- contract evaluations
- industrial design services
- plastic part development

Integrating solutions to fulfill rapid-response customer requirements and PM support were the PIFs' most frequent services currently performed, with 12 of the 17 respondents identifying these as their major work areas.

Table 4 – Rank Order of Current PIF Services

PIF Services	1									10	Total Responses
	Number of Responses										
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act	2	1	1	1	2	0	0	1	1	3	12
Integrate solutions in response to rapid response customer requirements	8	2	3	2	0	0	0	1	0	1	17
Science and Technology Prototyping to support Advanced Concept Development	0	4	4	1	1	0	1	5	1	0	17
PM support	4	4	2	0	2	4	0	0	0	1	17
Perform manufacturing support	1	4	1	4	1	4	0	1	0	0	16
Perform reverse engineering	1	0	0	0	3	3	6	1	1	1	16
Perform conceptual modeling & animation	2	0	0	0	4	1	3	0	3	2	15
Develop training devices/software apps	1	1	0	4	1	1	0	5	0	1	14
Develop technical data packages	1	1	5	3	2	1	0	0	2	1	16
Other (Describe Below)	2	0	0	1	0	1	1	0	1	1	7

Note: Most work shaded for each PIF service, based on highest number of responses.

Question 8: *Rank order the services your PIF performed **3 YEARS AGO** from most work (1) to least work (10).* In order to determine changes in the PIF workload over time, respondents were asked to rank order PIF services they provided 3 years ago, from most to least workload for each of the PIF services listed. Respondents could also enter free text for services not listed. Table 5 shows the total number of ranking responses for each PIF service. Total responses varied for several reasons: incomplete surveys, respondents did not work in the PIF 3 years ago, or the PIF does not perform that service. The shaded blocks highlight the highest number of responses for each PIF service in order to assess where most of the respondents felt their PIF service ranked in workload. No differences in additional services were noted by the respondents when comparing current workload with the workload 3 years ago. “Integrate solutions in response to rapid response customer requirements” was ranked number one by over half of the respondents.

Table 5 – Rank Order of PIF Services Performed 3 Years Ago

PIF Services	1									10	Total Responses
	Number of Responses										
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act	1	1	2	1	1	0	0	2	2	2	12
Integrate solutions in response to rapid response customer requirements	9	4	1	1	0	0	0	1	0	1	17
Science and Technology Prototyping to support Advanced Concept Development	0	2	5	2	1	0	0	5	2	0	17
PM support	4	4	2	0	2	4	0	0	0	1	17
Perform manufacturing support	1	4	1	5	3	2	0	0	0	0	16
Perform reverse engineering	2	0	0	0	2	3	6	2	0	1	16
Perform conceptual modeling & animation	2	0	0	0	5	1	3	1	1	2	15
Develop training devices/software apps	1	1	0	3	1	2	1	2	3	1	15
Develop technical data packages	1	1	5	2	1	3	1	0	1	1	16
Other (Describe Below)	2	0	0	1	0	1	1	0	1	1	7

Note: Most work shaded for each PIF service, based on highest number of responses.

Question 9: *Rank order the services your PIF performed **5 YEARS AGO** from most work (1) to least work (10).* In order to determine changes in the PIF workload over time, respondents were asked to rank order PIF services they provided 5 years ago, from most to least workload, for each of the PIF services listed. Respondents could also enter free text for services not listed. Table 6 shows the total number of ranking responses for each PIF service. Total responses varied for several reasons: incomplete surveys, respondents did not work in the PIF 5 years ago, or the PIF does not perform that service. The shaded blocks highlight the highest number of responses for each PIF service to assess where most of the respondents felt their PIF service ranked in workload. No differences in additional services were noted by the respondents when comparing

current workload with the workload 5 years ago. “Integrate solutions in response to rapid response customer requirements” was ranked number one by almost half of the respondents.

Table 6 – Rank Order of PIF Services Performed 5 Years Ago

PIF Services	1									10	Total Responses
	Number of Responses										
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act	1	1	2	1	1	0	0	2	1	1	10
Integrate solutions in response to rapid response customer requirements	8	4	1	1	1	0	0	0	0	0	15
Science and Technology Prototyping to support Advanced Concept Development	0	1	6	2	1	0	0	4	1	0	15
PM support	4	4	1	0	1	4	0	0	0	1	15
Perform manufacturing support	0	4	1	5	2	2	0	0	0	0	14
Perform reverse engineering	1	0	0	0	2	2	7	0	2	0	14
Perform conceptual modeling & animation	1	0	0	0	5	1	2	1	2	1	13
Develop training devices/software apps	1	0	0	3	1	1	1	3	3	0	13
Develop technical data packages	0	1	5	2	1	2	2	0	0	1	14
Other (Describe Below)	1	0	0	0	1	1	1	0	1	1	6

Note: Most work shaded for each PIF service, based on highest number of responses.

Question 10: *Do you feel your PIF receives work because of your RDEC's location in relation to your customers?* Over 88% of the respondents felt that the RDEC’s location was the reason why their customers chose them to perform the work (Table 7). RDECOM’s six research centers (see Figure 4) cover all areas with research in lethality, soldier systems, ground vehicles, chemical-biological, aviation and missile, and communications-electronics. Researchers and engineers at all of the RDECs work with PEOs and PMs to move technology solutions to the engineering and production phase (U.S. Army RDECOM 2014a).

Table 7 – Assessment of Customer Workload Based on PIF Location

Response	Percentage
Very Frequently	52.9%
Frequently	35.3%
Occasionally	11.8%
Rarely	0.0%
Never	0.0%

Question 11: *Do you feel your PIF receives work because of your RDEC's technical competence?* Over 87% of the respondents felt that the RDEC's technical competence was the reason their customers chose them to perform the work (Table 8). This response is directly in line with RDECOM's role across the PEOs and the acquisition community, in providing critical functions and skill sets such as research, development, systems engineering, design, performance analysis, modeling and simulation, software, reliability analysis, prototyping, integration, and testing (U.S. Army RDECOM, 2014a).

Table 8 – Assessment of Customer Workload Based on PIF Competence

Response	Percentage
Very Frequently	56.3%
Frequently	31.3%
Occasionally	12.5%
Rarely	0.0%
Never	0.0%

Question 12: *Consider the current amount of resources applied to each of the listed PIF services. Select the statement which most closely reflects your opinion regarding the balance of these activities.* In order to understand better the current state of PIF workload, respondents were asked to assess the balance of their current workload for their top capabilities. The percentages in Table 9 total to 100% for each PIF service and provide the results of what the respondents felt about changing the current PIF service workload.

Table 9 – Assessment of the Current Balance of PIF Activities

PIF Services	Right balance of work in this area	Should do more using current resources	Should do more with additional resources	Should reduce level of effort in this area	Do not perform work in this area
Develop competitive prototypes - WSARA	29.41%	11.76%	29.41%	0%	29.41%
Rapid response	76.47%	17.65%	0%	0%	5.88%
RDECOM/RDEC S&T Prototyping	41.18%	41.18%	17.65%	0%	0%
PM support	70.59%	17.65%	11.76%	0%	0%
Manufacturing	70.59%	17.65%	11.76%	0%	0%
Reverse Engineering	47.06%	23.53%	17.65%	0%	11.76%
Conceptual Modeling and Animation	47.06%	23.53%	5.88%	0%	23.53%
Training devices/ apps development	29.41%	23.53%	17.65%	0%	29.41%
Technical data package	58.82%	11.76%	17.65%	0%	11.76%
Other Activity	50%	16.67%	33.33%	0%	0%

The shaded areas show percentages highlighting discussion points. Seventy-seven percent of respondents characterized their current workload in the area of "integrating solutions in response to rapid response customer requirements" as being the right balance of work in their PIF. Further investigation of the responses presents a challenge to the RDEC leadership. All respondents indicated they felt there should not be a reduction in the level of effort in any of the areas in which they are currently working. This response could be very challenging because it does not show any willingness among the PIFs to discontinue efforts in their current areas or to let other PIFs absorb part of their current workload if they are forced to downsize.

The most common comments related to this question included the following:

- We are 100% customer driven; if they don't pay us to do these we won't do it.

- There are areas of diminishing commercial industrial base capability where it is becoming increasingly difficult for Government to rely upon industry to develop and provide solutions.
- PIF worked with its PM customer to give the PM a Government capability for competitive prototypes and manufacturing studies. PM and ARDEC investment was required. Customer demand does not currently require competitive prototyping—only the customer can determine what our workload balance should be—we must be flexible to adjust manpower and facilities to quickly adjusting requirements.
- Could do more, but our customers currently do not feel obligated to do this given budget constraints.
- Workload is dictated by customer demand.
- Science and Technology Prototyping to support Advanced Concept Development opportunities to do more.
- Many Tech Base Programs do not have PIF/manufacturing as part of their Integrated Product Teams (IPTs). ARDEC PIF has worked with systems engineering to work on processes that bring manufacturing into design IPT earlier. We still see opportunity in this area.
- PIFs should be involved to a greater extent in prototyping technology demonstrators.
- Need to be integrated more into the S&T efforts. Work often placed on contract that we could perform and allow S&T engineers gain hands-on experience.
- PIFs can validate technical data, many PMs who have an incomplete understanding of the quality and health of their technical data.
- When prototypes and parts are made in industry, data is oftentimes incomplete or not updated properly.

- Technical data packages have been inappropriately scaled back due to Operations and Maintenance Army (OMA) budget cuts.

- PIFs validate product data—there is an opportunity for RDECOM to raise the quality of product data through the enterprise activities of PIFs. When PIFs make parts, there is an opportunity to store this product data (including manufacturing data) to help PM customers as well as depots. When PIFs develop prototypes and manufacturing processes, this information can support the depot community as a corporate learning curve, helping depots and arsenals.

- Balance of activities is driven by our competence and capacity to support the customer.

Question 13: *What percentage (using work hours) of your PIF's products or services are used by RDECOM's core Army mission Science & Technology programs (Budget Activity 6.2: Applied Research or Budget Activity 6.3: Advanced Technology Demonstration)?* Almost 70% of the respondents felt that less than 10% of the work performed in the PIFs support 6.2 or 6.3 in-house S&T programs (Table 10). This supports the perception that the PIFs are rarely used to support S&T mission activities, but according to PIF management could and should be used to support 6.2 and 6.3 programs.

Table 10 – PIF Percent Support to Core S&T Programs

Percentage of PIF Products Used by S&T	Response
0 %	6.3%
1-10%	62.5%
11 - 20%	0.0%
21 - 30%	18.8%
>30 %	6.3%
unknown	6.3%

Question 14: *What Arsenal(s) and Depot(s) is your PIF the most aligned with?* Similar to the PIFs, the workload at the Army depots and arsenals has grown since 2001, retrofitting

equipment required by deployed troops. The depots and arsenals are facing the same set of budget challenges as the PIFs as the war winds down and work decreases. This fact could change the business environment for the depots and arsenals. One change has been made in recent years, including shifting management responsibility of the depots from Headquarters, Army Materiel Command (AMC), to the individual LCMCs. RDECOM PIF engineers work closely with LCMCs to provide sustainment engineering. This is a step closer to further coordinating depot industrial activities with PIF services to facilitate cooperation between the two organizations. It is clear from the survey responses (Table 11) that the PIFs are aligned with most of the depots and arsenals and have established working relationships with them, feeling that partnering with rather than competing with them is important for both sides. One of the Army's strategic goals is to continue to grow and expand Army depots partnerships.

Table 11 – PIF Arsenal and Depot Alignment

Depot	Responses
Dessert Chemical Depot, UT	0.0%
Umatilla Chemical Depot, OR	0.0%
Tooele Army Depot, UT	5.9%
Watervliet Arsenal	11.8%
Pine Bluff Arsenal	11.8%
Sierra Army Depot, CA	17.6%
Anniston Army Depot, AL	17.6%
Other (please specify)	17.6%
Blue Grass Army Depot, KY	23.5%
Red River Army Depot, TX	23.5%
Corpus Christi Army Depot, TX	29.4%
Rock Island Arsenal	52.9%
Tobyhanna Army Depot, PA	52.9%
Letterkenny Army Depot, PA	70.6%

Question 15: *Who does your PIF work/team with the most often? (Pick up to 2)* Collaboration is essential to RDECOM (U.S. Army RDECOM, 2014a). It is critical for the PIFs to collaborate with industry and other government agencies to solve difficult problems. All of the

PIFs responded that they do team and work with others, mostly with other government agencies and industry (Table 12). The depot teaming is not as strong; in the previous question it was identified as a growth area for PIF partnerships.

Table 12 – PIF Teaming

Teaming Partner	Responses
Other Government Agencies	70.6%
Industry	64.7%
Depots	29.4%
Other (please specify)	5.9%

Question 16: *What basis or mechanism(s) does your PIF use to facilitate PIF-Industry interaction?* Cooperative research and development agreements (CRADAs) have been used for years by RDECOM as a way to advance S&T knowledge through partnerships. RDECOM has more than 250 of these agreements with industry, universities, and other government agencies (U.S. Army RDECOM, 2014a). A CRADA is any formal written agreement between one or more federal laboratories and one or more non-federal parties under which the government, through its laboratories, provides personnel, services, facilities, equipment, intellectual property, or other resources (U.S. Department of Interior, n.d.). The responses to this question (Table 13) were as expected: most PIF-industry interaction comes through contracts and working relationships with the PMs. The other mechanism specified was test services agreements, which DoD laboratories may make available on a reimbursable basis, for the testing of materials, equipment, models, computer software, and other items.

Table 13 – PIF-Industry Interactions

Mechanisms Used to Interact	Responses
Co-located with industry partner	29.4%
Contracts or Agreements	76.5%
Industry events such as Industry Days	5.9%
PM sponsored work	58.8%
Other (please specify)	35.3%

Question 17: *Rank order your current support efforts (1 being the most supported).* Providing support to Army PEOs and PMs is the PIFs' primary activity (Table 14). With budgets shrinking, it is clear that Army PEOs and PMs are forced to invest in upgrading existing systems in lieu of purchasing new systems. I feel the PEOs and PMs see prototyping as a way to reduce costs and speed up the delivery of systems while achieving performance parameters.

Table 14 – PIF Rank Order of Support Efforts

PIF Efforts	Workload Rank			
	1 (Most)	2	3	4 (Least)
Current Operations	1	1	9	2
Army PEOs/PMs	11	4	1	1

Question 18: *With whom and what percentage of your workload is Rapid Response work?* Rapid response work is the rapid technical services and products the PIFs provide to implement timely upgrade, installation and fabrication support to new or existing systems to satisfy customer mission requirements. Most of the workload in this area is done for the Combatant Commands (COCOMs, i.e., U.S. Central Command), which is responsible for military operations in Central and South Asia (Table 15). The other rapid response work supports the Air Force, Navy, Marines, and Special Operations Command (SOCOM). Rapid response work is solely funded by OCO dollars.

Table 15 – PIF Rapid Response Customers and Workload

Customers	Workload							
	5%	10%	15%	20%	25%	30%	35%	40%
PM	1	2	0	0	1	2	0	0
COCOMs	1	3	2	1	0	0	0	1
Other	0	0	1	0	1	1	0	2

Question 19: *Who are the other potential alternative sources your PIF customers could use?* Many times the PMs work through contractors instead of the government PIFs to perform work (Table 16). Use of PIFs by the PMs will help them sustain their systems as the government will then own the technical package data rights. Government ownership of technical data rights reduces costs, thereby making a difference in the successful transition of technologies from the S&T community to PoRs (Muzzelo, 2013).

Table 16 – Alternative Sources for PIF Services

Alternative Source	Responses
Other Government Agencies	58.8%
Industry	82.4%
AMC Depots/Arsenals	35.3%
Other	5.9%
No other alternative source	5.9%
Other (please specify)	5.9%

Question 20: *What do you think is the greatest distinction between your PIF and this alternative source and why?* Each PIF manager was asked to identify the major difference between their PIF and alternative sources. I have highlighted the responses below:

- PIFs have the proven ability to respond quicker to meet urgent needs.
- PIFs have focused experienced, no contract requirements, ability to be nimble and change course instantly with no penalty. Best interest of the government is focus

- We have a government-owned, government-operated facility. Our customers get the best of both worlds: they interface with a government person, and we can touch industry as required.
- Commodity competency and capability built to support those competencies. PIFs have specialized capability and engineering staff.
- The PIFs pride themselves on our energized, highly trained, entrepreneurial spirited workforce. This highly integrated team cannot be easily duplicated anywhere
- The people and their personal and professional relationships
- The people, attitudes, motivation, and culture are a huge distinction.
- Location and no worries about expensive Engineering Change Proposals
- Government subject matter experts that want to build the best versus industry that needs to make a profit

Question 21: *What factor(s) did your customers consider when they selected your PIF over other alternative sources to perform the following work?* The data show most customers used the PIFs because of their ability to meet schedule and performance requirements (Figure 8). PIF facilities have proven over the past 10 years of war that they can take a requirement and develop a solution as quickly as possible to get it into the hands of users and then continue incremental improvements. Specific comments included:

- PIFs have the proven ability to respond quicker to meet urgent needs.
- PIFs have focused experience, no contract requirements, ability to be nimble and change course instantly with no penalty. Best interest of the government.

- We have a government-owned, government-operated facility. Our customers get the best of both worlds: they interface with a government person, and we can touch industry as required

Work Areas

1. Integrate solutions in response to rapid response customer requirements
2. Science and Technology Prototyping to support Advanced Concept Development
3. PM Support
4. Manufacturing
5. Reverse Engineering
6. Conceptual Modeling and Animation
7. Training devices/aids/software apps development
8. Technical data packages

Factors

Cost
Schedule
PIF Location
Performance

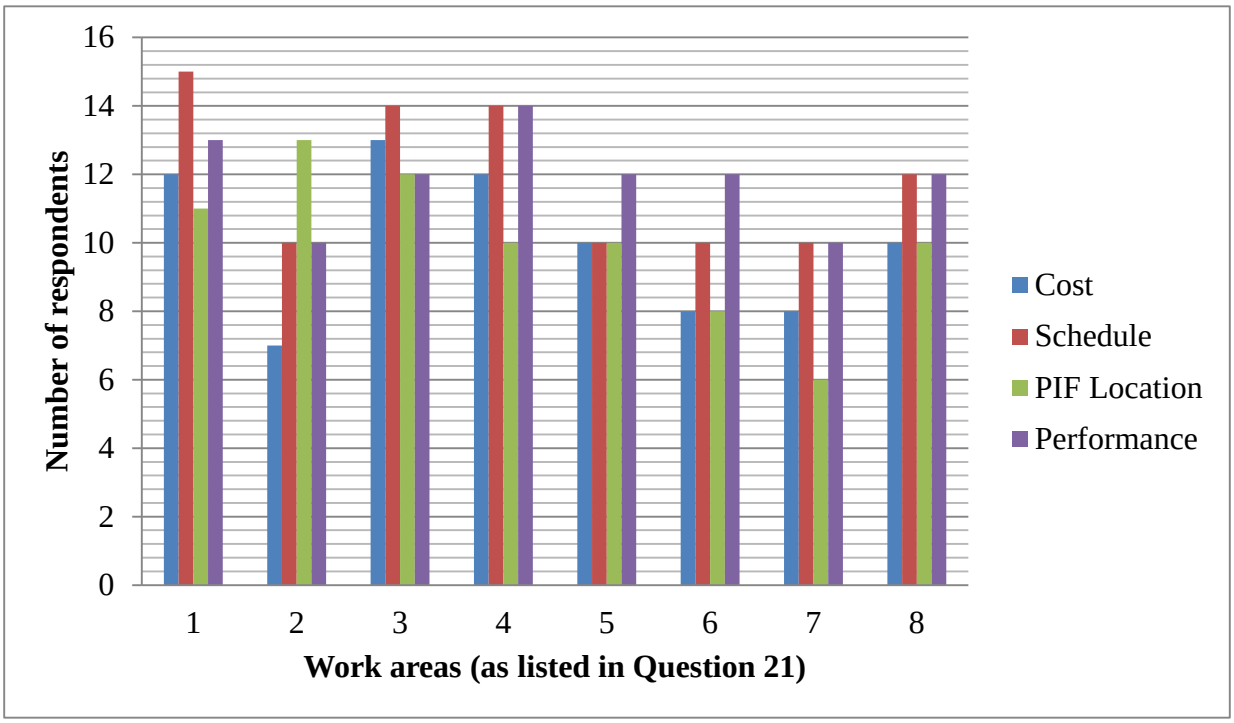

Figure 8 – Customers' Considerations When They Selected a PIF

Question 22: *Consider each category of work below. What factor(s) did your customers consider when they DID NOT select your PIF to perform that work and decided to use an alternative source?* When the PIFs were not selected it appears that it was due to cost (Figure 9). Customers consistently looked for the best value when selecting what organization they chose to perform the work. We have all seen the low-price strategy in the government, but it might not be the best approach for the complex services that the PIFs provide. PIF customers need to look at performance risk with lower cost organizations, especially in time of war. It has also been stated by one of the PIFs that their overhead rate could fluctuate and was out of their control, which could raise the cost to the customer. This PIF felt that their overhead rate should be around 4% to 6%, but at times approached 12% (Wayne Hudry, personal communication, March 19, 2014).

Work Areas

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Factors

Cost
Schedule
PIF Location
Performance

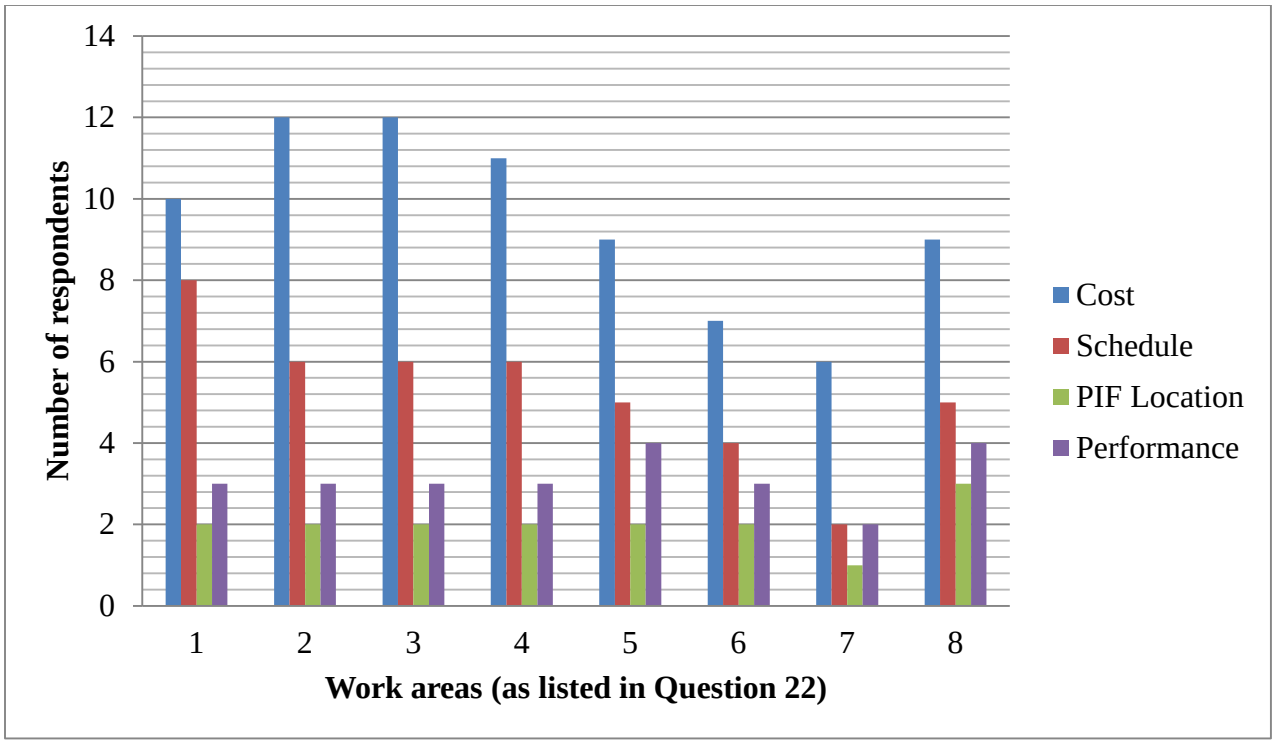

Figure 9 – Customers' Considerations When They Did Not Select a PIF

Question 23: *What capabilities do you have in the PIF that should be better utilized/leveraged?* Most of the respondents felt that the PIFs need to do more to support Science and Technology Prototyping to support Advanced Concept Development, provide the PMs with technology integration support, and develop government-owned technical data packages (Table 17). This response is consistent with other questions related to supporting WSARA and doing more work in-house to support 6.2 and 6.3 S&T mission programs. Other areas noted included electrical integration support, engineering studies, product development, and composites engineering and manufacturing.

Table 17 – PIF Services That Should Be Better Utilized

PIF Capabilities	Responses
Science and Technology prototyping to support Advanced Concept Development	76.5%
PM technology integration support	58.8%
Technical data packages	52.9%
Temporary Manufacturing	47.1%
Other (please specify)	41.2%
Training devices/aids/software apps development	35.3%
Reverse Engineering	29.4%
Conceptual Modeling and Animation	23.5%

Question 24: *What capabilities do you have in the PIF that are the least productive?* Thirty-one percent of the respondents felt that training devices/aids/software applications development was the least productive capability within the PIFs (Table 18). In order to achieve efficiency in training-aid development, the Army Acquisition Executive has designated the Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI, 2014) as the Army's acquisition agent for training enablers. PEOs and PMs must coordinate their system training aid acquisition strategy with PEO STRI to ensure compliance. It was unclear from the responses whether the PIFs coordinate with PEO STRI or work through the PM on training device development. This PIF capability area should be investigated; the lack of coordination with PEO STRI might account for this capability being least productive. Other areas noted included electrical integration support, engineering studies, product development, and composites engineering and manufacturing.

Table 18 – PIF Services That Are Least Productive

PIF Capabilities	Responses
Other (please specify)	38.5%
Training devices/aids/software apps development	30.8%
Conceptual Modeling and Animation	23.1%
Reverse engineering	15.4%
Temporary manufacturing	15.4%
PM technology integration support	7.7%
Science & Technology Prototyping to support Advanced Concept Development	0.0%
Technical data packages	0.0%

Question 25: *What PIF services do you currently not provide that would help your PIF generate additional business to offset diminishing supplemental funding?* Most of the respondents felt that partnerships with industry would help generate additional business, along with working with the Defense Logistics Agency (DLA) to re-engineer and validate product data for hard-to-source parts. As part of the larger DLA/AMC performance-based agreement, there is an opportunity to update and modernize technical data for many systems and components that are hard for DLA to source. This would lower cost to the Army in its acquisition of parts through DLA and address significant issues of lead-time for sustainment. The PIFs could also manufacture moderate to high quantities of spare parts, perform manufacturing pilot production and additive manufacturing process development, and expand its computer aided design efforts.

Question 26: *Do you believe that RDECOM would benefit by executing the PIFs as a Community of Practice (CoP)?* The respondents were almost equally split with their responses. A little more than half responded affirmatively, noting, “It would be a good idea to leverage shared knowledge and experience,” explaining that knowledge sharing between PIF groups could facilitate technology and work sharing across all of the PIFs. It was also commented that stronger

leadership would be needed for this to be successful, utilizing the current PIF charter and council. Other respondents felt this CoP approach would not work due to the current decentralized management of the PIFs across RDECOM. However, they also expressed the feeling that decentralized management was the best way to operate the PIFs. Because each PIF is embedded within a mission directorate as part of their RDEC, each PIF employs its own business model, aimed at that RDEC's customer needs, technologies, and priorities. These groups of responses were based on looking at the environment from the current PIF customer-funded operating environment. Many of the negative responses toward a CoP approach strongly felt that each PIF needed a defined customer lane and that any forced work strategies would fail. Comments highlighted that the PIFs current work is based on customer-driven requirements in a free-market environment, which will determine the size, strength, and capabilities of each PIF. One of the respondents noted that capitalism would be the best business model for the PIFs to follow, because it motivates and leans organizations according to performance and need. The few respondents who took the middle ground believed PIFs should leverage one another's capabilities, but did not believe that centralized RDECOM PIF management is the answer, noting challenges in command governance to achieve a unity of effort. It is clear that RDECOM leadership will have to overcome the PIFs' strong need to compete with one another for customer dollars to survive.

Question 27: *What are your significant customer(s) that would be considered "non-traditional customers" of your RDEC?* The following were listed as customers (random order):

- U.S. Air Force
- U.S. Marine Corps
- U.S. Navy

- U.S. Special Operations Forces
- U.S. Central Command
- Asymmetric Warfare Group
- Foreign Military Sales
- Department of Energy
- Department of State
- U.S. Forestry Service
- Federal Bureau of Investigation
- Homeland Security
- State and local law enforcement agencies
- U.S. Immigration and Customs Enforcement
- National Institutes of Health

Question 28: *If your PIF receives RDEC overhead funds for personnel costs or infrastructure improvements, please select the percentage of personnel related funding and capital investment funding you receive. Use your total annual PIF budget as the baseline when making your estimate. If you do not receive overhead funds, select 0%.* A majority of the respondents felt that the PIFs received zero percent in overhead funds from their parent RDEC to cover salary costs, training, and facility investments (Figure 10). It is clear that the PIFs rely on customer funding to cover all costs of operation. As customer funding shrinks, this will need to change for the PIFs to survive.

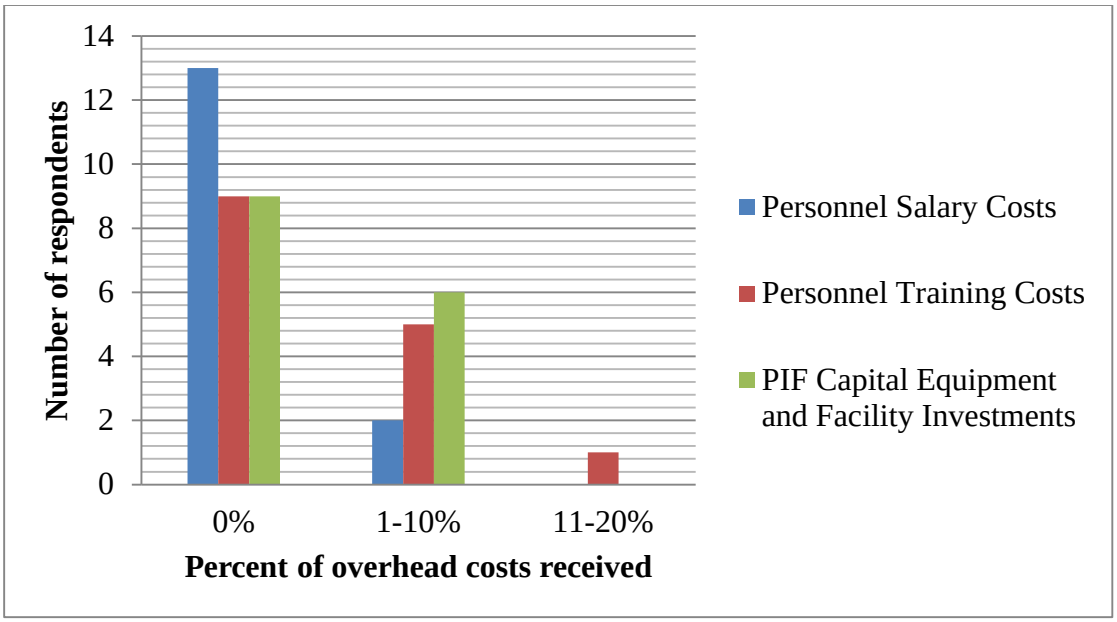

Figure 10 – Assessment of Overhead Funds Received

Question 29: *Do you feel your PIF receives overhead funding from your parent RDEC in proportion to the overhead funding paid by PIF customer reimbursable funding?* Again, a majority of the respondents (65%) felt that the PIFs received zero percent in overhead funds from their parent RDEC, even though overhead fees are charged to their customers (Table 19). It appears many of them feel this is an unfair situation.

Table 19 – Opinion on Overhead Funds Received

Response Choices	Responses
Yes	11.8%
No	64.7%
Abstain	23.5%

Question 30: *It is expected that PIF customer funding will decrease and focus will shift from quick reaction customer work back to supporting traditional mission technology base*

programs. What will be the biggest impact to your PIF if customer funding decreases? Responses were as follows:

- We will need to seek more funding in mission technology base programs, which we have done prior to offset the loss of quick reaction work.
- We will need to lower personnel levels.
- Change of customer base and balance of type of work.
- In a smaller market we can prove that we are a better value to the customer and thus increase our share of the market. New customers will need to be pursued to fill the gaps.
- As a customer-funded organization, we evolve with our customer's requirements. The quick reaction work has allowed us to build relationships with PM customers so we can now demonstrate the value of competitive prototyping and acquisition support. The main challenge in this area is to develop enough workload in this new area to maintain the current level of workforce, which grew to meet the needs of rapid response.
- Facilities will need to be reorganized and personnel may have to be reassigned.
- Forced collaboration with the other PIFs.
- Covering personnel salary costs will become a significant problem.
- Downsize the contractor workforce in proportion.
- Need to focus more on core S&T funded activities.

Question 31: *Systems engineering and integration skills are critical for effective prototyping. Do you feel that your RDEC recognizes and utilizes the opportunities the PIFs provide for RDEC engineers to hone their systems engineering skills?* One common benefit (59%) reported by the respondents was that the RDECs do use the PIFs to train and maintain systems engineering skills for their in-house workforce (Table 20).

Table 20 – Systems Engineering Utilization

Response Choices	Responses
Yes	58.8%
No	23.5%
I am not sure	17.6%

Question 32: *Has "The Weapon Systems Acquisition Reform Act (WSARA)" requiring that competitive prototyping be addressed before progressing to MS B had an impact upon your PIF?* Through the WSARA, the DoD's goal was to improve the acquisition process of defense systems. A strong majority of PIF managers (94%) indicated that they have not seen any increases in requests for competitive prototypes (Table 21). The Booz Allen Hamilton (2013) study reported that of the 474 federal managers, only 19% indicated that they have seen increases in the use of competitive prototyping in the acquisition process.

Table 21 – WSARA Workload Assessment

WSARA Impact	Responses
Have **NOT** seen any changes in PIF workload related to supporting WSARA activities	94.1%
I have seen changes in PIF workload related to supporting WSARA	5.9%

Question 33: *Please provide any additional comments you feel are relevant.* The following comments were received:

- Collaboration and competition do not have to be mutually exclusive terms.
- Sharing business techniques and lessons learned is valuable, but forcing mission lanes does not endear us to our most important asset, the customer.
- We should embrace the capitalistic approach and right size the organizations accordingly.

- WSARA, depot collaboration, and other activities should be invoked by ASA(ALT) through their funding streams.

Chapter 5 – Conclusions and Recommendations

The intent of this research paper was to assess the collective prototyping and integration capacity within RDECOM in this time of reduced defense budgets and loss of OCO funding, by providing an interpretation of the literature as well as the PIF manager survey. Sustaining PIF capacity will depend on their ability to shift their current war-focused engineering services to areas supporting RDECOM's S&T programs by enhancing both internal and external relationships and shifting or expanding current capabilities to grow new customer opportunities. The last 10 years of war have demonstrated that PIF capabilities are critical to supporting the warfighter, and efforts must be made to ensure this capability is preserved.

The data gathered by the survey support the research hypothesis and are consistent with the literature review. It is clear that as supplemental funding ends, the PIFs will lose a major portion of their current budgets and the result will be reductions in the PIF workforce. However, because they have developed their capabilities within RDECOM by being agile and entrepreneurial organizations, they have the demonstrated drive to evolve to support other areas. The PIFs are highly marketable and represent the essence of RDECOM. Over the past 10 years they have focused on operating as a 100% customer-funded operation, but all PIF managers feel they can generate additional business to offset diminishing supplemental funding and continue to support the Army in other arenas. After analysis of the survey results and literature review it became clear that the RDECOM PIFs can play a central role in the successful transition of technologies from the laboratory to the field and experts feel they should play a larger role in S&T activities in the future. In the past the PIFs were solely focused on attracting customers because they depended on customer funding to survive. This is still the case. They never turned away a customer for fear that the customer would not return. In order to be available for

customer projects, PIFs did not seek in-house S&T programs because they were fearful that they would tie up resources. The shift to supporting S&T missions will come down to trading off customer work for in-house S&T work. This will be an adjustment for the RDECs and PIFs, as customer work has been the priority. The RDECs will have to accept that the PIFs will not be able to seek customer programs at the same level if they are supporting in-house programs. One suggestion made by RDECOM leadership is that the PIFs should have the right of first refusal on all in-house engineering work involving 6.2 and 6.3 mission funding that the PIFs can perform. This would force the RDECs to use their PIFs for S&T activities and help the PIFs financially. Application of this suggestion would require a major shift in PIF management thinking, as they have never had to trade off customer work for in-house work. They would have to accept the approach that they might need to turn away outside customers to work mission programs. None of the PIFs have previously turned away an outside customer since in the past they were almost exclusively customer funded.

It should be pointed out that RDECOM as a headquarters function does not have the authority to optimize workload distribution across RDECOM nor to centrally manage the RDEC activities. They do not control the dollars for execution in either the mission or customer funding lines; control lies with ASA(ALT) and execution through the RDEC technical directors. RDECOM headquarters' responsibilities are in the areas of oversight and policy. However, RDECOM headquarters can enforce the regulations to ensure work is carried out according to the RDECs' assigned mission areas.

While some of the PIFs have duplicative capability, they have all developed their capabilities independently based on close alignment to customer-driven missions in their RDECs' areas of technical competence. PIF's should not seek customer work in areas that are

not defined in their mission (see Appendix C). The performing PIF activity must have the authority to accept reimbursable orders and should have a mission that allows it to provide goods and/or services to customers before accepting the funding. Their commonality and uniqueness play an important role in their ability to share work and collaborate to support the PEO and the acquisition communities by continuing to provide focused expert engineering services in the areas of systems engineering, design, prototyping, and integration. WSARA was established to improve the efficiency and cost-effectiveness of the defense acquisitions process. Despite this reform, PIF managers have seen no improvement in the role the PIFs play in acquisition. PMs going through the process of platform modernization realize that prototyping can hold the potential to reduce costs and speed up delivery while achieving required performance specifications. The readings highly suggest that prototyping can make the materiel acquisition process more efficient. The most common benefits appear to be the ability to refine requirements, reduce technical risks and validate designs early. Given the right Army and RDECOM management support, all of the PIF managers surveyed strongly feel that their facilities can play a role in tightening the linkages between RDECOM's S&T efforts and the PMs, PEOs, and the Army materiel acquisition community. One of the challenges in bridging the gap from S&T to PoRs is the fact that the government does not currently buy technical data packages for contractor technology development efforts. Using PIFs as part of S&T execution can result in government-owned technical data packages that can then be used by PMs to facilitate tech insertion.

Recommendations

The PIFs can clearly help the RDECs, other government agencies, and commercial companies to upgrade or build new systems, produce critical parts, and perform critical systems

engineering integration tasks. The RDECOM PIFs have proven they can take a requirement and develop a solution quickly to get it in the hands of the users. Rapid prototyping and systems integration have been the mainstay of the PIFs for the past 10 years, and I feel they have shown great successes supporting the warfighter as threats have changed, translating into reductions in fatalities on the battlefield. The PIFs have increasingly used new technologies to support rapid prototyping and reverse engineering for platform modernization, which can now be used to drive down costs by streamlining the acquisitions process. Rapid prototyping allows for a subsystem or system that is almost complete to be designed and fabricated, reducing system failures and costs due to unforeseen problems.

RDECs have the responsibility to prepare industry to be ready to manufacture systems for acquisition. While Congress does allow the PIFs to produce limited military systems and subsystems, RDECOM must not compete with industry, but partner with them to inform them about requirements. We must, however, realize that commercial industry will leave a business area if there is not a market for it or if the profit is not great enough to entice it to remain in the business. Prototypes by the government have historically been used to reduce technology risk and enhance manufacturing readiness, but not to fulfill the requirement for competitive prototypes to mature capabilities beyond TRL 6 as required in WSARA. PMs currently are looking for choices from industry in competitive prototyping to drive down costs and prepare the industrial base for large buys and are not seeking RDECOM competitive prototypes. Previous RDECOM leadership had tried to promote the idea of building RDECOM prototypes, but the idea never left the PowerPoint slide show.

Using the RDECOM PIFs' recognized state-of-the-art rapid prototyping capability, PIFs can provide a temporary manufacturing capability and rapidly respond to provide manufacturing

services until transition to an organic or commercial industrial base occurs. This capability includes the ability to provide full life-cycle support from design concept to fielding and sustainment of limited production items, which is a unique capability within the Army. Being geographically dispersed throughout the U.S. and having the ability to perform classified work gives PIFs direct access to customers and a variety of programs. Below is a list of recommendations based on the literature and survey results that highlight areas that could help the PIFs sustain and grow operations:

- RDECs should invest in the PIFs through capital improvements, funded through Section 219 or overhead dollars.
- PIFs should partner rather than compete with depots and industry.
- RDECOM and RDEC management should encourage the PIFs to collaborate rather than compete with one another.
- The RDECOM G-5 (Communications) should generate additional awareness of PIF capabilities within the DoD and industrial community.
- RDECOM management should plan to look for operational efficiency within the command by optimizing workload distribution. They will need to assess whether a centrally managed PIF enterprise would reduce duplication and foster cooperation.
- RDECOM management should work with ASA(ALT) to understand why the PIFs are unable to capitalize on WSARA in the area of prototyping.
- PIFs must continue to support development of RDECOM's systems engineering skills and expand this support to include contractors.

- PIFs, the RDECOM Manufacturing Technology Program Office and ASA(ALT) should find opportunities for the PIFs to support the Army's Manufacturing Technology Program.
- PIFs should perform Reverse Engineering in the areas of reliability and maintainability analysis and work with DLA on manufacturing obsolescent components, which may no longer be available from the original vendor.
- RDECs need to use in-house prototyping to validate 6.2 and 6.3 advanced system concept programs, and they must not contract out mission-funded prototype work. RDEC management might need to institute a PIF right-of-first-refusal before work is contracted out.
- RDECs, PIFs, and the Army Small Business Innovation Research (SBIR) Office must offer SBIR contractors the use of the PIFs for prototype fabrication to meet Phase II contract deliverables.
- PIFs should expand its customer relationship with SOCOM and Asymmetric Warfare Group.

There are a few additional points worth noting from the survey results. On the question of whether RDECOM management should look for operational efficiency within the command by optimizing workload distribution among the PIFs, the opinion was split. One side felt that developing a Community of Practice would help foster collaboration and sharing of technology and lessons learned. Those who opposed RDECOM management were very strong in their opinion. From my years working in RDECOM headquarters, it is my observation that a movement toward centralized management of the RDECOM PIFs would not improve efficiency or necessarily add value. Communities of Practice, on the other hand, are gaining favor within RDECOM because of the shared responsibility of this approach. I feel that centralized

management will not work because each PIF employs its own unique business model, aimed at that RDEC's customer needs, technologies, and priorities. It is clear from this study that each PIF's work is based on customer-driven requirements that have shaped each PIF's size, strength, and capabilities. They feel they have operated successfully in a free-market environment based on the need to attract customers to survive. This, along with the dedication of the PIF employees who strongly believe in the mission, has enabled them to thrive during the Iraq and Afghanistan conflicts. This same motivation will allow them to prepare to be agile and adapt to the changing marketplace as OCO dollars decrease.

Through consideration and implementation of these and other measures, it is projected that the RDECOM's PIFs can survive and thrive in the Army's post-war economic environment. Plans need to be made now to keep these facilities operating at a stainable level to allow them to grow quickly when needed for the next conflict. RDECOM will continue to develop and produce technical solutions that need to be fielded quickly to fill a new user requirement. PIF capabilities have become critical and an integral part of the Army's technology development and acquisition process. PIFs are an important part of RDECOM and serve a vital role in bridging the gap between research and development and the warfighter.

References

Booz Allen Hamilton. (2013). *Streamlining the process: Improving defense acquisitions through rapid prototyping*: *A candid survey of federal employees.* Retrieved from http://www.govexec.com/gbc/streamlining-process-improving-defense-acquisitions-through-rapid-prototyping/61672/

Coffey, T. (2013). *"Chance favors only the prepared mind:" The proper role for U.S. Department of Defense science and engineering workforce* (DTP-103). Washington, DC: Center for Technology and National Security Policy, National Defense University.

Defense Acquisition University. (2014). *Modification management*. Retrieved from https://dap.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=dc45b209-ec73-48be-ad61-65c798396a75

Innovationseeds. (2014). *TRL scale*. Retrieved from http://www.innovationseeds.eu/Virtual_Library/Knowledge/TLR_Scale.kl

Institute of Land Warfare. (2011). *The Army budget fiscal year 2012: An analysis*. Retrieved from http://www.ausa.org/publications/ilw/Pages/default.aspx

Muzzelo, L. (2013). *Technical data rights for advanced development science and technology projects.* Senior Service College Fellowship Research Report. Aberdeen Proving Ground, MD: Defense Acquisition University Press.

National Research Council, Committee on Accelerating Technology Transition. (2004). *Accelerating technology transition: Bridging the valley of death for materials and processes in defense systems*. Washington, DC: National Academy of Sciences Academies Press.

Perich, A. (2014b, January). *RDECOM prototype integration facilities (PIFs).* Briefing presented to Mr. Hewitt, Deputy Director RDECOM. Aberdeen Proving Ground, MD.

Quinn-Doggett, K. (2008). *Prototyping integration facilities (PIF) business strategy*. Unpublished manuscript. RDECOM Strategic Planning Office. Aberdeen Proving Ground, MD.

RAND Corporation. (2014). *Rapid acquisition of Army command and control systems.* Washington, DC: Author.

Rogers, P. (2013, May). *RDECOM engineering and manufacturing technology PIF enterprise.* Briefing presented to the Army Science Board. Aberdeen Proving Ground, MD.

Stadterman, T. (2012). *Improving U.S. Army analysis of alternatives to better address the Weapons Systems Acquisition Reform Act of 2009.* Senior Service College Fellowship Report. Aberdeen Proving Ground, MD: Defense Acquisition University Press.

U.S. Army PEO STRI. (2014). *Home page*. Retrieved from http://www.peostri.army.mil/

U.S. Army Research, Development and Engineering Command. (2013a). *Maximizing land combat power*. Unpublished manuscript. RDECOM. Aberdeen Proving Ground, MD.

U.S. Army Research, Development and Engineering Command. (2013b). *Memorandum of understanding (MOU) among the Research, Development and Engineering Command (RDECOM) Prototype Integration Facility (PIF) organization*. Unpublished manuscript. RDECOM. Aberdeen Proving Ground, MD.

U.S. Army Research, Development and Engineering Command. (2013c). *RDECOM campaign plan*. Unpublished manuscript. RDECOM Public Affairs Office. Aberdeen Proving Ground, MD.

U.S. Army Research, Development and Engineering Command. (2013d). *RDECOM lab infrastructure*. Briefing presented during the ASA(ALT) RD&E reviews. Washington, DC.

U.S. Army Research, Development and Engineering Command. (2013e, December). *Unique RDECOM Facilities Data Call Tasker to AMC*. Personal communication with RDECOM G4/9, Aberdeen Proving Ground, MD.

U.S. Army Research, Development and Engineering CommandPublic Affairs Office. (2014, March). RDECOM partnerships. *Army Technology*, *2*(2), 6. Retrieved from http://usarmy.vo.llnwd.net/e2/c/downloads/333507.pdf

U.S. Army Science Board. (2013). *Fiscal year 2012 study: The strategic direction for Army science and technology*. Retrieved from http://www.fas.org/irp/doddir/army/asb-strat.pdf

U.S. Department of the Army. (2013). *2012 Army small business innovative research commercialization brochure*. Retrieved from www.armysbir.army.mil

U.S. Department of Defense, Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer. (2013a, May). *Overseas contingency operations, Addendum A.* Retrieved from http://comptroller.defense.gov/

U.S. Department of Defense. (2013b, November). *U.S. Department of Defense Instruction: Operation of the defense acquisition system, Number 5000.02*. Retrieved from http://www.dtic.mil/whs/directives/corres/pdf/500002_interim.pdf

U.S. Department of the Interior. (n.d.). *CRADAs—Cooperative research & development agreements.* Retrieved from http://www.doi.gov/techtransfer/crada.cfm

Williams, C. (2009, August). Prototype Integration Facility (PIF) opens its doors. *TARDEC S&T News Update Volume 6*(8). Retrieved from http://www.tardec.info/GVSETNews/print_issue.cfm?hdst=fdbk&iid=0608

Glossary of Acronyms and Terms

APG.....Aberdeen Proving Ground

AMC .....Army Materiel Command

AMRDEC .....Aviation & Missile Research, Development & Engineering Center

AMS.....Army Modernization Strategy

ARDEC.....Armament Research, Development & Engineering Center

ARL.....Army Research Laboratory

AT&L.....Acquisition, Technology and Logistics

ATD……...Advanced Technology Development

ASA(ALT).....Office of the Assistant Secretary of the Army for Acquisition, Logistics, and Technology

AWG……..Army Asymmetric Warfare Group

BA.....Budget Activity

CERDEC.....Communications & Electronics Research & Development Engineering Center

C4ISR.....Command, Control, Communications, Computers, Intelligence, Surveillance & Reconnaissance

COCOM.....Combatant Command

CoP…….Communities of Practice

DAG.....Defense Acquisition Guidebook

DAU.....Defense Acquisition University

DCMA.....Defense Contract Management Agency

DLA……Defense Logistics Agency

DoD.....Department of Defense

ECBC.....Edgewood Chemical Biological Center

FAST.....Field Assistance in Science and Technology

GAO .....General Accounting Office

H0 .....Null Hypothesis

H1.....Alternate Hypothesis

IPT .....Integrated Product Team

JCOA……..Joint and Coalition Operational Analysis

LCMC .....Lifecycle Management Command

MS.....Milestone

MSC.....Major Subordinate Command

NDI .....Non-Developmental Item

NSRDEC.....Natick Soldier Research, Development & Engineering Center

OGA.....Other Government Agency

O&M……..Operation and Maintenance

OMA .....Operation and Maintenance, Army

OCO .....Overseas Contingency Operations

OEF .....Operation Enduring Freedom

OSD.....Office of the Secretary of Defense

PE……..….Program Element

PEO.....Program Executive Office

PIF.....Prototype Integration Facility

PM.....Project Manager

POM.....Program Objective Memorandum

PoR.....Program of Record

R&D.....Research & Development

RD&E .....Research, Development & Engineering

RDEC.....Research, Development & Engineering Center

RDECOM .....Research, Development & Engineering Command

RDT&E .....Research, Development, Test & Evaluation

RFEC.....RDECOM Forward Element Command

RFI .....Request for Information

SBIR……..Small Business Innovation Research

SME .....Subject Matter Expert

S&E.....Science and Engineering/Scientists and Engineers

SSCF……..Senior Service College Fellowship

S&T.....Science & Technology

STRI.....Simulation, Training, and Instrumentation

TARDEC.....Tank Automotive Research, Development & Engineering Center

TDR……Technical Data Rights

TRADOC .....Training and Doctrine Command

TRL .....Technology Readiness Level

WSARA .....Weapon Systems Acquisition Reform Act

USD(AT&L) ..Under Secretary of Defense for Acquisition, Technology and Logistics

Appendix A – Survey Instrument

Maintaining the U.S. Army RDECOM PIFs

Introduction

It is well recognized that the U.S. Army Research Development and Engineering Command (RDECOM) Prototype Integration Facilities (PIFs) provide an unmatched and critical capability within the army industrial base, supporting RDECOM's over-arching Science & Technology (S&T) strategic goal of transitioning technology to the warfighter. Since their inception they have provided a rapid method to field urgently needed products directly to the warfighter and serve a vital role in bridging the gap between S&T and the user community. They provide the agility necessary to rapidly upgrade current systems to counter urgent threats, as well as the agility to develop, apply and evaluate leap-ahead technology for future combat systems.

In this time of reduced budgets and operational changes as the war winds down, the RDECOM PIFs will need to leverage each other and adapt to new mission areas so they can be maintained and grow to continue to support RDECOM S&T, PMs, PEOs and LCMCs.

This survey is designed to ask senior Government Civilian/Military subject matter experts that work within the RDECOM PIFs to identify some of the PIF strengths, weaknesses, opportunities and threats, to help assess the impact that the anticipated funding decreases will have at each PIF.

When answering questions, please use generic terms and refrain from revealing confidential or classified information. The results of this survey will be included in my research paper as part of the Senior Service College Fellowship at the Defense Acquisition University.

Please read the following RDECOM STATEMENT.

If you have any technical questions please contact me, thomas.haduch@dau.mil. For RDECOM adminstrative questions please contact COL Hughes, Asst. Chief of Staff,
RDECOM, 410-306-4807 or 410-306-2966, frederick.j.hughes2.mil@mail.mil.

Please complete the survey NLT 12 FEB 2014.

Thank you for your support.

Sincerely,
Thomas Haduch
US Army RDECOM DAU Fellow

RDECOM Mandatory Statements

1) PRIVACY ACT STATEMENT

a) In accordance with the Privacy Act of 1974 (Public Law 93-579), this notice informs you of how the "Maintaining the U.S. Army Research, Development and Engineering Command Prototype Integration Facilities" Sample Survey of RDECOM Personnel findings will be used. It also provides information required by the Privacy Act.

Please read it carefully.

b) Authority: This is not an official, approved Army survey. This student survey is intended to support Mr. Thomas Haduch's Defense Acquisition University (DAU) Senior Service College Fellowship Program research paper requirements. Mr. Haduch is a RDECOM HQ employee and is currently in long term training as a DAU Senior Service College Fellow. The Director and this Command supports this study topic endeavor and encourages your assistance in helping Mr. Haduch complete his research paper requirements.

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Maintaining the U.S. Army RDECOM PIFs

c) Principal Purpose: The purpose of this survey is to obtain your RDECOM Prototype Integration Facility (PIF) experiences and opinions to gain insight into the PIF challenges and opportunities with the war winding down and declining DoD budgets.

d) Routine Uses: The survey findings will be included as part of a Defense Acquisition University, Senior Service College Fellowship research paper. Upon occasion, findings may be released to the Defense Acquisition University for educational purposes and the U.S. Army Research and Development Command upon request.

e) Disclosure: Providing information on this survey is voluntary. There is no penalty for not responding to any question.

f) Confidentiality: Your survey responses will be treated as confidential. We will not identify you and we will NOT include your name or other personally identifiable information in any report. Only group statistics will be reported. There are procedures in place to protect against accidental or unauthorized disclosure of survey responses. However, we cannot provide "confidentiality" or "non-attribution" to a participant regarding comments involving criminal activity/behavior or statements that pose a threat to yourself or others. Do NOT mention classified or operationally sensitive information.

RDECOM Mandatory Statements (continued)

2) INFORMED CONSENT NOTICE

a) In accordance with AR 70-25 (Use of Volunteers as Subjects of Research), this notice informs you of the provisions for the protection of human subjects for this research.

b) Purpose: This survey asks Soldiers and/or Government Civilians to share their experiences and opinions of the RDECOM Prototype Integration Facilities. The research findings will be used by Mr. Thomas Haduch, Defense Acquisition University, Senior Service College Fellow, to be included as part of his Defense Acquisition University, Senior Service College Fellowship research paper.

c) What you will be asked to do in this survey: You will be asked to read over the survey, answer questions if you choose to do so, and return the survey using the web-link instructions provided, https://www.surveymonkey.com.

d) Location: This project will be conducted virtually through the web-based survey.

e) Voluntary Participation: Providing information on this survey is voluntary. Any question may be skipped and you may continue answering the following questions. There is no penalty if you refuse to participate or decide at any time to discontinue participation. Answering survey questions indicates your informed consent.

f) Time Required: 2 weeks upon receipt of the survey request, NLT 12 FEB 2014.

g) Risks: This data collection is not expected to involve any risk or discomfort to you.

h) Benefits: While there is no direct benefit for your individual participation, your responses on this survey make a difference.

i) Compensation: No compensation is provided for your participation.

j) Confidentiality: Individual confidentiality will be maintained. Your survey responses will be treated as confidential. We will not identify you and we will NOT include your name or other personally identifiable information in any report. Only group statistics will be reported. There are procedures in place to protect against accidental or unauthorized disclosure of survey responses. However, we cannot provide "confidentiality" or "non-attribution" to a participant regarding comments involving criminal activity/behavior or statements that pose a threat to yourself or others. Do NOT mention classified or operationally sensitive information.

3) Whom to contact if you have questions about the survey or your rights as a participant:

Maintaining the U.S. Army RDECOM PIFs

James R. Oman
Director, Senior Service College Fellowship Program
Capital and Northeast Region Defense Acquisition University
Aberdeen Proving Ground, MD
Office: 410-272-9470
BB: 703-254-3255
James.oman@dau.mil

***1. Do you currently work in a RDECOM Prototype Integration Facility (PIF) as a Government employee?**

This survey is intended for current RDECOM Prototype Integration Facility Military and Government Employees only. If you select No, you will be taken out of the survey.

- ◯ Yes
- ◯ No

2. In which Prototyping Integration Facility do you work?

- ◯ Armament Research, Development and Engineering Center
- ◯ Aviation and Missile Research, Development and Engineering Center
- ◯ Communications-Electronics Research, Development and Engineering Center
- ◯ Edgewood Chemical Biological Center
- ◯ Tank Automotive Research, Development and Engineering Center
- ◯ Natick Soldier Research, Development and Engineering Center

3. Is your PIF embedded within one or more of your Research, Development and Engineering Center mission directorates or is it a dedicated stand-alone PIF?

- ◯ Embedded
- ◯ Stand-alone
- ◯ Mix

4. What is your position title and series: (i.e. Mechanical Engineer – 830)

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Maintaining the U.S. Army RDECOM PIFs

5. What is your role in the Prototyping Integration Facility?

- ◯ Manager (i.e. Supervisor, Team Leader)
- ◯ Engineer
- ◯ Technician
- ◯ Other (please specify)

6. How many years of experience do you have working in the PIF?

- ◯ <1 year
- ◯ 1-5 years
- ◯ 6-10 years
- ◯ 11-15 years
- ◯ > 15 years

Maintaining the U.S. Army RDECOM PIFs

7. Select the ranking of the services (1 to 10) your PIF performs CURRENTLY, from most work (1) to least work (10). Then select how you determined your ranking, either based on workload or funding; if you selected "other," discuss your rationale.

	Ranking	Rationale
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act		
Integrate solutions in response to rapid response customer requirements		
Science and Technology Prototyping to support Advanced Concept Development		
PM support		
Perform manufacturing support		
Perform reverse engineering		
Perform conceptual modeling and animation		
Develop training devices/aids/software apps		
Develop technical data packages		
Other (Describe Below)		

Describe Other Services and/or Other Ranking Rationale Used

Maintaining the U.S. Army RDECOM PIFs

8. Select the ranking of the services (1 to 10) your PIF performed 3 YEARS AGO from most work (1) to least work (10). Then select how you determined your ranking, based on workload or funding; if "other" is selected, discuss your rationale.

	Ranking	Rationale
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act		
Integrate solutions in response to rapid response customer requirements		
Science and Technology Prototyping to support Advanced Concept Development		
PM support		
Perform manufacturing support		
Perform reverse engineering		
Perform conceptual modeling and animation		
Develop training devices/aids/software apps		
Develop technical data packages		
Other (Describe Below)		

Describe Other Services and/or Other Ranking Rationale Used

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Maintaining the U.S. Army RDECOM PIFs

9. Select in rank order the services (1 to 10) your PIF performed 5 YEARS AGO from most work (1) to least work (10). Then select how you determined your ranking, based on workload or funding; if "other" is selected, discuss your rationale.

	Ranking	Rationale
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act		
Integrate solutions in response to rapid response customer requirements		
Science and Technology Prototyping to support Advanced Concept Development		
PM support		
Perform manufacturing support		
Perform reverse engineering		
Perform conceptual modeling and animation		
Develop training devices/aids/software apps		
Develop technical data packages		
Other (Describe Below)		

Describe Other Services and/or Other Ranking Rationale Used

10. In general do you feel your PIF receives work because of your RDEC's location in relation to your customers?

- ◯ Very Frequently
- ◯ Frequently
- ◯ Occasionally
- ◯ Rarely
- ◯ Never

Maintaining the U.S. Army RDECOM PIFs

11. In general do you feel your PIF receives work because of your RDEC's technical competence?

- ◯ Very Frequently
- ◯ Frequently
- ◯ Occasionally
- ◯ Rarely
- ◯ Never

12. Consider the CURRENT amount of resources applied to each of the listed PIF activities. Please select the statement which most closely reflects your opinion regarding the balance of these activities. If you feel the current balance of work in an area should change, please explain why in the box below each.

	right balance of work in this area	should do more using current resources	should do more with additional resources	should reduce level of effort in this area	currently do not perform any work in this area
Develop competitive prototypes in accordance with the Weapon System Acquisition Reform Act	◯	◯	◯	◯	◯
Reason balance should change:					
Integrate solutions in response to rapid response customer requirements	◯	◯	◯	◯	◯
Reason balance should change:					
RDECOM/RDEC Science and Technology Prototyping to support Advanced Concept Development	◯	◯	◯	◯	◯
Reason balance should change:					
PM support of their acquisition strategy	◯	◯	◯	◯	◯
Reason balance should change:					

Manufacturing

Reason balance should change:

Reverse Engineering

Reason balance should change:

Conceptual Modeling and Animation

Reason balance should change:

Training devices/aids/software apps development

Reason balance should change:

Technical data packages

Reason balance should change:

Other Activity not listed - Describe in the Text Box Below

Reason balance should change:

Maintaining the U.S. Army RDECOM PIFs

13. What percentage (using work hours) of your PIF's products or services are used by RDECOM's core Army mission Science & Technology programs (Budget Activity 6.2: Applied Research or Budget Activity 6.3: Advanced Technology Demonstration)?

- ◯ 0 %
- ◯ 1-10%
- ◯ 11 - 20%
- ◯ 21 - 30%
- ◯ >30 %
- ◯ unknown

14. What Arsenal(s) and Depot(s) is your PIF the most aligned with (check all that apply):

- ☐ Anniston Army Depot, AL
- ☐ Blue Grass Army Depot, KY
- ☐ Corpus Christi Army Depot, TX
- ☐ Deseret Chemical Depot, UT
- ☐ Letterkenny Army Depot, PA
- ☐ Red River Army Depot, TX
- ☐ Sierra Army Depot, CA
- ☐ Tobyhanna Army Depot, PA
- ☐ Tooele Army Depot, UT
- ☐ Umatilla Chemical Depot, OR
- ☐ Rock Island Arsenal
- ☐ Watervliet Arsenal
- ☐ Pine Bluff Arsenal
- ☐ Other (please specify)

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15. Who does your PIF work/team with the most often? (Pick up to 2)

- ☐ Other Government Agencies
- ☐ Industry
- ☐ Depots
- ☐ Other (please specify)

16. What basis or mechanism(s) does your PIF use to facilitate PIF - Industry interaction (check all those that apply)?

- ☐ Co-located with industry partner
- ☐ Contracts or Agreements
- ☐ Industry events such as Industry Days
- ☐ PM sponsored work
- ☐ Other (please specify)

17. Rank order (1 to 7) your current support efforts (1 being the most supported, 7 being the least supported); select the rationale used for your ranking:

	Ranking	Rationale
Current Operations		
Army PEOs/PMs		
AMC Depots/Arsenals		
Army Field Support Brigade		
RDECOM S&T support		
Other DoD or Government Agency S&T support		
Other		

Other (please give organization name and specify "other" rationale used to make your ranking determination)

Maintaining the U.S. Army RDECOM PIFs

18. With whom and what percentage of your workload is Rapid Response work? Rapid Response is defined as the work your PIF performs based on short time delivery requirements demanded by your customer to meet a current, critical or operational need (must add to 100%):

	Percentage
PM	
COCOM	
Other	

Other (please specify)

19. Who are the other potential alternative sources your PIF customers could use? (Check all that apply)

- [ ] Other Government Agencies
- [ ] Industry
- [ ] AMC Depots/Arsenals
- [ ] Other
- [ ] No other alternative source
- [ ] Other (please specify)

20. What do you think is the greatest distinction between your PIF and this alternative source and why?

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21. Consider each category of work below. What factor(s) did your customers consider when they selected your PIF over other alternative sources to perform that work? Identify other potential alternative sources if known.

	Cost	Schedule	PIF Location	Performance	My PIF does not perform this type of work
1. Integrate solutions in response to rapid response customer requirements	☐	☐	☐	☐	☐
2. Science and Technology Prototyping to support Advanced Concept Development	☐	☐	☐	☐	☐
3. PM Support	☐	☐	☐	☐	☐
4. Manufacturing	☐	☐	☐	☐	☐
5. Reverse Engineering	☐	☐	☐	☐	☐
6. Conceptual Modeling and Animation	☐	☐	☐	☐	☐
7. Training devices/aids/software apps development	☐	☐	☐	☐	☐
8. Technical data packages	☐	☐	☐	☐	☐

Other Potential Alternative Source(s)

Maintaining the U.S. Army RDECOM PIFs

22. Consider each category of work below. What factor(s) did your customers consider when they DID NOT select your PIF to perform that work and decided to use an alternative source?

	Cost	Schedule	PIF Location	Performance	My PIF does not perform this type of work
1. Integrate solutions in response to rapid response customer requirements	☐	☐	☐	☐	☐
2. Science and Technology Prototyping to support Advanced Concept Development	☐	☐	☐	☐	☐
3. PM Support	☐	☐	☐	☐	☐
4. Manufacturing	☐	☐	☐	☐	☐
5. Reverse Engineering	☐	☐	☐	☐	☐
6. Conceptual Modeling and Animation	☐	☐	☐	☐	☐
7. Training devices/aids/software apps development	☐	☐	☐	☐	☐
8. Technical data packages	☐	☐	☐	☐	☐

23. In general what capabilities do you have in the PIF that should be better utilized/leveraged (check all that apply)?

- ☐ Science and Technology Prototyping to support Advanced Concept Development
- ☐ PM technology integration support
- ☐ Temporary Manufacturing
- ☐ Reverse Engineering
- ☐ Conceptual Modeling and Animation
- ☐ Training devices/aids/software apps development
- ☐ Technical data packages
- ☐ Other (please specify)

Maintaining the U.S. Army RDECOM PIFs

24. In general what capabilities do you have in the PIF that are the least productive use of the PIF capabilities (check all that apply)?

- [ ] Science & Technology Prototyping to support Advanced Concept Development
- [ ] PM technology integration support
- [ ] Temporary manufacturing
- [ ] Reverse engineering
- [ ] Conceptual Modeling and Animation
- [ ] Training devices/aids/software apps development
- [ ] Technical data packages
- [ ] Other (please specify)

25. What PIF services do you currently not provide that would help your PIF generate additional business to offset diminishing supplemental funding?

26. RDECOM Policy 55, Enterprise Collaboration, describes a Community of Practice (CoP) organizational approach that enables a unity of effort for visibility, governance, knowledge sharing in a charters task organized structure. Do you believe that RDECOM would benefit by executing the PIFs as a CoP? Please include rationale for your assessment.

27. List significant customer(s) (up to 5) that would be considered "non-traditional customers" of your RDEC, i.e. non-government, non-Army, Homeland Security, Department of Justice, State and local Law Enforcement Agencies, etc. Do not provide any organization information that might be sensitive.

1
2
3
4
5

Maintaining the U.S. Army RDECOM PIFs

28. It is generally understood that PIFs are self-sustaining through customer reimbursable funding. If your PIF receives RDEC overhead funds, to include Section 219 funding under the National Defense Authorization Act of 2009, for personnel costs or infrastructure improvements, please select the percentage of personnel related funding and capital investment funding you receive, using your total annual PIF budget as the base in your estimate. If you do not receive overhead funds, select 0%.

	Percentage
Personnel Salary Costs	
Personnel Training Costs	
PIF Capital Equipment and Facility Investments	

29. Do you feel your PIF receives overhead funding from your parent RDEC in proportion to the overhead funding paid by PIF customer reimbursable funding?

- ◯ Yes
- ◯ No
- ◯ Abstain

30. It is expected that PIF customer funding will decrease and focus will shift from quick reaction customer work back to supporting traditional mission technology base programs. What will be the biggest impact to your PIF if customer funding decreases?

31. Systems engineering and integration skills are critical for effective prototyping. Do you feel that your RDEC recognizes and utilizes the opportunities the PIFs provide for RDEC engineers to hone their systems engineering skills?

- ◯ Yes
- ◯ No
- ◯ I am not sure

Maintaining the U.S. Army RDECOM PIFs

32. Has "The Weapons Systems Reform Act" requiring that competitive prototyping be addressed before progressing to MS B had an impact upon your PIF? If so, please describe below.

- ◯ Have NOT seen any changes in PIF workload related to supporting WSRA activities
- ◯ I have seen the following changes in PIF workload related to supporting WSRA

33. Please provide any additional comments you feel are relevant. Also, please indicate if the survey was completed as a group.

Appendix B – Narrative Responses (Survey Questions 12, 20, 25, 26, 30, 33)

Question 12: *What comments do you have regarding the balance of activities and the amount of resources applied to your PIF's current activities?*

1. We are 100% customer driven—if they don't pay us to do these we won't do it. Workload is dictated by customer demand.

2. Diminishing commercial industrial base capability where it is becoming increasingly difficult for government to rely upon industry to develop and provide solutions.

3. PMs and RDECOM PIFs can work together to build a government capability for competitive prototypes and support manufacturing studies. PM and RDECOM investment will be required. There are many areas where such investments would be helpful to the PM community.

4. Customer demand does not currently require competitive prototyping—only the customer can determine what our workload balance should be—we must be flexible to adjust manpower and facilities to quickly adjusting requirements. Could do more, but our customers currently do not feel obligated to do this given budget constraints.

5. Science and Technology Prototyping to support Advanced Concept Development—even though some PIFs do work in this area, we still see opportunities to do more.

6. Many tech base programs do not have PIF/manufacturing as part of their IPTs. PIFs have worked with systems engineering to bring manufacturing into the design IPT earlier. We still see an opportunity in this area.

7. Need to reduce the competitive nature within the RDECs and internally within each RDEC (PIF vs. S&T Directorates). PIFs should be involved to a greater extent in prototyping technology demonstrators. Need to be integrated more into the S&T efforts.

8. Work often placed on contract that we could perform and allow S&T engineers gain hands-on experience.

9. My PIF has encountered many PMs who have an incomplete understanding of the quality and health of their technical data. When prototypes and parts are made in industry, data is oftentimes incomplete or not updated properly. PMs can benefit from more PIF support in this area.

10. Manufacturing—some technical skills have been lost in the last several years and not replaced.

11. Should be able to engage in supporting with reverse engineering and manufacturing of low-quantity items where the traditional source is no longer in business.

12. My organization is extremely conservative in allowing us to perform reverse engineering work for legal reasons.

13. Conceptual Modeling and Animation—personnel underutilized, very strong capability with high impact and available resources.

14. Training devices/aids/software apps development—personnel underutilized, very robust integrated capability with high return on investment (ROI).

15. Technical data packages—very mature capability that has been inappropriately scaled back due to OMA/AWCF budget cuts. There is an opportunity for RDECOM to raise the quality of product data through the enterprise activities of PIFs. When PIFs make parts, there is certainty in the quality of the product data. There is opportunity to store this product data (including manufacturing data) to help PM customers as well as depots.

16. When PIFs develop prototypes and manufacturing processes, this information can support the depot community as a corporate learning curve, helping depots and arsenals become more competitive.

17. We view our balance of activities [as] driven by our competence and capacity to support the customer. If an area is out of balance we feel it is our responsibility to reshape if we want to lure that business.

18. The amount of funding received is inconsistent with the level of support provided.

Question 20: *What do you think is the greatest distinction between your PIF and alternative sources for PIF services?*

1. Our ability to perform rapid response work.

2. We are expensive and not well led.

3. Focused, experienced, no contract requirements, ability to be nimble and change course instantly with no penalty. Best interest of government is our focus.

4. We have a government-owned, government-operated facility. Our customers get the best of both worlds, they interface with a government person, and we can touch industry as required.

5. Commodity competency and capability built to support those competencies. My PIF has specialized capability and engineering staff to support the materials and manufacturing processes for advanced munitions and weapons; we have specialized capability with advanced metals, such as titanium, tungsten, molybdenum as well as specialized manufacturing processes. The PIF provides innovations to the manufacturing processes to support these advanced needs through ManTech (manufacturing technology programs).

6. The PIF prides itself on our energized, highly trained, entrepreneurial spirited workforce. This highly integrated team which cannot easily be duplicated anywhere.

7. The people and their personal and professional relationships.

8. The people, attitudes, motivation, and culture are a huge distinction.

9. The people and their attitude

10. Technology focus

11. Subject Matter expertise

12. Location, expertise, lack of need for a contract. No worries about expensive Engineering Change Proposals.

13. Government subject matter experts that want to build the best vs. industry that needs to make a profit (not implying poor technical knowledge of contractors).

14. Have the most experience to support vehicle development.

Question 25: *What PIF services do you currently not provide that would help your PIF generate additional business to offset diminishing supplemental funding?*

1. Partnerships with industry

2. Working with DLA to re-engineer and validate product data for hard-to-source parts. As part of the larger DLA/AMC performance-based agreement (PBA), there is an opportunity to update and modernize technical data for many systems and components that are hard for DLA to source. This would lower cost to the Army in its acquisition of parts through DLA and address significant issues of long lead-times to support sustainment.

3. Manufacturing moderate to high quantities—spares for procurement.

4. Manufacturing Pilot Production/Process Development.

5. Additive Manufacturing, electronic circuit board manufacturing, carc painting

6. Engineering, CAD

Question 26: *Do you believe that RDECOM would benefit by executing the PIFs as a Community of Practice (CoP)?*

1. Yes, it would be a good idea to leverage shared knowledge and experience.

2. I believe that Knowledge Sharing between groups is the base to spread technology, but we seem to get bogged down with internal politics and weak leadership.

3. I think if you try to have all the PIFs work as a CoP it will tear them apart. You must teach them to become responsible leaders and hold them responsible before you can get them to work as a team.

4. I think RDECOM would benefit by executing as a CoP because work could be distributed around to the PIFs.

5. No, each PIF is embedded as part of their sponsoring RDEC and works under their own business model optimized for that RDEC's requirements and priorities.

6. No, my experience is the unintended consequence of collaboration is lane definition and forced work strategies. This simply does not support a customer-funded environment.

7. Yes, as a chartered group as the PIF Council, I believe we are already operating and practicing this policy.

8. No, customer-driven requirements (free market) should determine the size, strength, and capabilities of the PIF. Capitalism works pretty well. It naturally motivates and leans organizations according to performance and need.

9. I believe PIFs should leverage each other's capabilities, but I do not believe that a centralized RDECOM PIF entity should be in line with our customer's desires.

10. I believe the customer should drive the business base.

11. In order for this CoP to succeed, it must respect the autonomy of each of the PIFs.

12. Significant challenges must be overcome in the areas of governance and unity of effort.

13. Yes, the greater visibility at a higher level than the RDEC can only benefit the reputation of RDECOM

14. No, we have a Charter written that provides a framework for interaction between the Centers.

15. Should not be necessary if swim lanes (areas of expertise) are understood by PEOs/PMs. e.g. if 51% or more of a job involves antenna design/placement it goes to CERDEC, if 51% is weapon design it goes to ARDEC, if 51% involves integration onto a platform that is TARDEC, etc.

Question 30: *It is expected that PIF customer funding will decrease and focus will shift from quick reaction customer work back to supporting traditional mission technology base programs. What will be the biggest impact to your PIF if customer funding decreases?*

1. We seek more funding in mission technology base programs, which we have done prior to the onset of quick reaction work.

2. We will need to lower personnel levels.

3. Change of customer base and balance of type of work.

4. Change in contract support levels.

5. In a smaller market we can prove that we are a better value to the customer and thus increase our share of the market. New customers will need to be pursued to fill any gaps.

6. As a customer-funded organization, we evolve with our customer's requirements. The quick reaction work has allowed us to build relationships with PM customers so we can now

demonstrate the value of competitive prototyping and acquisition support. The main challenge in this area is to develop enough workload to in this new area to maintain the current level of workforce, which grew to meet the needs of rapid response.

7. Facilities will need to be reorganized and personnel may have to be reassigned.

8. Will see forced collaboration with the other PIFs.

9. PIF has built up extensive infrastructure to support highly complex programs and a decrease in customer funding will have an impact on that infrastructure.

10. In my opinion, we should adjust/flex to the customer's demands.

11. Pay of people will become a significant problem.

12. Downsize contractor workforce in proportion.

13. We will focus more on core, S&T funded activities.

Question 33: *Please provide any additional comments you feel are relevant.*

1. Collaboration and competition do not have to be mutually exclusive terms. Sharing business techniques and lessons learned is valuable, but forcing mission lanes does not endear us to our most important asset, the customer.

2. We should embrace the capitalistic approach and right size the organizations accordingly.

3. WSARA, depot collaboration, and other activities should be invoked by ASA(ALT) through their funding streams.

Appendix C – RDECOM RDECS*

Aviation & Missile Research, Development & Engineering Center

Mission: Deliver collaborative and innovative technical capabilities for responsive and cost-effective research, product development, and life-cycle systems engineering solutions.

Overview: AMRDEC is the Army's focal point for providing research, development, and engineering technology and services for aviation and missile platforms across the life cycle. AMRDEC provides a wide array of technologies, hardware and software applications, and products and services. These run the gamut from game-changing technologies to detect and destroy threats, enhance performance, lethality, survivability, and reliability of aviation and missile systems along with programs to miniaturize missile and aircraft components, provide modeling and simulation applications for these technologies and systems, and the associated training applications. Also, AMRDEC serves as the Department of Defense (DoD) lead for rotorcraft S&T as well as gel propellants.

Armament Research, Development and Engineering Center

Mission: Empower, unburden, and protect the soldier by providing superior armaments solutions that dominate the battlefield.

Overview: ARDEC develops advanced weapons, ammunition, and fire control systems for the U.S. Army, providing the technology for more than 90%of the Army's lethality. These technologies include energetics, warheads, directed energy, integrated weapon systems, and networked fire control. ARDEC understands the importance of working with soldiers to provide solutions to their unique challenges and equipment requirements.

Communications-Electronics Research, Development and Engineering Center

Mission: To develop and integrate C4ISR technologies that enable information and cyber dominance, and decisive lethality for the networked Soldier.

Overview: Whether soldier-borne or integrated onto ground or aviation platforms, the Army relies on CERDEC's technical expertise to develop, seek out, and engineer C4ISR integrated capabilities to address soldier needs. CERDEC's government-unique and world-unique facilities support a broad range of technical areas that leverage expertise in the radio, digital, and electronic realms of information technology and systems engineering.

Edgewood Chemical Biological Center

Mission: Integrate life-cycle science, engineering, and operation solutions to counter chemical, biological, radiological, nuclear, and high-yield explosive (CBRNE) threats to U.S. forces and the nation.

Overview: As the nation's principal research and development laboratory for countering chemical and biological weapons of mass destruction, ECBC provides solutions to complex CBRNE threats for both the military and the nation. Products, scientific advances, and critical advice are provided to support the total military acquisition life cycle from basic and applied research through demilitarization to address our nation's unique needs. ECBC employs a talented workforce with specialized experience as well as state-of-the-art CBRNE equipment and facilities. Using these intrinsic capabilities, ECBC can safely design, build, test, and support projects from original conception to a final product completely in-house. With a long history of developing cutting-edge technologies in the areas of detection, protection, and decontamination, ECBC is considered a national resource for CBRNE solutions. ECBC will continue to sustain the core competencies and workforce to counter enduring and emerging chemical and biological

threats and continue to create success for soldier and CBRNE clients to meet the evolving CBRNE defense needs.

Natick Soldier Research, Development and Engineering Center

Mission: RD&E to maximize the Soldier's survivability, sustainability, mobility, combat effectiveness, and field quality of life by treating the Soldier as a system.

Overview: NSRDEC supports the current fight and transforms the future force with the Soldier as the decisive edge. With a unique human-centric focus, NSRDEC adds value through basic science; technology generation, application, and transition enabling rapid fielding of the right equipment; Soldier systems technology integration and transition; and solving field problems rapidly.

Tank Automotive Research, Development & Engineering Center

Mission: Develop, integrate, and sustain the right technology solutions for all manned and unmanned DoD ground vehicle systems and combat service support equipment to improve current force effectiveness and provide superior capabilities for the future force.

Overview: TARDEC is the nation's laboratory for developing advanced military ground vehicle technologies, process integration expertise, and system-of-systems engineering solutions for force projection technology, ground vehicle power and mobility, ground vehicle robotics, ground systems survivability, and vehicle electronics and architecture.

** Source: U.S. Army Research, Development and Engineering Command. (2013a)*

Appendix D – RDECOM PIF Descriptions*

Prototype Integration Facility (PIF) Operations

- 22 Buildings
  - Approximately 385K square feet
- Contractor Facilities
  - Adds approximately 665K square feet
- Includes house fabrication, assembly, test, integration, laboratory, aircraft hangar, warehouse, chemical storage, and office space
- 120 Government and ~1000 Contractors
- 300+ Subcontractors
- 2000+ material vendors

AMRDEC Prototype Integration Facility (PIF)

PIF Mission: Through commitment, collaboration, and continuous improvement deliver best-value, rapid response hardware solutions for our customers.

Business Model: The PIF teams with government and industry partners leveraging specific capabilities to create a cadre of technical, business and manufacturing experts, providing flexible processes and reconfigurable facilities.

PIF Core Competencies:

- Rapid Response
  - Current Operations - Total requirements unknown, immediate need, quantity may be mission/threat specific.
  - Sustainment - OPTEMPO increases, Obsolescence, Source of supply for critical high demand items.
  - Technology Insertion - Prototype, Validation, Verification, & Production Unit, Post production modifications are usually mission specific & low quantity.
  - Acquisition - Independent cost estimates, Hardware to support proof of principle or risk reduction, Developing or Improving technical data for Government Purpose Rights.

Past / Recent Products and Innovations:

- Iraqi Armed 407
- OH-58F
- Kiowa Warrior Cockpit and Sensor Upgrade Program (CASUP)
- Customs and Boarder Patrol UH-60
- US Navy Autonomous Underwater Vehicle
- Patriot Fiber Optic Modem (PFOM)
- AH-1W – USMC – Gun Feed System, Software Integration, FMS Taiwan

Prototype Integration Facility (PIF) Operations

Validated Product Designs Transitioned to Depots Through Customers:

- **Solventless Propellant modernization process under development. Will transition to Redford Army Ammunition Plant**
- **Objective Gunner Protection Kit – Over 50,000 produced at Depots**
- **Picatinny Blast Shield (US, Canadian) – 533 produced at Depots**
- **Abrams Shields – 700 produced at Depots**

ARDEC Prototype Integration Facility (PIF) aka Manufacturing Technology Center

PIF Mission:

- Synchronize manufacturing readiness (MRL) with technology readiness (TRL)
- Validate engineering product design through manufacture of prototype hardware
- Stabilize designs in a pre-production environment by manufacturing and integrating hardware to establish mature product data
- Limited manufacturing capability for a customers needs in rapid response until transition to organic or commercial industrial base can occur.

Busine

PIF Core Competencies:

- Update technical data to reflect modern manufacturing methods
- Produce prototype quantities to assess manufacturing readiness (MRL maturity)
- Develop manufacturing data to support PM as a "Smart Buyer"
- Evaluate/update legacy supply-chains to address obsolescence

Past / Recent Products and Innovations:

- D1.9 Titanium Webbing Code
- Depot transition of titanium webbing

Prototype Integration Facility (PIF) Operations

- ISO-9001 registered QMS
- Engineering Analysis expertise (CAD Lab / FEA / CFD)
- System Engineering Integration Lab
- Fabrication & Integration Facilities
- Integrated 100,000+ sf facility
- Secure 139,000 sf hardstand
- MIL-STD-810 Test Lab

CERDEC **Prototype Integration Facility (PIF)**

PIF Mission:

Engineering design, development, fabrication, installation, integration, testing, and fielding of shelter, vehicular, aircraft, watercraft and soldier prototype C4ISR systems.

Business Model:

- Reimbursable / Customer Funded

PIF Core Competencies:

- Engineering and C4ISR Systems Design
- Fabrication, Assembly and Prototyping, and
- Environmental Testing and Evaluation for Integrated C4ISR Platforms

Past / Recent Products and Innovations:

- PM RADARS LCMR vehicle cab kit redesign
- PM WIN-T Inc 1 systems re-engineering
- USMC Tactical Imagery Production shelter systems design / build

Prototype Integration Facility (PIF) Operations

Advanced Design and Manufacturing (ADM), ECBC's PIF, Innovative Development of Warfighter Tools from Concept to Product

ECBC **Prototype Integration Facility (PIF)**

PIF Mission:

Use integrated design, engineering and manufacturing to get the right technology to the right place, at the right time.

Business Model:

Provide a combination of flexible design and fabrication capabilities that can be used to address urgent needs or accelerated programs by rapidly developing custom products anytime across the acquisition life cycle

Top Customer(s): DTRA, JPEO CBD.

PIF Core Competencies:

CBRNE Product Development, Additive Manufacturing, 3D Data Capture, Rapid Injection Molding, Conceptual Modeling and Animation including Mobile Interactive Training Applications

Past / Recent Products and Innovations:

- Colorimetric Reconnaissance Explosives Squad Screening (CRE$S)
- Second generation TAC-BIO
- Heavy Mobile Expeditionary Laboratory (HMEL)
- Global Strike, JSAM, Minehound Accessories
- Supports RFAST-C with process and site implementation, project work and (7) personnel

Prototype Integration Facility (PIF) Operations

- Approximately 28K square feet of space distributed across 4 separate facilities.
- Fabrication, clothing design, shelter integration, sewing & fabric seam sealing.
- 30 government and 2 contractors

NSRDEC **Prototype Integration Facility (PIF)**

PIF Mission: Design and fabricate prototypes to support the RD&E process; to support feasibility, fit, and performance assessments; and for limited production of prototype items for specific end users.

Business Model: Individual specialized prototyping areas are embedded in the technical Directorates they support (e.g. Clothing Design, Parachutes/Aerial Delivery, Tents & Covers, Shelters & Food Service Equipment). Customers are primarily internal NSRDEC, the NSRDEC affiliated PMs, or the co-located TACOM-ILSC.

PIF Core Competencies: Fabric prototyping and design to include clothing & related equipment, parachutes & aerial delivery equipment, tents & covers as well as shelter and food service equipment prototyping and integration.

Past / Recent Products and Innovations:
- RFI Project: Ammunition Pack System for Small Dismounted Teams
- Army Aircrew Combat Uniform for Females
- Enhanced Parachutist Drop Bag
- "Sacred Space" Mobile Chapel for expeditionary basing

Prototype Integration Facility (PIF) Operations

Key Capabilities:
- Project Management ProE/CAD 3D Modeling
- Finite Element Analysis (FEA)
- Mechanical & Electronic Eng. Design
- Technical Data Package Development
- 112,000 sf. Facility
- 16 Integration Bays
- Robotic Welding
- Laser Cutting
- Water Jets with chamfering capability
- Turn Mill
- Circuit Board Design & Mfg.

TARDEC **Prototype Integration Facility (PIF)**
Center for Systems Integration (CSI)

Mission: To develop, fabricate and integrate advanced solutions into current and future ground systems

Business Model:
- Customer reimbursable organization: PEOs (Ground Combat Systems, Combat Service & Combat Service Support, Land Systems), REF, SOCOM, RDECOM.
- CSI collaborates with RDECs for specialized capabilities, industry for surge capability and depots for production.
- Contracts are primarily 4464 for materials and services
- Annual Workload of ~$30M-$40M.
- 116 Government and 41 Contractor Personnel

Core Competencies: Ground Systems Integration, Prototyping, Systems Engineering, Reverse Engineering, Drawings, Technical Manuals, Watercraft Systems Integration, Bridge Design

Past / Recent Products and Innovations:
- Capability Set-13
- RPG Defeat for MRAP FOV
- Line of Communication Bridge
- Caiman EFP Kit Integration
- Robotic Deployment System
- HMMWV & MRAP Egress Trainers
- Overhead Wire Mitigation Kits
- Add-On Armo Kits
- HMMWV Blast Cab
- Fuel & Water Distribution & Treatment Equipment
- Army Watercraft Upgrades
- ROBODEX
- ET-REMADE

** Source: U.S. Army Research, Development and Engineering Command. (2013d)*