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TECHNOLOGY TRANSITION AND ADOPTION: A STUDY IN SEARCH OF METRICS FOR EVALUATING TRANSITION

by

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December 2010

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Accurate measures for technology adoption and transition are needed to provide objective evaluation systems for DoD acquisition programs. Currently, the DoD uses cost, schedule, and performance to evaluate the success of their programs. Research from this area of study suggests that although cost, schedule, and performance have their benefits, these metrics do not give an entirely accurate representation of success. A multidimensional framework involving additional measures by which to evaluate technologies might give the DoD a more reliable and complete account of their acquisition systems. Better transition metrics could equate to an improved transition rate for the DoD, more efficient resource allocation, and fielding superior systems to the warfighter. Specifically, this study was an assessment of the DARPA AEO and how they should measure success with regards to technology transition and adoption. Through greater comprehension of this topic, the AEO hopes to improve the transition rate for their programs by understanding the factors that they can affect.

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TECHNOLOGY TRANSITION AND ADOPTION: A STUDY IN SEARCH OF METRICS FOR EVALUATING TRANSITION

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Accurate measures for technology adoption and transition are needed to provide objective evaluation systems for DoD acquisition programs. Currently, the DoD uses cost, schedule, and performance to evaluate the success of their programs. Research from this area of study suggests that although cost, schedule, and performance have their benefits, these metrics do not give an entirely accurate representation of success. A multidimensional framework involving additional measures by which to evaluate technologies might give the DoD a more reliable and complete account of their acquisition systems. Better transition metrics could equate to an improved transition rate for the DoD, more efficient resource allocation, and fielding superior systems to the warfighter. Specifically, this study was an assessment of the DARPA AEO and how they should measure success with regards to technology transition and adoption. Through greater comprehension of this topic, the AEO hopes to improve the transition rate for their programs by understanding the factors that they can affect.

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

AEO	Adaptive Execution Office
ARPA	Advanced Research Project Agency
DoD	Department of Defense
DARPA	Defense Advanced Research Projects Agency
GAO	Government Accountability Office
GWOT	Global War on Terrorism
JCIDS	Joint Capabilities Integration and Development System
NPS	Naval Postgraduate School
PCR	Program Completion Report
PM	Program Management
POR	Program of Record
QCT	Quality-Cost-Time
R&D	Research and Development
S&T	Science and Technology
TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicle

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I. INTRODUCTION

A. DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)

1. Defense Advanced Research Projects Agency (DARPA)

The Advanced Research Project Agency (ARPA) was created in 1958 under the Eisenhower administration. The agency was the brain child of then Secretary of Defense, Neil H. McElroy, who came up with the idea in response to the Soviets' launch of Sputnik, the first man-made orbiting satellite. Originally stood up to handle the satellite and space research and development projects, ARPA was to provide focus to the nation's efforts with the ultimate goal being to dominate the Soviets in space (Belfiore, 2009). As described by Belfiore (2009):

> It would become the research-and-development branch of the military, with creative-minded program managers in charge of funding out-there research around the country that might or might not bear fruit, but that had a potential for big payoffs. Those projects that did not succeed would be handed off to the service branches of the military for further development and eventual use.

DARPA's mission is to maintain the technological superiority of the U.S. military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research bridging the gap between fundamental discoveries and their military use (DARPA, 2010). Credited for the invention of the internet, the first stealth fighter (DARPA website, 2010), and other technologies that have significantly advanced the state of the art, DARPA is known for being one of the most innovative organizations in the Department of Defense (DoD). DARPA's reputation for tackling the hardest technological challenges has even earned the agency their own phrase used to describe problems that are extremely hard to solve: "DARPA hard."

As a research and development (R&D) agency independent of the military services, technology transition and adoption is extremely relevant to the mission of DARPA. There is no dispute as to their ability to successfully develop cutting-edge technologies, but bridging the gap between the agency and the ultimate end user remains a significant challenge for DARPA to overcome. This study hopes to provide DARPA, and more specifically, the Adaptive Execution Office (AEO), a better understanding of the topic as well as insight into how they might improve the technology transition and adoption of their programs.

2. Adaptive Execution Office (AEO)

The AEO was created by DARPA in 2009. Their mission is to harness the creativity of DARPA program managers and America's science and engineering community to transition DARPA technology to the warfighter faster and more effectively (AEO website, 2010). Whereas DARPA's focus has been more long-term in order to prevent technology surprise from harming America's national security (DARPA, 2010), the AEO's focus is more near-term; addressing the technological challenges of the current warfighter with rapid, adaptable solutions. Their objective is to promote adaptability in the DoD by getting additional revolutionary technologies to the field more quickly and by advancing technologies that will help them build in adaptability from first principles (AEO website, 2010). With present conflicts in Afghanistan and Iraq, the AEO's mission adds even more relevance to DARPA's contribution to the warfighter.

The uses four thrust areas to further define their objectives as an organization and provide more focus to their mission areas. The four thrust areas were taken directly from the AEO website (2010) and have been listed below with a brief description of each area:

- Adaptive Systems: Adaptive platforms and architectures that enable more effective, flexible and mission-responsive systems as well as support fast insertion of new DARPA technology for purposes of field testing and operational deployment.
- Operationally-Focused Systems Integration: Systems that align DARPA technologies with explicit opportunities for military operational impact intended to yield revolutionary new mission capabilities or enable significant increases in mission effectiveness.
- Accelerated Systems Production Technology: Innovative technologies that optimize product development and pipeline management to accelerate the production of new hardware and software systems to be delivered to the warfighter.
- Comprehensive System Assessment: New system assessment technologies and techniques that enable efficient, rigorous, and informative readiness assessments of emerging and mature DARPA technology.

B. TECHNOLOGY ADOPTION AND TRANSITION

Technology adoption and transition is a very complex topic involving many intricacies. It is curious then, that the DoD uses the three simplest metrics to evaluate the success of defense acquisition programs: cost, schedule, and performance. Not to infer that cost, schedule, and performance are bad metrics by which to gauge success. On the contrary, there are many advantages to using these metrics. For example, all three are easily quantifiable, making them easy to measure. Infrastructure exists, i.e. processes, methods, and systems, to easily track them. They are easy to define and it is simple to formulate common understandings of what they mean across multiple organizations. However, despite their strengths, many studies in this topic have shown that they do not tell the whole story, and sometimes, paint an entirely inaccurate picture.

Many schools of thought exist on the subject and an abundance of research has been conducted to provide understanding of the multiple facets that influence technology adoption and transition. In general, most research on transition measurement recommends a much wider range of success measures than just cost, schedule, and performance. These metrics are usually contingent on some aspect(s) of the technology being measured. This section should provide the reader perspective into these issues as well as the background into the intricate subject of technology adoption and transition.

1. Why Do We Need to Measure Transition?

Accurate measures of technology transition are needed for several reasons. Concerning this study, the DARPA AEO asked the Naval Postgraduate School (NPS) for an assessment of how it should measure success with regards to technology transition and adoption. The AEO has two primary reasons for needing better measurements by which to evaluate technology transition. The first reason is to simply better understand the subject. Through greater comprehension of this topic, the AEO hopes to improve the transition rate for their programs by understanding the factors that they can affect. The second reason the AEO has for needing better metrics for technology transition is to be able to justify spending taxpayer money on their programs. Better transition metrics can help tell a more accurate story to decision makers and help the AEO secure future funding for their programs. This second reason will be discussed in more detail in the rest of this section.

The most prevalent reason for DoD organizations is the need to objectively quantify transition for programs funded by taxpayer dollars. Federal technology transfer programs are increasingly being expected to increase the rate of transfer and to quantify the effectiveness of their transfer programs (Spann, Adams, and Souder, 1995, February). Measuring successful transition gives justification for R&D funding provided by the Government. In organizations like DARPA, where successful transition is at the heart of their primary mission, ways to quantifiably measure successful transition could provide justification not only for their programs, but for the organizations themselves. The correct metrics and measures of effectiveness can provide this validation that taxpayer money is not being wasted or misappropriated.

To put it into current context, there is much debate about ending the use of supplemental appropriations. Supplemental appropriations are additions to regular annual appropriations and provide budget authority beyond the original estimates for programs or activities that are too urgent to be postponed until the next regular appropriation (DoD Office of Inspector General, 2009, April). The use of supplementals has increased over the last several years, largely as a result of an increase in DoD funding and the use of supplementals to provide that funding for activities such as the Global War on Terrorism (GWOT) (GAO, 2008, January). With contingency operations decreasing in Iraq and remarks given by President Obama (2009, December) to begin pulling troops out of Afghanistan in 2011, the activity for the GWOT will decrease along with the use of supplemental appropriations. Simply put, organizations will be competing for the same piece of pie they have gotten in previous years with supplemental funding, when in reality, the pie itself has gotten much smaller. As organizations become forced to justify their budgetary needs, the need for metrics that accurately evaluate and measure technology transition will most likely increase.

It must be stated that as much as measures of transition are needed, the importance of public perception of technology transition cannot be understated.

American taxpayers have little tolerance for over-budget programs that are constantly behind schedule. With mounting budget pressures escalating as a result of the recession, there is even less room for error. In a conference hosted by Credit Suisse and Aviation Week, Defense Secretary Robert Gates pushed the military services to find $100 billion in savings from overhead over the next five years to plow back into troop costs and weapons programs (Shalal-Esa, 2010, December). Taking into account the public pressure for acquisition reform and the current budget challenges, the DoD will be required to do more with less. These issues may be compounded by the fact that technology transition is not black and white. Success and failure are subjective, measures are not identical across all technologies, and transition is not always quick. Public opinion and perspective of technology transition is just as important as the measures themselves.

2. Multi-Dimensional Framework

Finding the right metrics to measure project and program success is hard because project success is multidimensional. Freeman and Beale (1992) summarized this point well:

> Success means different things to different people. An architect may consider success in terms of aesthetic appearance, an engineer in terms of technical competence, an accountant in terms of dollars spent under budget, a human resources manager in terms of employee satisfaction. Chief executive officers rate their success in the stock market.

The DoD primarily measures the success of their acquisition programs with metrics that track cost, schedule, and performance. Measuring the cost, schedule, and performance may be effective for tracking conventional acquisition programs, but with regard to technology transition, in many instances, these metrics may not be enough. Shenhar, Dvir, Levy, and Maltz (2001) commented that measuring projects solely on cost, schedule, and performance can lead to an incomplete and misleading assessment. For example, a program that develops a technology on time, within budget, and performs as advertised meets all conventional standards for success. However, if the technology gets to the user and the user is unsatisfied with it, even over a non-performance issue, the user will not employ the technology, and the transition has failed. In order to assess the true quality of transition within the DoD, the DoD must first reassess how they measure it, and subsequently how they evaluate their program managers who develop the technologies.

Shenhar, Dvir, Levy, and Maltz (2001) developed a multi-dimensional framework for the assessment of project success which reflects how success measures are contingent on time. Their model consisted of four dimensions: project efficiency, impact on the customer, business success, and preparing for the future. Included in the following table are their four success dimensions along with the measures for each dimension.

Table 1. Emerged four success dimensions (From Shenhar, Dvir, Levy, and Maltz, 2001)

Success dimension	**Measures**
1. Project efficiency	Meeting schedule goal
	Meeting budget goal
2. Impact on the customer	Meeting functional performance
	Meeting technical specifications
	Fulfilling customer needs
	Solving a customer's problem
	The customer is using the product
	Customer satisfaction
3. Business success	Commercial success
	Creating a large market share
4. Preparing for the future	Creating a new market
	Creating a new product line
	Developing a new technology

As the above study alluded to, cost, schedule, and performance metrics do not force organizations to view technology adoption and transition from any point of view other than their own. In their study of project success dimensions, Lipovetsky, Tishler, Dvir, and Shenhar (1997) found that although these measures of success can help to evaluate internal organizational goals, other measures should be used to evaluate external effectiveness, such as the project’s impact on the customer and on the developing organization itself. Lipovetsky, Tishler, Dvir, and Shenhar (1997) measured the success of 110 defense projects based on four dimensions: meeting design goals, benefits to the customer, benefits to the developing organization, and benefits to the defense and national infrastructure. Out of these four dimensions, their analysis concluded that benefits to the customer was by far the most important success dimension. Furthermore, other areas of study, such as marketing literature on new product development, reflect the same findings, where user satisfaction is a key measure of success. The findings of this study support the argument for using additional metrics, other than cost, schedule, and performance, to evaluate successful technology adoption and transition. In particular, metrics that track how the technology is meeting the customer's needs should be used.

As these examples illustrate, a more comprehensive list of metrics that accounts for the needs of all parties involved could help to improve technology adoption and transition measurement within organizations using only cost, schedule, and performance to track their success. As Spann, Adams, and Souder (1995, February) summarized,

> [Sponsors, developers, and adopters] could improve their measurement practices by identifying those measures most appropriate in the total process rather than focusing on the most easily measured dimensions, by developing a shared understanding of the measures most important to each party to the process and by working toward complementary goals and measures.

3. Project Strategy Based Success Measures

Griffin and Page (1996) take a different approach, where they believe that the most appropriate set of measures for assessing project-level success depends on the project strategy. Using their example, success criteria will be different for a new product that creates an entirely new market than for a project that extends an existing product line. To expand on their theory, if success depends on project strategy, then strategy depends on factors such as the values and priorities of the organization. Different organizations with different priorities will have different strategies and thus, different measures of success. For example, the strategy for a firm developing a product for profit will be very different than a non-profit organization, like the DoD, developing products for the nation's defense. The priorities of these two organizations are very different and thus the metrics by which they measure success will be different as well.

A previous study conducted by Griffin and Page (as cited in Griffin and Page, 1996) determined that project success can be grouped into three independent dimensions: consumer-based, financial, and technical or process-based success. Griffin and Page (1996) describe the perfect product that meets all three of these dimensions:

> The perfect product (a silver bullet) is wildly sought after by customers who are delighted with it, provides enormous financial return to the firm, and in addition, is technically elegant, provides a performance advantage to the firm, or was commercialized efficiently.

The problem is that the perfect product development project does not exist. Realistically, organizations will have to make tradeoffs between the three dimensions mentioned above based on their priorities, and since every organization is different, they will require different measures of success. It is for these reasons it could be argued that a standard set of metrics is inappropriate to measure technology transition across organizations. One could also argue that most projects within a single organization are unique and thus require their own measures of success. If a standard set of metrics is not appropriate for measuring different projects, it begs the question as to why the DoD uses a standard set of metrics (cost, schedule, and performance) across every program?

4. An Alternative View

Not everyone agrees that unique sets of project-based measures are the answer. Skogstad, Steinert, Gumerlock, and Leifer (2009) argue in favor of:

> The need for a universal design project outcome performance measurement metric that allows comparison of design projects with different natures. [Skogstad, Steinert, Gumerlock, and Leifer] claim that without such a common denominating measurement, resource allocation for diversified companies and venture capitals must remain rather suboptimal, and the creation of design research theory is severely hindered.

A universal measurement metric would be incredibly useful for organizations like DARPA who develop technologies ranging from microchips to unmanned aerial vehicles (UAVs). Such a metric would afford them the ability to compare different technologies to each other for the sake of comparing transition efforts and making resource allocation decisions. Though it is hard to deny the appeal, the feasibility of a universal measurement metric is a long way from being realistic.

5. Viewing Failure As Success

Just as success is hard to define, in an innovative environment where the development of technologies often leads to unexpected results, failure can be hard to define as well. Elmquist and Masson (2009) question the logic of setting goals at the beginning of a project in an innovative environment because innovation often yields unexpected results. They go on to explain that cost, schedule, and performance measures, or the quality-cost-time (QCT) framework as they call it, has other shortcomings as well. The QCT evaluation framework ignores value creation outside specifications and considers projects as separate units, independent of each other, ignoring both how projects generate knowledge and how knowledge is transferred between projects (Elmquist and Masson, 2009). Many projects in an innovative environment fail, but products of failed R&D projects often help to advance other projects. The QCT framework has no way of accounting for that which is gained during failure.

Innovative ideas inherently involve risk, which creates inconsistent goals for public agencies like the DoD. Leung and Isaacs (2008) summarize this issue, noting that while innovation necessarily involves risk, this orientation can sometimes be considered in conflict with the stewardship role of a public sector agency. In an innovative environment, risk often translates to failure. As stewards of taxpayer money, the DoD makes every effort to avoid failure, but still requires innovation to keep the military relevant in the context of today's conflicts. Many organizational processes and constructs, especially within the acquisition framework, work to reduce risk while consequently decreasing innovation. As Elmquist and Masson (2009) stated:

> To develop innovative capabilities, companies need to promote creativity (e.g., Amabile, 1998) and experimentation (e.g., Thomke, 2001) and keep a certain amount of slack in their structures (Nohria and Gulati, 1996) – all connected to taking risks – which is exactly what project management methods try to eliminate.

In the conventional defense acquisition environment, failure is often times considered a negative consequence of poor program management. In the private industry, failure is not always perceived as negative. At Google for instance, they allow their people to pursue projects that are of a personal interest and do not penalize them if they fail. In fact, they encourage their people to fail as long as they do it quickly and intelligently. By allowing their people to follow their personal interests, it cultivates a culture of innovation and creativity. Encouraging them to fail quickly gives their people confidence that they will not be penalized for their ideas, but also promotes abandoning ideas that don't materialize before too many resources are committed to them. Google also looks at failure as an opportunity to learn rather than a waste of time and resources. Technology adoption should be viewed from this same perspective.

As mentioned before, the traditional view of failure within the DoD is negative. This is understandable considering that the cost of failure in a DoD organization could mean the loss of life. With millions and sometimes billions of taxpayer money at stake, it is obvious as to why the defense acquisition community also views failure negatively. However, failure, much like success, is subjective. One could view failure, especially as it pertains to the development of technology, as a valuable opportunity for learning. Above, Google was used as an example of how failure can be a powerful driver of innovation. The DoD must be cognizant of the subjective nature of measuring transition in order to be effective at evaluating new and innovative technologies.

DoD organizations cannot manage technology transition the same way as conventional acquisition and expect to get results. Failure is a necessary and important component of innovation, where one cannot be separated from the other. This relationship complicates technology adoption and transition greatly. Innovation forces organizations like the DoD into a delicate trade space, where the DoD must balance their responsibilities to the American taxpayer and their requirement for cutting edge technologies needed for the next conflict.

6. Contingent Effectiveness Model and the Effects of Public Policy

In his examination of university and government technology transfer activities, Bozeman (2000) uses the Contingent Effectiveness Model to describe the subjective nature of technology transition. The major assumption of the Contingent Effectiveness Model is no single notion of effectiveness makes much sense, either theoretically or practically (Bozeman, 2000). Bozeman (2000) explains that the model includes five broad dimensions that determine effectiveness: (1) characteristics of the transfer agent, (2) characteristics of the transfer media, (3) characteristics of the transfer object, (4) the demand environment, and (5) characteristics of the transfer recipient. These metrics are not all inclusive, but suggest overarching metrics applicable to any transition situation, while providing a good example as to the complexity of transition measurement.

Another factor that significantly influences technology transition is public policy. Bozeman (2000) uses the Cooperative Technology Paradigm to describe one of the Government's roles as a broker, developing policies affecting industrial technology development and innovation. In Bozeman's (2000) opinion, the most significant U.S. public policy was enacted in the 1980s and 1990s. These policies highlighted the issue of technology transition and spurred research for technology transfer within the U.S. and elsewhere (Bozeman, 2000). The table below includes the list of technology policies passed in the 1980s and 1990s:

Table 2. Major technology policy legislation of the 1980s and 1990s (From Bozeman, 2000)

Bayh–Dole Act of 1980 (PL 96-517): permits universities and small business to obtain title to inventions funded by the federal government so as to license inventions.
Stevenson–Wydler Technology Innovation Act (1980) (PL 96-480): requires federal laboratories to establish technology transfer offices and to set aside funds for technology transfer.
Small Business Innovation Development Act of 1982 (PL 97-219): requires federal agencies to provide special set aside funds for small business R&D.
Cooperative Research Act of 1984 (PL 98-462): eliminates treble damage of anti-trust so that firms, universities and federal laboratories can engage in joint pre-competitive R&D.
Federal Technology Transfer Act (1986) (PL 99-502): authorizes national laboratories to enter into cooperative R&D agreements (CRADAs) and negotiate licensing agreements.
Executive Orders 12591 and 1218 of 1987: promotes commercialization of federal technology.
Omnibus Trade and Competitiveness Act of 1988 (PL 100-418): renames the National Bureau of Standards as the National Institute for Standards and Technology and expands its mission; establishes centers for transferring manufacturing technology.
National Competitiveness Technology Transfer Act of 1989 (PL 101-189): extends CRADA authority to all federal laboratories, including weapons labs.
Defense Authorization Act of 1991 (PL 101-510): establishes model programs for linking defense laboratories with state and local government and small businesses; provides Defense Manufacturing Technology Plan.
Defense Authorization Act of 1993 (PL 103-160): renames the Defense Advanced Research Projects Administration and authorizes dual-use technology programs for industrial application.

The central point of cooperative technology policies is clear: putting universities and government laboratories to greater use as progenitors of technology and applied science (Bozeman, 2000). Public policy has had a profound effect on the issue of technology transition, particularly in providing exposure to the issue for research.

C. ORGANIZATION OF REPORT

This study is focused on the issue of technology transition and adoption, and helping the AEO of DARPA create a framework for evaluating their programs for successful transition. In Chapter II, the methodology is discussed to include the initial interviews with acquisition professionals, the database that was created for the study, explanation of the categories and metrics used in the database, and the program completion reports (PCRs) that were provided by DARPA to conduct the research.

In Chapter III the complexities and issues of technology transition metrics will be explored. Current metrics used to evaluate technology transfer along with the subjectivity of this area will be considered. Also, the technology adoption indices that were created and used to evaluate the PCRs will also be discussed in this chapter.

In Chapter IV, analysis will be conducted on the data gathered in the database and the theoretical framework created for the AEO will be explained. Correlations and regressions were run on the different metrics evaluated within the database and analyzed. The AEO Measurement Model will be reviewed as well as the different factors that make up the model.

Lastly, in Chapter V, the recommendations will be explained and the areas for further study will be outlined.

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II. METHODOLOGY

The research methodology for this thesis consisted of three facets. First, seven interviews were conducted with acquisition professionals from various acquisition organizations within the DoD to collect their opinions and thoughts on technology adoption within their respective organizations. Second, a database was built with metrics that were vetted from the interviews, as well as from research conducted on technology adoption. To collect data for the database, DARPA granted access to 116 PCRs from the AEO. Third, the data was analyzed and a model for technology adoption was created. The analysis preceding the model consisted of statistical analysis of the different metrics used to categorize the 116 technologies.

A. INTERVIEWS

Interviews with seven acquisition professionals were conducted from different organizations within the DoD. The acquisition professionals consisted of field grade program managers from the special operations community, senior-ranking civilian directors from the special operations and conventional acquisition communities, a federally funded research and development center engineer from the conventional acquisition community, and a retired military member working for the defense industry. They were chosen for this study because they provided a diversity of acquisition perspectives and they each had at least 12 or more years of acquisition experience. The goal of the interviews was to collect preliminary data on technology adoption from the acquisition professionals' perspectives and to attempt to identify metrics for successful technology adoption to include in the database. The interviews were conducted via telephone and lasted in the range of 45 minutes to two hours depending on the time the interviewee could allot.

The interviews with the acquisition professionals yielded many interesting findings. Many of the results were used as metrics, or provided valuable inputs for metrics, in the database. There were also other significant takeaways from the interviews that should be noted.

After the interviews were completed, one of the more obvious observations that emerged was the lack of a standard system, framework, or process for technology transition and adoption. The research in this area is consistent with this finding, as is discussed in the first chapter of this study, but it is notable that the interviews confirmed it. Although no standard framework exists within the DoD for technology transition and adoption, the DoD does use standard metrics, cost, schedule, and performance, by which to measure technology transition and adoption. In fact, many firms in industry also use the same metrics. As was discussed in the first chapter, a multi-dimensional approach could offer a more accurate measurement of technology transition. In essence, this study could help to identify additional metrics the DoD, and more specifically the DARPA, could use to increase their transition rate.

Another significant observation that came out of the interviews was the existence of two different models for technology transition within the DoD. One model exists within the special operations acquisition community, while the second exists within the conventional acquisition community. In both models, technology readiness level (TRL) and user involvement were the key drivers of transition. In the special operations acquisition community, program managers rarely deal with immature technologies, i.e. technologies with low TRLs. The speed required to field a technology to the warfighter is very important in this community, thus these program mangers do not typically have the time required to develop technologies for use. The majority of their programs involve technologies that can readily be incorporated into systems or used in an “as-is” manner to provide the needed capability. The special operations program managers also have direct user involvement in their programs. By having direct access to the actual users of their systems, program managers get direct feedback to incorporate into their programs. These firsthand inputs help the technology perform to the user’s expectations and thus give it a much more likely chance of being adopted.

In the conventional acquisition community, program managers rarely have the same luxuries as their counterparts from the special operations community. Requirements for defense acquisition programs come from the Joint Capabilities Integration and Development System (JCIDS) process, where the program managers are assigned programs that are needed to fulfill particular requirements. Often times, there is not a commercially viable solution that can be taken and used to meet these requirements. In fact, even if a commercial solution exists, it still typically requires modification that involves developing the technology. The point being, that program managers from the conventional acquisition community are often forced to develop immature technologies with low TRLs. They do not get to pick and choose technologies based on their technological maturity. Program managers from the conventional acquisition community rarely have access to their direct end user in the way special operations program managers do. Many times, end user involvement on a conventional acquisition program involves an end user representative from a major command or headquarters. Suffice it to say, conventional acquisition program managers do not get the same valuable feedback from representatives of the user as they would from a direct user of the system. Without direct end user involvement, the likelihood that the technology will be well-received by the end user decreases, along with its chances for adoption.

B. DATABASE

The database was built to evaluate the 116 technologies documented in the PCRs provided by DARPA on different technology adoption metrics. The following sections describe the PCRs and the different categories and metrics used in the database. The database in its entirety can be found in Appendix E of this study.

1. Program Completion Reports

A PCR is a mechanism for DARPA program managers to capture important details that pertain to their projects. Typically, a PCR contained an explanation on the need for the technology, the state of the art at the time the program was started, the important development details of the technology, and the degree to which each technology transitioned. Each of 116 PCRs were read to determine whether they would be included in the database. If the PCR related to a particular technology, it was evaluated against the metrics and its data was collected for inclusion into the database. If the reports did not pertain to a technology, they were omitted from the database. Out of the 116 PCRs, three of the reports were excluded for not containing any information on a specific technology: Training Superiority/DARWARS, Photonics Technology Access Project (PTAP), and Sonofusion. It is important to note that by conventional standards, the word "program" typically denotes a major weapons system within defense acquisition and the word "project" denotes a smaller endeavor, usually part of a program. DARPA uses the word "program" even though their programs typically differ greatly in size and scope than conventional acquisition programs. Unless specifically describing a program of record (POR) or major acquisition program, the two terms are used synonymously throughout this report.

The metrics for the database were derived from the interviews conducted with acquisition professionals, as well as research conducted on the subject of technology adoption. Each of the 116 PCRs was read and, based on the information contained within the PCR, each of the 116 technologies were evaluated on each individual metric contained within the database. It is important to note that the PCRs were read and evaluated on each individual metric and category solely by the author. At the beginning of data collection, 22 metrics and 25 categories were recorded for each technology. As the research was analyzed, many metrics were omitted from the database that were either found to be statistically insignificant or insufficient data existed within the PCRs to evaluate the technologies on these metrics. After these metrics were omitted, the final version of the database contained 15 metrics and 16 categories for each technology.

2. Database Categories and Metrics

To better understand technology adoption, it was necessary to compare both successfully and unsuccessfully transitioned technologies and evaluate them against the same metrics. The metrics selected for the database represented findings from the interviews with acquisition professionals or from research conducted on the subject of technology adoption. The other categories included in the database collected descriptive data for comparing the technologies. The following is the list of the different categories and metrics selected for inclusion in the database, and a description of how the technologies from the PCRs were coded for each category and metric.

a. Technology Fielded to Warfighter

This category was coded in the database as either a "1" or "0", where 1 = Yes and 0 = No. The determination for this category was based on whether or not the technology transitioned to a military user in an "as is" condition upon project completion. Significant aspects of technologies that were only partially transitioned to military users were coded as a "1" in this category. Reports that did not provide adequate detail to make a judgment were assigned a "0" for this category. For the sake of avoiding double counting technologies in this and the POR category, it was assumed that technologies fielded to the warfighter were made into their own PORs, but not recognized in the POR category unless it transitioned into another, or multiple, PORs.

b. Receiving Service/Organization

If the technology was transitioned, the organization to which it was transitioned was recorded in this category. Technologies that were only partially transitioned to other organizations were also recorded in this category. If a technology was partially transitioned to multiple organizations, all organizations were listed in this category. To avoid any proprietary issues, if the technology was transitioned to the commercial community, "contractor" was recorded in this category.

c. Project Transitioned to Program of Record (POR)

This category was coded in the database as either a "1" or "0", where 1 = Yes and 0 = No. PCRs that did not specifically state whether the technology was made into a POR or did not provide adequate detail to make a judgment were coded a "0" in this category. Due to the fact that not all technologies are designed to become individual PORs, technologies that became a significant part of another POR were marked "1" for this category.

d. Technical Spin Offs to DoD Science and Technology (S&T) Projects

This category was coded in the database as either a "1" or "0", where 1 = Yes and 0 = No. This category determined whether technologies were transitioned to

DoD S&T projects for further development. Technologies that were only partially transitioned to DoD S&T projects were also coded as a "1" in this category. Reports that did not provide adequate detail to make a judgment were assigned a "0" for this category.

e. Technical Spin Offs Into Other DARPA Projects

This category was coded in the database as either a "1" or "0", where 1 = Yes and 0 = No. This category determined whether technologies were transitioned into other DARPA projects for further development or inclusion into other technologies. Technologies that were only partially transitioned into other DARPA projects were also coded as a "1" in this category. Reports that did not provide adequate detail to make a judgment were assigned a "0" for this category.

f. Spin Offs Into Commercial Projects

This category was coded in the database as either a "1" or "0", where 1 = Yes and 0 = No. This category determined whether technologies were transitioned to commercial organizations for further development. Technologies that were only partially transitioned to commercial organizations were also coded as a "1" in this category. Reports that did not provide adequate detail to make a judgment were assigned a "0" for this category.

g. Not Transitioned

This category was coded in the database as either a "1" or "0", where 1 = Yes and 0 = No. This category determined whether technologies were not transitioned and discontinued altogether at the completion of the project. Technologies that were only partially transitioned were coded as a "0" in this category. Reports that did not provide adequate detail to make a judgment were assigned a "1" for this category.

h. Transition Speed

This category was coded in the number of months it took for the technology to be transferred from project start to completion. This category will be marked with "N/A" if the technology was not transitioned or "UKN" (unknown) if the transition speed was not given in the report.

i. Major/Core Aspect of Project

This category was coded in the database as either a “1” or “0”, where 1 = Yes and 0 = No. It measures the extent to which the technology was transitioned. If a major or core aspect of the project was transitioned for use within another organization, this technology was coded as a “1” in this category. If the technology was not transitioned, or if only a minor portion of the technology was transitioned, the technology will be coded a “0” for this category. Reports that did not provide adequate detail to make a judgment were assigned a “0” for this category.

j. Minor/Trivial Aspect of Project

This category was coded in the database as either a “1” or “0”, where 1 = Yes and 0 = No. It measures the extent to which the technology was transitioned. If a minor or trivial aspect of the project was transitioned for use within another organization, this technology was coded as a “1” in this category. If the technology was not transitioned at all, or if a major portion of the technology was transitioned, the technology will be coded a “0” for this category. Reports that did not provide adequate detail to make a judgment were assigned a “0” for this category.

k. PCR Word Count

The word count of each PCR was recorded for this category.

l. Money Obligated for Further Development

This category was coded in the database as either a “1” or “0”, where 1 = Yes and 0 = No. If an organization was willing to invest further money into the technology, the technology will be coded a “1” for this category. If the report made no specific mention to further funding, it will be assumed that no money was obligated for further development and the technology will be coded a “0” for this category.

m. Technically Baffling Report

This category was coded in the database as either a “1” or “0”, where 1 = Yes and 0 = No. If the report required extensive background knowledge in a particular subject and/or was written in a language that made it incomprehensible to the average person, the PCR was deemed technically baffling and coded a "1" for this category. If any of the reports were written in an overly technical manner to the point where making a judgment on one of the categories proved to be difficult, the column was coded "TBR" (Technically Baffling Report) for that category.

n. Test Environment

This category was coded in the database as a "1", "2", or "3", where 1 = Lab, 2 = Field, and 3 = Other. If the technology was tested using modeling and simulation, analytical studies, or in a lab (controlled) environment, it will be coded a "1" for this category. If the technology was tested in the field or a simulated field environment, it will be coded a "2" for this category. If the technology was a combination of both lab and field testing, it will be coded a "3" for this category. If it cannot be ascertained from the PCR how the technology was tested, it will be coded "N/A" for this category.

o. Improves Warfighter Safety

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology would directly improve warfighter safety, ranging from "would not improve safety," a "1" on the scale, to "would vastly improve safety," a "7" on the scale. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivial improvement to warfighter safety," "3" represented "somewhat improves warfighter safety," "4" represented "improves warfighter safety," "5" represented "notable improvement to warfighter safety," and "6" represented "significantly improves warfighter safety."

p. Improves Warfighter Job Satisfaction

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology would directly improve warfighter job satisfaction, ranging from "would not improve job satisfaction," a "1" on the scale, to "would vastly improve job satisfaction," a "7" on the scale. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivial improvement to warfighter job satisfaction," "3" represented "somewhat improves warfighter job satisfaction," "4" represented "improves warfighter job satisfaction," "5" represented "notable improvement to warfighter job satisfaction," and "6" represented "significantly improves warfighter job satisfaction."

q. Addresses Immediate Warfighter Need

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology addresses an immediate warfighter need, ranging from "does not address an immediate warfighter need," a "1" on the scale, to "significantly addresses an immediate warfighter need," a "7" on the scale. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivially addresses immediate warfighter need," "3" represented "somewhat addresses immediate warfighter need," "4" represented "addresses immediate warfighter need," "5" represented "notably addresses immediate warfighter need," and "6" represented "very much addresses immediate warfighter need."

r. Addresses Future Warfighter Need

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology addresses a future warfighter need, ranging from "does not address a future warfighter need," a "1" on the scale, to "significantly addresses a future warfighter need," a "7" on the scale. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivially addresses future warfighter need," "3" represented "somewhat addresses future warfighter need," "4" represented "addresses future warfighter need," "5" represented "notably addresses future warfighter need," and "6" represented "very much addresses future warfighter need."

s. Technological Maturity

This metric was coded in the database on a "1" to "9" scale, based on the actual TRL scale used in defense acquisition. The technology's maturity was matched with the closest TRL description and coded in the database. The TRL descriptions are included in the table below:

Table 3. Technology readiness level descriptions (From DoD Defense Acquisition Guidebook, 2006, July)

TRL Level	Description
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in the laboratory.
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near, or at, planned operational system. Represents a major step up from TRL 6, requiring demonstration of an actual system prototype in an operational environment such as an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.
8. Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. Actual system proven through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

t. Perceived Usefulness

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees of the technology's perceived usefulness to the military, from "not useful," a "1" on the scale, to "very useful," a "7" on the scale. If the technology's development was stopped before the perceived usefulness could be determined, it was coded a "N/A" for this metric. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivially useful," "3" represented "somewhat useful," "4" represented "useful," "5" represented "notably useful," and "6" represented "significantly useful." This measure was coded because a significant amount of research on the technology adoption model suggests perceived usefulness to the end user is a good indicator of successful transition.

u. Builds On Existing Technology, Continuous Vs. Disruptive

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology would build on existing technology. Technologies that advance existing technologies in an evolutionary manner were rated as continuous, a "1" on the scale. Technologies that are innovative and revolutionary were rated as disruptive, a "7" on the scale. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "mostly continuous," "3" represented "somewhat continuous," "4" represented "in between continuous and disruptive," "5" represented "somewhat disruptive," and "6" represented "mostly disruptive." It is commonly accepted that continuous technologies typically involve less technological risk but provide less significant impacts in terms of technological advancement. In contrast, disruptive technologies usually require taking a much larger technological risk, but the technological payoff is much more significant. To further understand this tradeoff and its relationship with technology transition, this metric was recorded.

v. Game Changing/Revolutionary Capability

This metric was coded in the database on a “1” to “7” Likert scale. The technology was rated anywhere from “1” to “7” based on varying degrees to which the technology would provide a revolutionary capability, from “not revolutionary,” a “1” on the scale, to “exceptionally revolutionary,” a “7” on the scale. To distinguish the measures in between “1” and “7,” the following numbers equated to these ratings: “2” represented “trivial revolutionary capability,” “3” represented “somewhat revolutionary,” “4” represented “revolutionary,” “5” represented “notably revolutionary,” and “6” represented “significantly revolutionary.” There is a lot of research that suggests technologies providing revolutionary capability have more significant impacts. This metric was included in the database to explore the relationship between revolutionary capability and technology transition.

w. Enhances Legacy Technology’s Performance

This metric was coded in the database on a “1” to “7” Likert scale. The technology was rated anywhere from “1” to “7” based on varying degrees to which it would enhance an existing technology’s performance, from “no enhancement,” a “1” on the scale, to “complete enhancement,” a “7” on the scale. To distinguish the measures in between “1” and “7,” the following numbers equated to these ratings: “2” represented “trivial enhancement,” “3” represented “somewhat enhanced performance,” “4” represented “enhanced performance,” “5” represented “notable enhancement,” and “6” represented “significant enhancement.” This metric was coded to account for the numerous legacy platforms the DoD upgrades on a continuous basis.

x. Prepares DoD for the Future

This metric was coded in the database on a “1” to “7” Likert scale. The technology was rated anywhere from “1” to “7” based on varying degrees to which the technology prepares the DoD for the future in terms of creating a mission or need for future technologies and capabilities, from “not at all,” a “1” on the scale, to “exceptionally so,” a “7” on the scale. To distinguish the measures in between “1” and “7,” the following numbers equated to these ratings: “2” represented “trivially prepares

DoD for the future," "3" represented "somewhat prepares DoD for the future," "4" represented "prepares DoD for the future," "5" represented "notably prepares DoD for the future," and "6" represented "significantly prepares DoD for the future." This metric is different than addresses future warfighter needs because it describes how technologies pave the way for subsequent technologies and create missions for capabilities that may not currently exist. Prepares DoD for the future was coded in an attempt to determine the relationship between technologies that offer capability suited to fit future DoD missions/infrastructure and successful transition.

y. Mission Fit

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology fits the mission needs of the DoD. The scale ranges from "no fit," a "1" on the scale, to "great fit," a "7" on the scale. If the technology did not develop to a point where a determination could be made, "N/A" was used for this metric. To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivial fit," "3" represented "somewhat fits DoD mission needs," "4" represented "fits DoD mission needs," "5" represented "notable fit," and "6" represented "significant fit." This metric is somewhat similar to the metric addresses immediate warfighter needs because often times mission needs of the DoD coincide with immediate warfighter needs. However, mission fit goes beyond needs and also describes how well the technology fits into the existing DoD infrastructure. It was coded to determine the relationship between technologies that offer capability suited to fit current DoD missions/infrastructure and successful transition.

z. Flexibility In Mission Use

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology would be flexible enough to meet various missions, from "not flexible," a "1" on the scale, to "very flexible," a "7" on the scale. If the technology's development was stopped before the flexibility could be determined or if this metric did not apply to the specific technology, it was coded “N/A.” To distinguish the measures in between “1” and “7,” the following numbers equated to these ratings: “2” represented “trivially flexible,” “3” represented “somewhat flexible,” “4” represented “flexible,” “5” represented “notably flexible,” and “6” represented “significantly flexible.” This was included as a metric because it was hypothesized that flexible technologies would transition more readily in the DoD rather than inflexible technologies.

aa. Adaptive to User Needs

This metric was coded in the database on a “1” to “7” Likert scale. The technology was rated anywhere from “1” to “7” based on varying degrees to which the technology could be adapted to meet different user needs, from “not adaptable,” a “1” on the scale, to “very adaptable,” a “7” on the scale. If the technology’s development was stopped before the adaptability could be determined or if this metric did not apply to the specific technology, it was coded “N/A.” To distinguish the measures in between “1” and “7,” the following numbers equated to these ratings: “2” represented “trivially adaptable,” “3” represented “somewhat adaptable,” “4” represented “adaptable,” “5” represented “notably adaptable,” and “6” represented “significantly adaptable.” This metric was selected for the database because research on technology adoption shows that technologies that are well adapted to user needs are more likely to be adopted.

bb. Interoperability With Existing Technologies

This metric was coded in the database on a “1” to “7” Likert scale. The technology was rated anywhere from “1” to “7” based on varying degrees to which the technology would be interoperable with legacy platforms, from “not interoperable,” a “1” on the scale, to “very interoperable,” a “7” on the scale. If the technology’s development was stopped before the interoperability could be determined or if this metric did not apply to the specific technology, it was coded “N/A.” To distinguish the measures in between “1” and “7,” the following numbers equated to these ratings: “2” represented “trivially interoperable,” “3” represented “somewhat interoperable,” “4” represented “interoperable,” “5” represented “notably interoperable,” and “6” represented "significantly interoperable." This metric was selected because research in the areas of economics, information systems, and marketing suggests that interoperability is a key criterion for successful adoption.

cc. Saves Government/User Resources

This metric was coded in the database on a "1" to "7" Likert scale. The technology was rated anywhere from "1" to "7" based on varying degrees to which the technology would save the government/user resources in the form of money, time, personnel, and/or assets. The scale ranges from "no savings," a "1" on the scale, to "significant savings," a "7" on the scale. If the technology's development was stopped before the savings could be estimated or if this metric did not apply to the specific technology, it was coded "N/A." To distinguish the measures in between "1" and "7," the following numbers equated to these ratings: "2" represented "trivially savings," "3" represented "somewhat saved resources," "4" represented "average savings," "5" represented "above average savings," and "6" represented "notably above average savings." This metric was coded to establish whether the prospect of saving resources increased the likelihood of transition.

C. LIMITATIONS OF THE STUDY

One limitation of this study was that the PCRs were only read and evaluated by one person, the author. Thus, the research and findings are based solely on the author's judgment and biases. Another evaluator may have a completely different perspective, resulting in different findings.

Another limitation of this study is the lack of standardization between the PCRs. For the most part, PCRs had the same general sections for the program managers to include details about their programs. However, the information contained within each report was far from standard. Each program manager had their different writing styles, backgrounds, and perspectives, all of which influenced the way they wrote the PCR. For example, some reports were written in such a manner that they were too technical for the common person to understand. In other reports, some details were left out, like the duration of the program. The lack of details in some reports and the lack of standardization across all PCRs could have affected the findings of this study.

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III. TRANSITION NOT SO BLACK AND WHITE

Measuring transition is not such a black and white issue. Identifying worthwhile metrics presents a number of unique challenges. Some of these challenges were discussed briefly in Chapter I, but the aim of this chapter is to discuss the complexity of this issue in the context of how it relates to this study. In the first section, current measures of transition and the subjectivity of measuring transition will be explored. In the second section, the technology transition indices will be explained and analyzed.

A. ISSUES WITH MEASURING TRANSITION

1. Current Measures of Transition

As Shenhar, Dvir, Levy, and Maltz (2001) noted, projects may differ in terms of technology, size, complexity, risk, and other variables. Yet much of the traditional project management literature has treated all of the projects the same when it comes to measuring project success. Cost, schedule, and performance, as mentioned in the first chapter of this study, have long dominated as the measures used by the DoD and industry alike. However, there are no standard ways to measure successful transition, nor would standard measures of successful transition be appropriate. All organizations and technologies are different, which dictates different measures of success for different situations. Successful transition should be defined by the organizations based on their circumstances and the type of technology being developed.

2. Subjectivity of Successful Transition

Transition is subjective because success and failure are defined through the eye of the beholder. Even the time at which success is measured after introduction can effect whether a product is seen as successful or not (Griffin and Page, 1996). What some organizations may define as a failed transition, others might define as success. To illustrate this concept, one only has to look to the categories included in the database mentioned in the previous chapter.

From each PCR, data was collected on the transition details for each technology. Among the data collected was whether the technologies were transitioned to the warfighter, to a POR, to other government and DARPA S&T projects, or even commercial projects. Subjectivity becomes a factor when attempting to define which type of transition mentioned previously constitutes success. Is transitioning a technology directly into the hands of the warfighter considered more successful than a technology that is transitioned as a critical piece of a POR, but not to the warfighter? It all depends how the organization defines success as well as how they define failure. In order to control the subjective nature of transition with regard to this study, several different indices of technology transition and adoption were created and the results were analyzed.

Due to the many ways to measure technology and the issue over quality versus quantity, subjectivity makes the issue of technology transition much more complicated.

a. Many Ways to Measure Transition

Bozeman (2000) used his "out the door" effectiveness criterion to describe the general perspective most commonly used by organizations with regards to technology transition. Bozeman's (2000) "out the door" effectiveness criterion is based on the fact that one organization has received the technology provided by another with no consideration of its impact. One must consider the meaning of Bozeman's definition of "out the door." This definition, which is commonly used, does not effectively measure transition at all. In fact, it really only constitutes the physical definition of transition. In reality, there is no standard for measuring technology transition, nor would a standard set of metrics for this purpose be appropriate. The definitions of success will vary across all organizations and requires a distinctive set of metrics in order to be an effective gauge of success for each organization. While some measures of transition could be applied to many organizations, technology transition is a very unique experience for different organizations. The measures of success for each organization should be decided at a micro level, where metrics can be tailor-made to fit the circumstances surrounding the specific technology.

b. Quality Versus Quantity

Even the way technologies transition is subject to debate. Is successful transition defined as the quantity of applications a technology affects or is a single transition that has a profound impact on a market or the user considered more successful? The answer to this question depends on the way success is defined and how the organization itself measures transition. For example, in the research conducted for this report, technologies received credit on whether they transitioned to the warfighter, became a significant part of a POR, transitioned to other DoD or DARPA S&T programs, or even transitioned outside the government to the commercial sector. Discussions were held to determine if programs that were fielded to the warfighter and subsequently became PORs themselves should also be counted as transitioning to a POR or was it considered double counting? Ultimately, it was decided that technologies transitioned to the warfighter that also have a significant impact on other PORs would be considered a candidate for both categories; otherwise the technologies would only be counted once. This example illustrates that this issue of technology transition is not black and white. It is very subjective and should be approached as such.

B. TECHNOLOGY TRANSITION INDICES

In an attempt to measure and quantify the success of the AEO with regards to technology transition, transition indices were created to measure the different aspects of transition. Multiple factors were used in the index and multiple variations of the transition index were created and evaluated for their effectiveness in identifying technologies that transitioned successfully. The following describes the method for creating the indices, the top technologies identified by the indices, grouping grids formulated for the sake of comparing the top technologies against each other on a few key metrics, and a recommendation for the top indices for the AEO to use in order to evaluate their success as an organization at technology transition.

1. Technology Transition Indices

The different technology transition indices included various categories that factored into the score calculated by each index. The categories included as factors in all of the indices were where the technology was transitioned to and the extent of the transition. More specifically, whether the technologies were transitioned to the warfighter, a POR, a DoD or DARPA S&T program, in a commercial capacity, or not at all, and the extent of the transition, either major, minor, or unknown. Four of the indices also contained factors that took transition time into account as part of the calculation. There were eight indices in all; all giving different weights to the different factors. The weights for the factors included in each index were based purely on the author's judgment. Table 4 includes each index and the weight it assigned to each factor as well as whether or not it took transition time into account:

Table 4. Technology transition indices

	Transitioned to:						**Extent of transition:**		
Index	**Warfighter**	**POR**	**DoD S&T**	**DARPA**	**Commercial**	**Not**	**Major**	**Minor**	**Time**
1	50	30	10	10	0	0	1	0.3	N/A
2	35	35	10	10	10	0	1	0.5	N/A
3	35	35	10	10	10	0	1	0.5	Yes
4	50	30	10	10	0	0	1	0.5	Yes
5	50	50	0	0	0	0	1	0.3	N/A
6	50	50	0	0	0	0	1	0.3	Yes
7	20	20	20	20	20	0	1	0.3	N/A
8	20	20	20	20	20	0	1	0.3	Yes

The four indices that accounted for transition time multiplied the first two factors, where the technology transitioned to and the extent of the transition, by a weight assigned to the amount of time it took to transition the technology. The weights used for the transition time factor are included in Table 5:

Table 5. Weights used for transition time factor

Months	Weight
6 months or less	1
12 months or less	0.8
18 months or less	0.6
24 months or less	0.4
Above 24 months	0.2
"N/A"	0
"UKN"	Random

Transition time was defined in this instance as the amount of time it took from program start to program completion. Since not all of the PCRs contained the time it took from program start to completion, a system was devised to assign transition time weights to those technologies that transitioned but did not include program start and completion dates in the PCR. This system included taking the technologies that did have program start and completion dates in their PCRs and calculating the amount of technologies that fit into each category listed in Table 5, by percentage. The same percentage was then calculated out of the technologies without program start and completion dates to determine the amount of arbitrarily assigned weights needed for the unknown technologies. For the “six months or less” and “12 months or less” categories, the percentage for randomly assigned weights was less than one. Instead of rounding up in both of these categories, an extra weighting for the categories of “18 months or less” and “above 24 months” was added. The table below shows the number of random weights assigned for the 30 unknown technologies:

Table 6. Assigned random weights

Months	Weight	Assignments per Category
6 months or less	1	0
12 months or less	0.8	0
18 months or less	0.6	3
24 months or less	0.4	3
Above 24 months	0.2	24

Once the amount of random weights per category was determined, the 30 unknown technologies were randomly assigned a weighting using the random number generator in Excel. For consistency purposes, the same assignment of weights was used for all technologies across all four indices that accounted for transition time as a factor. Each index calculated a score for every technology ranging on a scale from zero to 100. A zero represented the most unsuccessful transition and a score of 100 represented the most successful transition.

2. Top Technologies

A list was compiled of the top ten technologies with the highest scores in each index. When there were more than ten technologies with equal scores, the additional technologies were included unless the number of technologies precluded it. Such was the case with index five, where the top five technologies with a score of 100 were followed by 26 technologies with a score of 50. Index seven also had a similar result, where after the top seven technologies, 16 followed with a score of 12. After all of the top technologies were listed, the lists were examined for technologies that showed up in multiple indices. A master list of all of the top technologies from all of the indices was created. The following table lists the programs that were identified by the indices as the top technologies, as well as the number of indices the technology scored in the top ten:

Table 7. Top technologies identified by technology transition indices

Top Technologies	**Number of Indices**
Wasp Micro Air Vehicle	8
Active Templates	8
Real-Time Adversarial Intelligence and Decision-Making (RAID)	7
Video Verification of Identity Program (VIVID)	7
Radar Scope	5
Shape Charge Armor	5
Dynamic Optical Tags (DOTS)	4
Sensing and Patrolling Enablers Yielding Enhanced SASO (SPEYES)	4
Virtual Autopsy Program	4
Optimum Design of Tailored Topological Armors for Blast and Ballistic Threat Defeat	4
Low-Cost Cruise Missile Defense (LCCMD)	4
Fast Connectivity for Coalitions and Agents Project (Fast C2AP)	3
Direct Thermal to Electric Conversion (DTEC)	3
High-Frequency Active Auroral Project (HAARP) Instrument Completion	3
Technology for Efficient, Agile Microsystems (TEAM)	3
Advanced Tactical Targeting Technology (AT3)	2
Program Composition for Embedded Systems (PCES)	2
Self Decontaminating Surfaces (SDS) Program	2
UltraLog	2
Multicell and Dismounted Command and Control (M&DC2)	2
Language and Speech Exploitation Resources (LASER) POR	1
Boomerang	1
Micro Air Vehicle Advanced Concept Technology Demonstration (MAV ACTD)	1
Advanced Precision Optical Oscillators (aPROPOS)	1
High Performance Corrosion Resistant Materials (HPCRM)	1
Sticky Flare	1

As the table shows, there were only two technologies that scored in the top ten of all indices, the Wasp Micro Air Vehicle and Active Templates. This is significant because regardless of the different ways transition was evaluated across the eight indices, these two technologies always scored high. They could be considered examples of successful transition and used as a comparison for other technologies. It is also important to note that if all of the technologies with a score of 12 had been included in Index 7, both the Real-Time Adversarial Intelligence and Decision-Making and the Video Verification of Identity technologies would also have scored in the top ten of all indices.

3. Top Technology Grids

In order to conduct further analysis of the top technologies identified by the indices, the technologies were compared against one another based on how they scored on a few different metrics. The metrics for the comparison were chosen by identifying metrics that successfully transitioned technologies and unsuccessfully transitioned technologies showed significant variance. In this instance, successful transition was defined as technologies that were directly transitioned to the warfighter and unsuccessful transition was defined as technologies that were not transitioned at all. The average scores for all metrics were calculated for technologies that were successfully transitioned to the warfighter and compared to the average scores for all metrics of all of the technologies that were not transitioned.

The four metrics used to compare the top technologies were immediate warfighter need, continuous versus disruptive technology, revolutionary capability, and technological maturity. The comparisons were set up on grids, where one metric was on the horizontal axis and the other was on the vertical axis. The technologies were plotted inside the grid based on how they scored on each metric. The only exception was the Advanced Precision Optical Oscillators program which scored among the top technologies but did not have sufficient data to plot. The following figure shows the legend used for this analysis:

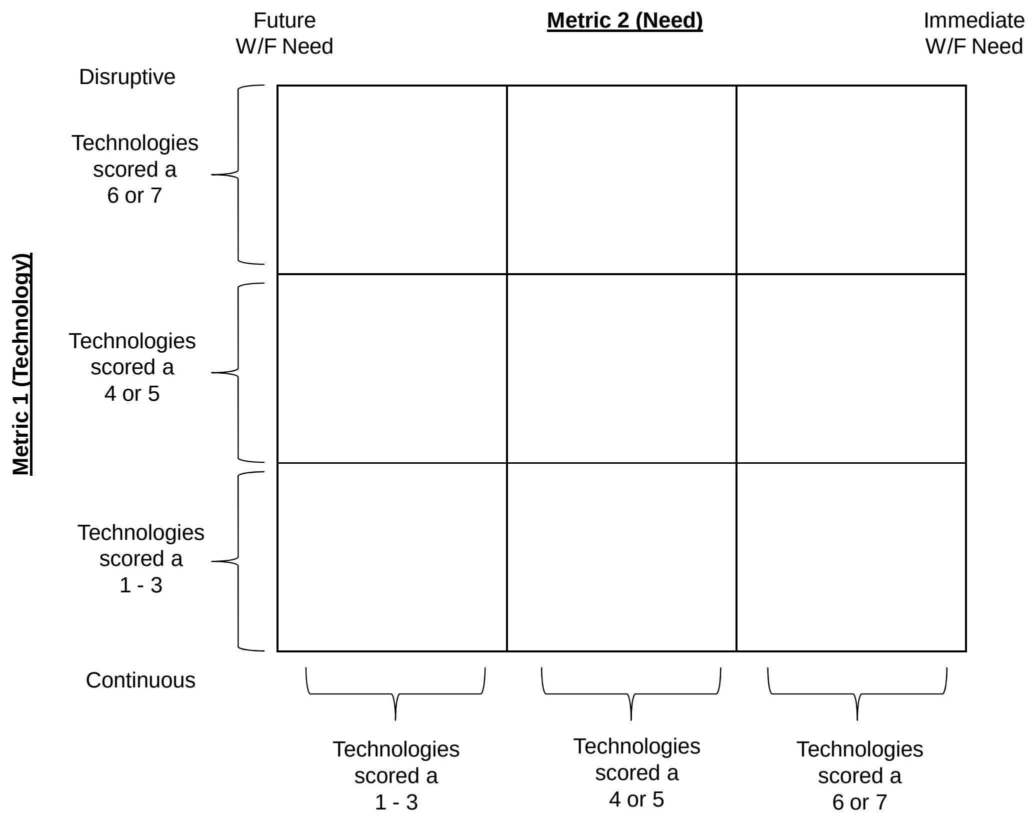

Figure 1. Legend for grid analysis

After all of the top technologies were plotted on each grid, the findings were evaluated and analyzed. The subsequent sections discuss the findings for the three grid comparisons conducted on the top technologies.

a. Immediate Warfighter Need Versus Disruptive Technology

The following figure compares the top technologies on addressing immediate warfighter needs and the degree to which the technology is disruptive:

Need

Future W/F Need — Immediate W/F Need

Technology: Disruptive — Continuous

Technology \ Need	Future W/F Need		Immediate W/F Need
Disruptive	RAID TEAM SDS M&DC2	LCCMD DTEC AT3	WASP DOTS LASER Boomerang
	Virtual Autopsy Program HAARP PCES Ultralog Sticky Flare	Active Templates Fast C2AP	Radar Scope SPEYES MAV ACTD
Continuous	HPCRM		VIVID Shape Charge Armor T-PANELS

Figure 2. Immediate warfighter need vs. disruptive technology

As the figure shows, the top technologies are split between addressing immediate and future warfighter needs. Out of the top 25 technologies, ten score significantly high and ten score significantly low on the immediate warfighter need metric which would indicate that there is not a significant relationship between addressing immediate versus future warfighter needs and being a successfully transitioned technology. With regard to being continuous versus disruptive technology, the figure shows that 21 out of the 25 technologies score at least a four on this metric. This means that the majority of top technologies are at least somewhat disruptive in terms of building on existing technology.

b. Immediate Warfighter Need Versus revolutionary Capability

The following figure compares the top technologies on addressing immediate warfighter needs and the degree to which the technologies provide a revolutionary capability:

Need

Capability	Future W/F Need		Immediate W/F Need
Revolutionary	RAID SDS	Fast C2AP DTEC AT3	WASP Radar Scope DOTS SPEYES LASER Boomerang MAV ACTD
	HAARP TEAM PCES Ultralog Sticky Flare	Active Templates LCCMD	VIVID Shape Charge Armor T-PANELS
Existing	Virtual Autopsy Program M&DC2 HPCRM		

Figure 3. Immediate warfighter need vs. revolutionary capability

As was observed in the first grid, the top technologies are split between addressing immediate versus future warfighter needs. However, 12 out of the 25 technologies, scored very high in terms of providing revolutionary capability and ten more followed with a score of at least a four on this metric. These findings indicate top technologies that transition successfully tend to provide the user, at least to some degree, with game-changing capability. There is also a fairly heavy concentration of technologies that score the highest on both metrics. This should be of no surprise considering that technologies able to address immediate warfighter needs and provide revolutionary capability should have no trouble successfully transitioning. Thus, to find technologies that score high on these metrics among the top technologies is not unexpected.

c. *Mission Fit Versus Technological Maturity*

The technological maturity metric is scored on a nine-point scale as opposed to the other metrics, which are scored on a seven-point scale. The following figure is the legend which reflects this difference in scoring:

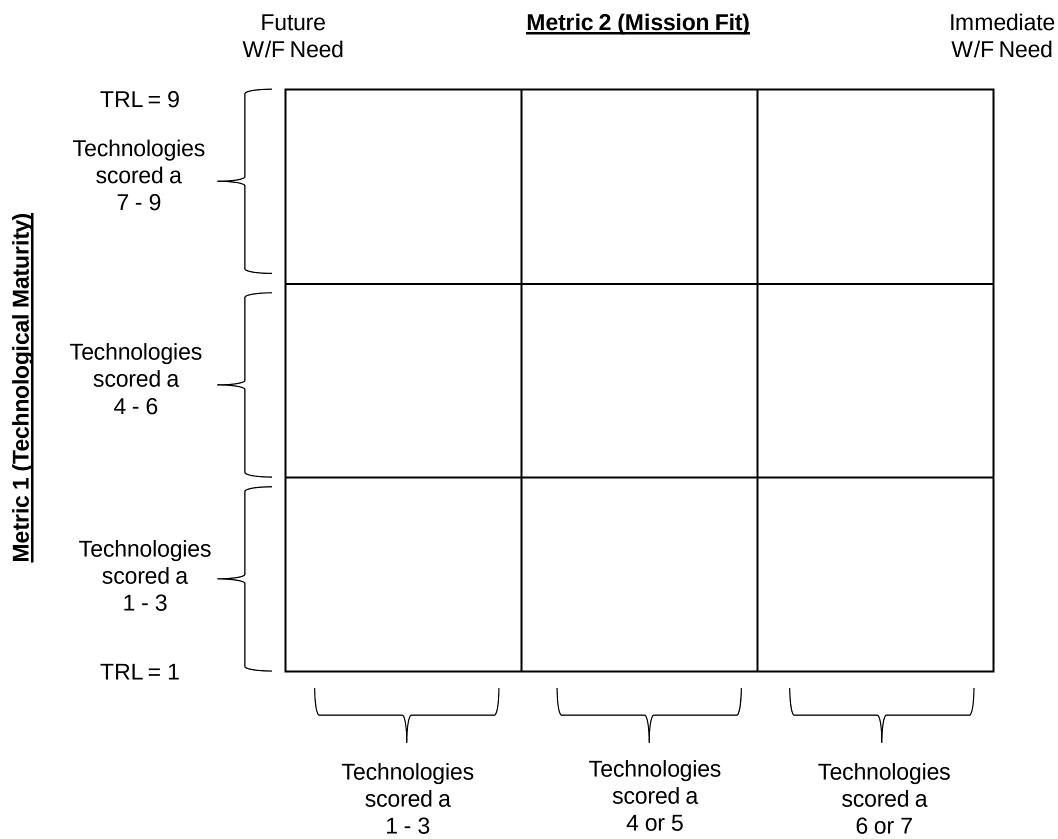

Figure 4. Legend for grid analysis with TRL metric

Figure 5 compares the top technologies based on how well they meet DoD mission needs and their technological maturity:

Mission Fit

No Fit → Great Fit

Technological Maturity (TRL = 9 at top, TRL = 1 at bottom)

TRL = 9	Virtual Autopsy Program HAARP	PCES	WASP Radar Scope Shape Charge Armor DOTS SPEYES Fast C2AP Boomerang
	RAID DTEC TEAM SDS M&DC2 HPCRM Sticky Flare	Active Templates LCCMD AT3 Ultralog LASER	VIVID MAV ACTD
TRL = 1			T-PANELS

Figure 5. Mission fit vs. technological maturity

The top technologies were split again, where ten of the technologies scored high on the mission fit metric, ten scored low, and there were five in the middle. This could be explained by the fact that mission fit is a description of how well a technology meets DoD mission needs. Some of the top technologies may be more focused toward future needs and capabilities and thus does not fit current DoD mission needs well. With the technological maturity metric, out of the top 25 technologies, only one had a TRL lower than four. This should come as no surprise, but the correlation between technological maturity and successful technology transition appears very high. The more technologically ready a system is, the better its chances are at successfully transitioning. Again, there is a high concentration of technologies that score highly on both of these metrics. This suggests a strong correlation between mission fit, technological maturity, and successful transition.

4. Top Index for Technology Transition

Out of the eight original indices formulated for this research, the four using transition time as a factor, indices three, four, six, and eight, should not be considered as a top index for use. Although decreasing the time it takes to develop and transition a technology is a primary objective of the AEO, it does not make a good measure for evaluating successful transition. For example, the Wasp Micro Air Vehicle took approximately 60 months to complete. The way the indices allotting for transition time were setup, this technology would receive the lowest weight possible, other than a zero for not transitioning. However, one only has to look at the amount of programs this technology has affected and, more importantly, the impact it has had on the user in the field to appreciate how successfully it has transitioned. Transition time is an extremely important metric for improving technology transition, but many of the top technologies considered successful in the index analysis were not necessarily considered quick with regard to technology development standards.

Out of the four remaining indices, indices one, two, five, and seven, could all be used for measuring technology transition depending on the definition of transition. All four of the indices weight the different types of transition differently. Index one weights transition to the warfighter more heavily than any other type of transition, while putting significant emphasis on transitioning to a POR, less emphasis on DoD and DARPA S&T transitions, and no emphasis at all on commercial transitions. Index two weights warfighter and POR transition equally, but above all other types, and considers the other three transition types equally. Index five only weights warfighter and POR transition and does not consider any other types. Index seven weights all types of transition equally. The indices illustrate the subjective nature of technology transition, where all value various strategies related to transition, differently. It should be noted, the extent of transition, though important, will not be discussed in detail in this section. Ultimately, it is up to the AEO to decide how much weight to assign a partial and full transition.

For example, if the AEO considers transitioning technology to the warfighter the highest form of transition, an index like index one should be used to evaluate their programs. If the AEO considers all forms of transition successful, they might think about using index similar to seven, where no type outweighs another. This type of index could be very useful in certain situations where the quantity of transitions was more important than the quality. If the AEO considers all forms of transition successful, but still some forms more successful than others, they might consider an index like index two. If the AEO believes only certain types of transition are successful, they should look into using an index like five, where only the most important types of transition are measured.

In the author's opinion, taking into account that the AEO is a DoD organization, giving greater weight to technologies that successfully transition to the warfighter and to PORs is more logical than giving equal credit to technologies that transition to other programs for further development, or outside of the DoD altogether. The author is also of the opinion that both warfighter and POR transition should be weighted equally due to the fact that not all technologies are meant to be fielded to the warfighter. Some technologies are not even meant to be their own POR, but still contribute significantly to other platforms and PORs. The integral roles these technologies play should not be overlooked by weighting them less than technologies that are fielded directly to the warfighter. Also, technologies that transition to other S&T programs or to the commercial sector also deserve credit as well. These types of transition should be incorporated into the index because by being transitioned there is obviously some value created by that technology and it should be accounted for. To do otherwise would insinuate that the technology was a waste of resources and no value was gained from it.

For these reasons, the author would recommend using an index similar to **index two** for evaluating technology transition within the DoD.

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IV. STATISTICAL ANALYSIS

This chapter will discuss the analysis used to examine the data collected from the PCRs. First, significant correlations between some of the metrics used to evaluate PCRs will be discussed. Second, a regression analysis of metrics within each factor that influence technology transition will be discussed. Lastly, the model used to establish a framework for a better understanding of the factors that influence technology transition will be examined.

A. CORRELATIONS

The first part of the analysis consisted of running correlations on the database metrics to see which metrics used to evaluate the technologies had a significant relationship. The results of the analysis are shown in Table 8 on the next page, followed by observations and theories for a few of the more significant relationships identified.

Table 8. Metric correlations

Metrics	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Improves Warfighter Safety (1)	1.000														
Improves Warfighter Job Satisfaction (2)	0.259	1.000													
Addresses Immediate Warfighter Need (3)	0.462	0.323	1.000												
Addresses Future Warfighter Need (4)	-0.220	-0.039	-0.404	1.000											
Technological Maturity (5)	0.177	0.314	0.276	-0.085	1.000										
Perceived Usefulness (6)	0.169	0.230	0.325	-0.142	0.375	1.000									
Continuous vs. Disruptive (7)	0.053	0.032	0.022	-0.048	0.149	0.460	1.000								
Revolutionary Capability (8)	0.186	0.161	0.172	-0.064	0.204	0.540	0.811	1.000							
Enhances Legacy Technology (9)	-0.256	0.104	-0.053	0.229	0.103	0.299	0.221	0.294	1.000						
Prepares DoD for Future (10)	-0.168	0.043	-0.120	0.155	0.203	0.433	0.652	0.612	0.483	1.000					
Mission Fit (11)	0.137	0.126	0.383	-0.270	0.275	0.616	0.511	0.614	0.374	0.504	1.000				
Flexibility (12)	-0.012	0.014	-0.061	-0.162	-0.122	0.221	0.298	0.385	0.178	0.460	0.366	1.000			
Adaptable (13)	-0.107	-0.058	-0.071	-0.068	-0.134	0.130	0.275	0.278	0.178	0.396	0.325	0.680	1.000		
Interoperability (14)	-0.020	-0.072	-0.010	-0.164	-0.170	0.144	0.213	0.247	0.050	0.242	0.153	0.433	0.367	1.000	
Saves Resources (15)	-0.029	0.051	0.067	-0.159	0.039	0.548	0.463	0.510	0.376	0.472	0.495	0.422	0.353	0.272	1.000

1. Expected Correlations

Addresses immediate warfighter need has a fairly significant positive correlation with both the improves warfighter safety and improves warfighter job satisfaction metrics. This should come as no surprise considering that most technologies aimed at improving warfighter safety or job satisfaction are probably based on requirements emerging from problems experienced in Iraq and Afghanistan, i.e. immediate warfighter needs. It is also expected that addresses immediate warfighter need has a rather negative correlation with addresses future warfighter need. Though immediate and future warfighter needs can sometimes coincide, more often than not they do not, as is reflected in the analysis.

The continuous versus disruptive metric, which evaluates technologies on the extent to which they build on existing technologies, has a very significant correlation with the metric that rates a technology on the degree to which it provides a revolutionary capability. This correlation between these two metrics is the highest out of all of the metrics. The high significance of this relationship is expected because technologies that were rated as being continuous, a technology that builds incrementally and improves on an existing technology, would most likely provide a capability that was not revolutionary or game changing. In the same regard, technologies that were rated as disruptive, a new technology that has unexpected benefits, would most likely provide a revolutionary capability, and thus would receive a high rating for this metric. These two categories also correlate significantly with the prepares DoD for the future metric. This is due to the fact that disruptive technologies providing revolutionary capability would help to prepare the DoD for future missions that are not yet fully realized.

Adaptive to user needs and flexible in mission use also share a very significant relationship, the second highest out of all the metrics. This is also an expected result. Technologies that display a high adaptability to user needs should also be very flexible with regards to mission use because technologies that are very adaptable can probably perform multiple missions.

2. Unexpected Correlations

Addresses future warfighter need did not show a significant relationship with the two metrics that evaluated technologies on being continuous versus disruptive and the extent to which the capability provided by the technologies was revolutionary. A strong correlation should exist between these metrics because as time progresses and technology makes new advances, technology becomes more disruptive and tends to provide capabilities that were not previously available. Furthermore, future warfighter needs will most likely be different from immediate warfighter needs, where different technological solutions will be required to meet new enemies. For these reasons, the relationship between these metrics should be highly correlated.

Enhances legacy technology also had some unexpected correlations. First, it shows a somewhat significant, negative correlation with the improves warfighter safety metric. This is unexpected because logically, one would expect that at least some technologies aimed at making the warfighter safer would seem to be improvements to existing technologies. This data suggests that this relationship is negative, which is a confusing result. Secondly, enhances legacy technology also has practically no correlation with immediate warfighter need, which is also puzzling. Immediate warfighter needs are usually satisfied with continuous technologies that incrementally build on the capability of existing systems. In essence, if the current technology that the warfighter possesses is not giving them the needed capability, enhancements to that technology are often made to yield the desired performance. One would think that at least a small relationship would exist between these two metrics, but the data implies otherwise.

Prepares DoD for the future and addresses future warfighter need also has a relationship that is less significant than expected. One would think that these two metrics would be highly correlated since addressing future warfighter needs would also be a direct method of preparing the DoD for the future. Technologies that address future warfighter needs would also pave the way for other similar systems and prepare the DoD infrastructure to receive such technologies. Thus, to find no relationship between these metrics is odd.

Flexibility in mission use, adaptive to user needs, and interoperability with existing technologies are all very poorly related to improves warfighter job satisfaction. This is very unexpected because technologies that are flexible, adaptive, and interoperable with existing systems should be very highly correlated with improving warfighter job satisfaction since these metrics essentially measure ease of use. However, these very low correlations might be explained by the fact that out of all the metrics, these three metrics had the highest amount of "N/A" ratings due to the fact that certain technologies were very hard to evaluate in these areas.

3. Mission Fit

It should be noted that the mission fit metric is significantly correlated to many of the other metrics used to evaluate the technologies. Among the most significant correlations with mission fit are perceived usefulness, continuous versus disruptive, revolutionary capability, and prepares DoD for the future metrics. All of these metrics should be significantly correlated with mission fit because they all are measures of how well a technology fits an existing DoD mission. For example, with perceived usefulness, if the technology was evaluated as very useful, there is most likely a DoD mission that the technology is particularly suited for. The degree to which a technology is considered continuous or disruptive also correlates significantly with how well it will fit into an existing DoD mission. If the technology is too disruptive, it will not fit existing missions because it probably will provide new capability that a mission may not exist for.

A couple of metrics that mission fit is not significantly correlated to are improves warfighter safety and improves warfighter job satisfaction. The fact that these metrics are not significantly correlated suggests that DoD missions are not focused on making warfighter jobs better or the user safer. Rather, as far as technologies are concerned, accomplishing a certain objective or providing a specific capability are most likely the concern.

It is also important to note that the correlations reported do strongly suggest that there are significant overlaps between some of the metrics. This indicates that all of the metrics are not independent of one another. Therefore, future statistical work should include a factor analysis to examine if the metrics can be reduced to a smaller number of underlying measures.

B. REGRESSION MODELS

1. Methodology

In order to find metrics to conduct regression analysis on, indices were created to try to identify the most successfully transitioned technologies. Originally there were eight indices, which were narrowed down to four. The four indices that were not chosen for regression analysis were the indices that considered time as a factor. They were excluded primarily because, in the model used in this study, time did not make a valid factor for evaluating successful transition. Using the four final indices as the dependent variable and all of the metrics as the independent variables, four initial regression models were created. In order to conduct the regressions, all metrics for the technologies had to contain a value. Thus, it was necessary to omit some metrics and technologies in the database that contained many "N/A" or "TBR" values. For this reason, the initial regression was done with 101 technologies in order to include 11 metrics. This differs from the 103 technologies used for the other regressions run with less metrics. From the initial regressions, key metrics were identified and selected for further analysis.

The AEO Measurement Model will be discussed in the next section of this chapter, but for the sake of comprehension, it will be briefly described here. The AEO Measurement Model is made up of three factors: worthiness, DoD market factors, and the DARPA development process. When combined, all of these factors influence the effectiveness of technology transition. After reviewing the initial regression analysis, certain metrics were chosen to represent two of the factors in the AEO Measurement Model. Technical maturity, continuous versus disruptive, and revolutionary capability were the three metrics that were chosen to represent the worthiness factor. Immediate warfighter need and mission fit were selected to represent the DoD market factors. To choose these metrics, the averages for all the metrics were taken from technologies that transitioned to either the warfighter, a POR, or in some cases both, and compared to technologies that did not transition at all. The metrics listed above were selected because their averages showed significant differences between the technologies that transitioned and those that did not.

In the next round of regression analysis, first, the three worthiness metrics, technical maturity, continuous versus disruptive, and revolutionary capability, were run against the top four indices, where the indices were the dependent variables and the metrics were the independent variables. Subsequently, the two DoD market factors metrics, immediate warfighter need and mission fit, were also run against the top four indices, where the top four transition indices served as the dependent variables and the metrics were the independent variables. After analyzing the results from these regressions, all of the metrics were included in the same regression and run against the top four transition indices, where the indices were the dependent variables and the metrics were the independent variables. The results of all the regressions were analyzed and compared against each other. The results are discussed below.

2. Findings

All four of the initial regressions run showed a significant relationship between each of the four final indices and the metrics technological maturity and mission fit. The r-squared values were fairly significant as well, indicating that the metrics used are somewhat good at predicting technology transition. The results of the analysis, the p-values for the technological maturity and mission fit metrics along with the R Square values for each regression, are shown in Table 9. The full regression outputs are included in Appendix A of this study.

Table 9. Regression with indices, technological maturity, and mission fit

Metrics (P-values)	Index #1	Index #2	Index #5	Index #7
Technological Maturity	0.00164	0.00101	0.01907	0.00018
Mission Fit	0.00464	0.00041	0.00340	0.00027
R Square Value	0.48760	0.46393	0.42407	0.45891

In the second round of regressions, the individual metrics that were selected as representatives for two of the three factors influencing technology transition in the AEO Measurement Model were analyzed using regression. In all four regressions with the worthiness metrics, only the technological maturity metric was significant to all four indices. The results of the analysis, the p-values for the worthiness metrics and the R Square values for each regression, are shown in Table 10. The full regression outputs are included in Appendix B of this study.

Table 10. Regression with worthiness metrics

Metrics (P-values)	Index #1	Index #2	Index #5	Index #7
Technological Maturity	0.00000	0.00000	0.00000	0.00000
Continuous vs. Disruptive	0.51553	0.26445	0.74893	0.07406
Revolutionary Capability	0.28466	0.75888	0.36378	0.87745
R Square Value	0.34857	0.32646	0.26961	0.32044

When analyzing the DoD market factors metrics, only the mission fit metric was significant to all four indices; immediate warfighter need was significant only for index seven. The results of the analysis, the p-values for the DoD market factors metrics and the R Square values for each regression, are shown in Table 11. The full regression outputs are included in Appendix C of this study.

Table 11. Regression with DoD market factors metrics

Metrics (P-values)	Index #1	Index #2	Index #5	Index #7
Immediate Warfighter Need	0.65181	0.11955	0.45902	0.02894
Mission Fit	0.00000	0.00000	0.00001	0.00000
R Square Value	0.33008	0.30918	0.29360	0.26388

In the third round of regressions, the five metrics from the two AEO Measurement Model factors were analyzed against all four indices. The results were consistent with the previous two increments of regression analysis, where the only two significant metrics across all four indices were technological maturity and mission fit. The results of the analysis, the p-values for the five metrics and the R Square values for each regression, are shown in Table 12. The full regression outputs are included in Appendix D of this study.

Table 12. Regression with worthiness and DoD market factors metrics

Metrics (P-values)	Index #1	Index #2	Index #5	Index #7
Technological Maturity	0.00002	0.00003	0.00063	0.00003
Continuous vs. Disruptive	0.23662	0.11949	0.44149	0.03719
Revolutionary Capability	0.76780	0.37087	0.72519	0.30607
Immediate Warfighter Need	0.82489	0.17069	0.57509	0.04083
Mission Fit	0.00142	0.00015	0.00121	0.00024
R Square Value	0.45541	0.43727	0.37896	0.41270

The trend of the technological maturity and mission fit metrics having significance in all regressions performed suggests that these two metrics are consistently strong predictors of transition across all of the models attempted in this study. Another noteworthy finding that emerged as a result of the regression analysis is that the r-square value for the metrics of the two AEO Measurement Model factors was somewhat significant in the individual regressions that were conducted, but became more significant as all five metrics were combined. The R Square value increased significantly, indicating that these five metrics, when combined, are a better predictor of technology transition than as individual factors.

3. Is Creating an Index to Measure Transition a Good Idea?

The findings in the regression analysis should come as no surprise to DARPA program managers. They confirm that the technologies that transition and become adopted by their users typically have a high degree of readiness and fit well with a DoD mission. However, the findings within the regression analysis pose an interesting dilemma. With the technological maturity and mission fit metrics appearing as very significant predictors of technology transition, instead of attempting to create an index that identifies metrics that will predict successful transition, maybe technologies should be evaluated on readiness. Technological maturity, a measure of the readiness of a technology to be transitioned, and mission fit, a measure of existing need for the technology, are both good indicators of whether or not a technology is prepared for transition. The DoD can control, to a certain extent, the TRL of a technology by dedicating more resources to the development of the technology. Though the DoD cannot control mission need, it can select technologies to develop based on whether they meet DoD mission needs.

Evaluating technologies solely on readiness would be difficult for an organization like DARPA to do. First, DARPA consistently develops technologies with very low TRLs. Part of their purpose as an organization is to push the technological envelope and that often requires developing very immature technologies. Secondly, DARPA cannot focus primarily on DoD mission needs because that would require them to focus on the near-term, immediate needs of the DoD. Though they do this on a limited basis, part of their purpose as an organization is to try and develop technological solutions to long-term problems and advance the state of the art. DARPA could not fulfill this purpose if they only focused on developing technologies to meet current DoD mission needs.

A surprising result of the regression analysis is that once technological maturity and mission fit are included in the regression models, the rest of the metrics turn insignificant. This result suggests that these two factors dominate transition and that most of the other metrics do not matter. Further statistical analysis should be conducted on this data to explore possible reasons why this occurs.

C. THEORETICAL MODEL OF TECHNOLOGY TRANSITION

The AEO Measurement Model used to analyze the data collected from the PCRs consists of three separate factors that influence technology transition. The three factors affecting AEO technology transition are the merit of the technology itself (worthiness), the process used to develop the technology (development process), and the market factors (demand). The AEO Measurement Model is depicted in Figure 6:

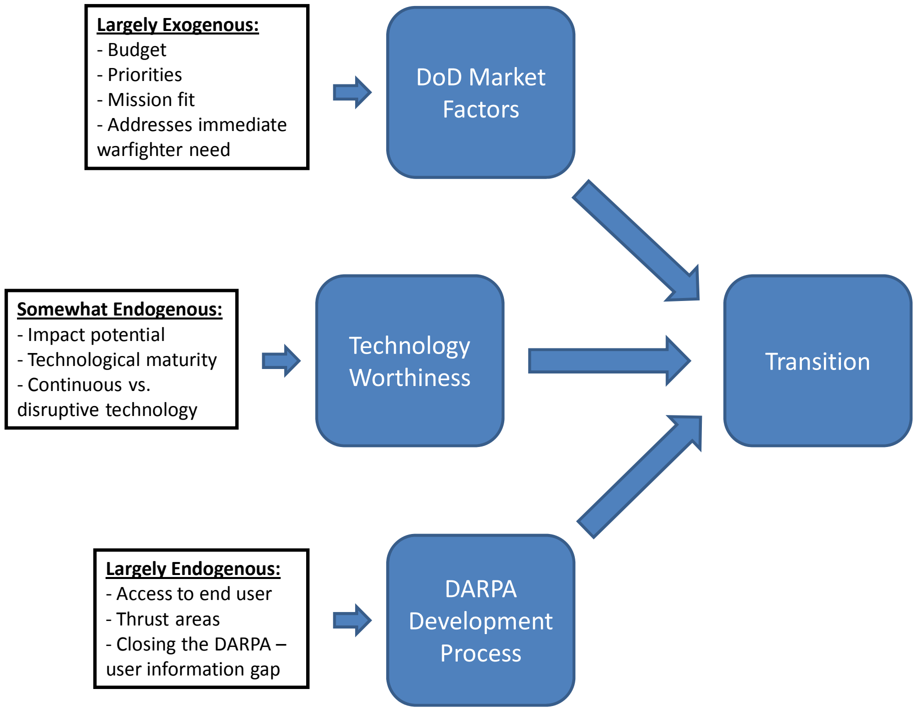

Figure 6. AEO measurement model

The three factors are discussed in more detail in the subsequent sections.

1. Technology Worthiness

The technology worthiness factor represents the merit of the technology itself. Obviously, technologies that demonstrate a revolutionary capability or significantly enhance an already existing capability would transition more easily than technologies that do not, but a technology's worthiness can be evaluated on several different metrics. To identify the metrics to gauge the worthiness of the technology, the data collected from the PCRs were analyzed by creating different indices to identify the top technologies. The top technologies were then compared to technologies that did not transition. The worthiness metrics that showed a significant variance between successful and unsuccessful technologies were chosen to represent technology worthiness in the AEO Measurement Model. It is important to note that many metrics can be used to evaluate technology worthiness. The most appropriate metrics will vary depending on the situation, organizations involved, as well as the types of technologies being evaluated.

The three metrics identified from the analysis for the technology worthiness factor in the AEO Measurement Model were the metric used to evaluate the degree to which the technology would build on existing technology (continuous vs. disruptive), the metric used to evaluate the degree to which the technology provided revolutionary capability (impact potential), and the technological maturity metric used to assess the estimated TRL of the technology. These metrics represent the quality of the technology, where quality does not necessarily constitute highest scores in all three of these categories, but the right combination of metrics that enhance the value of the technology. The higher the technology's quality, the more like it is to be adopted and transitioned.

To some extent, organizations can increase the quality of a technology by dedicating more resources to its development. Resources could include monetary, personnel, expertise, manufacturing processes or capability, to increase the TRL or readiness of a technology to be transitioned. In some cases however, no amount of extra time, effort, or money will be enough to advance the technology far enough for transition.

2. DARPA Development Process

The DARPA development process factor represents the process by which DARPA develops and fields their technologies. This factor might include having systems in place to interpret the needs of the warfighter and to ensure the people with the appropriate authority are aware of the technologies being developed by DARPA. The PCRs contained information regarding the development of technologies, not the processes by which they were developed and transitioned. For this reason, the technologies were not evaluated on this basis and no metrics were included in the database to examine DARPA's development process. However, the initial interviews with acquisition professionals did offer insight into potential process issues that would most likely affect technology transition. An example includes access to the end user.

Access to the end user refers to the degree of involvement the user has in the development of the technology. As indicated in a few of the interviews by acquisition professionals from the conventional acquisition community, end user involvement usually occurs by proxy; where a member from headquarters or command represents the user during the development process. Without direct feedback from the real user, programs may suffer from the lack of critical inputs needed to design and develop a system that meets user expectations. To improve technology adoption and transition, organizations could amend their processes to permit direct contact with the true user, allowing them real-time feedback in order to develop a system that better meets user needs, while increasing the odds of successful transition.

For an organization like DARPA, access to the end user is critically important because innovation happens through close working relationships with the end user, where having intimate knowledge of end user needs helps to close the information gap between them and the developing organization. DARPA can affect this by setting up infrastructure, processes, and programs that allow program managers access to the end user. As described on the AEO website (2010), one of their strategies is to establish strong organizational relationships connecting warfighters to DARPA's performers and demonstrate the transition worthiness of DARPA technology by rigorously assessing their strengths and limitations.

Development process cannot account for all innovation. Innovation also happens through users, where users will take a technology and use it in ways never expected nor intended by its developer. As indicated by a couple of the interviews, special operations forces are a good illustration of this type of community. The creativity and innovation displayed by this category of user cannot be predicted. Thus, even the best process cannot account for it because the user themselves cannot account for it until the technology reaches their hands. Program managers cannot account or plan for something that is impossible to predict.

The processes organizations use to develop and transition technology can be controlled, to a certain degree, by the organizations that use them. Organizations can easily control the processes they put into place, but cannot control whether the processes are accepted and used by the organizational culture. Organizations can become entrenched in the processes they use, where removing them can become a significant challenge and not always successful. With technology transition, it is important to put effective processes into place that promote transition because organizational inertia can make them difficult to change or remove if they are ineffective.

Part of the development process includes making the receiving organization ready to accept the technology. By preparing the receiving organizations, the odds of successfully transitioning a technology will increase. An example might be if the technology requires certain infrastructure to support the technology, the receiving organization would need to have that infrastructure in place upon receiving the technology. The onus of post-delivery requirements falls on both the developer of the technology as well as the recipient. Processes should be in place to ensure a seamless transfer from one organization to another.

3. DoD Market Factors

Unlike the other two factors in the AEO Measurement Model, the DoD market factors are driven by external forces and cannot be controlled by DARPA in any way. Some of these factors include competition in the market, demand of the user, DoD budget, mission needs, and priorities. All of these factors represent the market pull, or demand for the technology. The greater the demand for the technology, the more likely it is to successfully transition. To evaluate the demand for the technologies, metrics were required that would indicate the level to which the technologies met the needs of the DoD. As with the technology worthiness factor, the data collected from the PCRs were analyzed by creating different indices to identify the top technologies. The demand metrics of the successfully transitioned technologies that showed the most variance when compared to the unsuccessfully transitioned technologies were picked to represent the DoD market factors in the AEO Measurement Model. Again, it is important to note that many metrics could represent DoD demand and that the metrics chosen for this model may not be appropriate in the context of other situations.

The two metrics used to represent DoD market factors were the extent to which the technology fit the mission needs of the DoD, as well as the extent to which the technology addresses an immediate warfighter need. These metrics are good representations of DoD demand because demand is very difficult to predict. The immediate needs of the warfighter may or may not align with the future needs of the warfighter, but current warfighter needs are known. What the warfighter needs in the future is not. A significant factor to transition is timing, and since tomorrow's demand is hard to predict, the current needs of the DoD should provide an accurate indicator of how technology transition is affected by demand.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. RECOMMENDATIONS

To summarize the recommendations and findings of this study, a success map was developed for the AEO. The success map is attributed to Neely, Adams, and Kennerly (as cited in Perkmann, Neely, and Walsh, 2010, May). As Bremser and Barsky describe it (as cited in Perkmann, Neely, and Walsh, 2010, May), a success map articulates a simple theory of how the alliance between technology transition and the AEO works and identifies the cause and effect relationships underpinning success. The success map created for the AEO is shown in Figure 7:

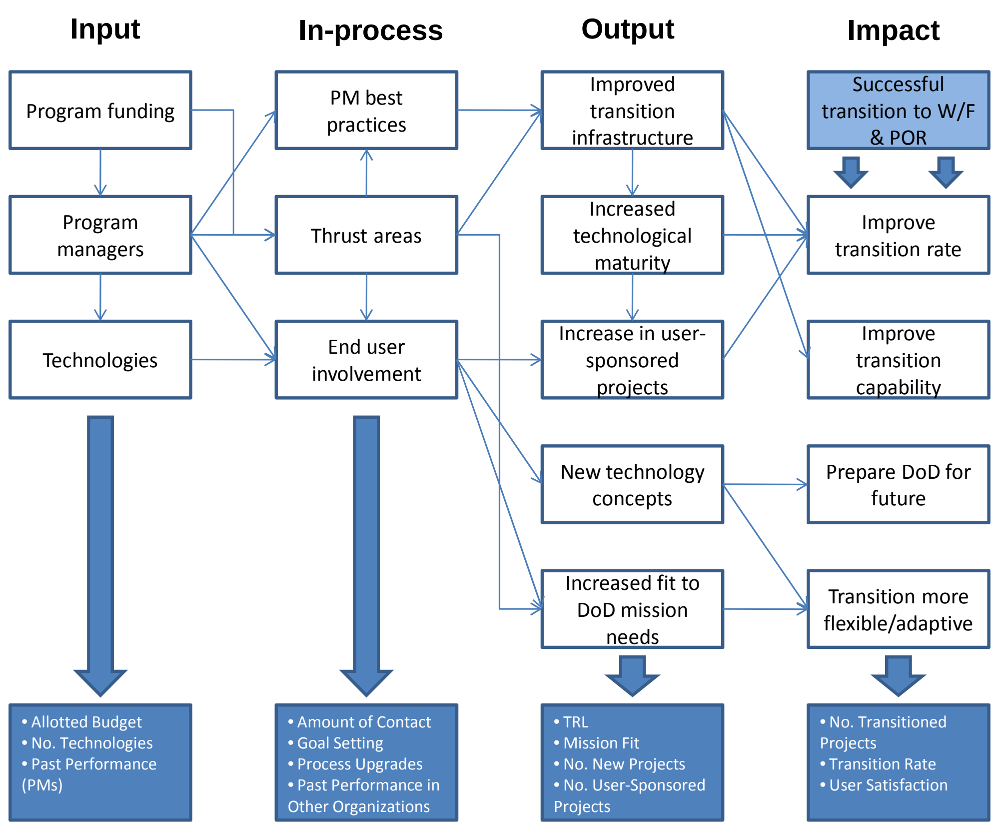

Figure 7. AEO success map

Brown (as cited in Perkmann, Nelly, and Walsh, 2010, May) described four stages in an alliance: input, in-process, output, and impact, as are shown on the success map above. The white boxes represent the success map, while the dark boxes contain appropriate measures for the four different stages.

1. Inputs

While inputs constitute the first stage in the process, a first necessary ingredient for a successful alliance is the mobilization of adequate resources (Perkmann, Nelly, and Walsh, 2010, May). The resources required for success in the AEO success map are the program funding, program managers, and the technologies. Funding for DARPA/AEO programs comes from the DoD budget. Successful transition can be influenced, to some extent, by the amount of funding allocated to the program. As described earlier in this report, competition exists, and is increasing, between DoD organizations for funding as the use of supplemental appropriations begins to decrease. For the AEO, success is dependent on securing enough funding to execute programs and continue to develop the processes necessary to achieve the AEO thrust initiatives.

Another one of the ingredients to DARPA's success is their highly qualified program managers. DARPA draws talented and intelligent program managers from all aspects of various professional communities. Working for DARPA represents a pinnacle professional achievement for many; where program managers are expected to be innovative and push the technological envelope. DARPA's ability to attract very capable program managers and subject matter experts to execute their programs is a big driver for success.

The phrase "DARPA hard" is used to describe challenges that are seemingly insurmountable from a technological perspective. DARPA has earned this homage because they tackle some of the most difficult S&T challenges that exist. Technologies, the third input listed in the success map, are never in short supply. As long as technology is needed, there will always be new technological advancements to be made. Access to technologies should not be difficult to maintain, but will be required to ensure successful transition for the AEO.

2. In-Process

The three elements that make up the input stage are necessary for the next stage in the success map, the in-process stage. In the AEO's success map, the in-process stage is made up of three elements: program management best practices, the AEO thrust areas, and end user involvement. The availability of funding and astute program managers help to develop program management (PM) best practices. Resources fund the research, development, and institution of processes and infrastructure that is proven to be successful in transitioning technology. Program managers play a significant role in creating PM best practices by documenting and sharing lessons learned to create continuity among DARPA program managers. Finding the successful development methods and implementing them within the AEO is critical to their success as an organization in transitioning technologies. Equally as critical is keeping continuity and continually looking for ways to improve the processes in place.

Program managers and sufficient funding are also required to achieve the AEO thrust areas. The AEO thrust areas represent organizational goals related to specific mission areas. Program managers must buy in to these goals and be dedicated to them in order for the organization to be successful. Sufficient funding is needed to establish the infrastructure and processes to help the AEO program managers accomplish the goals. The thrust areas also provide vision to the AEO program managers. Vision is crucial to achieving successful transition in any organization in order to motivate employees and provide purpose to their jobs.

End user involvement is a critical element to successful technology transition affected by both program managers and technologies. Program managers must establish productive work relationships with the end user throughout the entire development process. By doing so, communication can be established to ensure real time inputs into the system by the operators who use it. This relationship helps the program manager understand the user's requirements for the system, which results in the technology meeting user expectations and increases the probability it will successfully transition. End users must also have access to the technologies in order to provide input into their development. Getting the technologies into the hands of the operator early and often will result in a better developed product, which will increase the chances for successful transition.

3. Output

In the third stage, the above in-process activities should subsequently lead to the generation of actual outputs (Perkmann, Nelly, and Walsh, 2010, May). Creating PM best practices and implementing the AEO thrust areas should produce an improved transition infrastructure, which will in turn lead to increased technological maturity. End user involvement should result in an increase in user-sponsored projects because it demonstrates a commitment by the AEO to delivering quality systems to the user. End user involvement will also lead to new technology concepts because by granting the user access to the technology throughout the development process, the user will come up with ways to use the technology that the developers never thought of. In doing so, new technology concepts are developed that will lead to other projects. Implementation of thrust initiatives and end user involvement generates an increase in the degree to which the technologies fit DoD mission needs. The AEO thrust areas address current warfighter needs, while direct user input informs developers of ways the technology can better meet their needs in the field.

4. Impact

In the final stage, the exploitation of these outputs should lead to a range of impacts (Perkmann, Nelly, and Walsh, 2010, May). Improved transition infrastructure, increased technological maturity, and an increase in user-sponsored projects, will all improve the transition rate of the AEO. By improving the transition infrastructure, better processes and methods for transition will be developed and used, resulting in an increased transition rate. Increased technological maturity increases the technology's readiness. More technologies with higher technological maturity will transition more often than technologies with low technological maturity. Thus, technologies with higher technological maturity will lead to better transition rates. An increase in user-sponsored projects indicates that the user will be more committed to developing the technology for two reasons. First, the user has money invested and wants to ensure the technology provides a return on investment. Second, an investment by the user usually indicates the user is interested in what the technology can offer them. For these two reasons, the user is likely to stay committed to the project, leading to an increase in the rate of programs that transition.

Improved transition capability is a direct impact of an improved transition infrastructure. Better processes and program management practices will make the AEO a more capable organization with regard to transition. Improved infrastructure also makes program managers more capable. It can eliminate inefficiencies or impediments that employees encounter on a daily basis. Eradicating these obstructions can improve the work environment by making it less stressful for the employees, leading to increased productivity.

Identifying new technology concepts help to prepare the DoD for the future. Users are inventive. When a user is given a technology to test, often times unexpected results occur. Users will utilize the technology in ways never intended by the developer. A technology with only one initial mission becomes multi-faceted and able to adapt to other mission scenarios. The manner in which users choose to apply a new technology could identify new technology concepts for other programs or even uncover new capability gaps that the user or developer never knew existed. This dynamic helps to prepare the AEO, and on a broader level, the DoD, for the next iteration of the technology.

Both new technology concepts and increased fit to DoD mission needs will help to make transition more adaptive and flexible to user needs. New technology concepts are born out of new needs that emerge as a result of user involvement in the development process. Due to user involvement, the developers must remain adaptable and flexible in order to incorporate changes to meet the user's requirements. DoD mission needs tend to change with the emergence of new threats. The AEO transition process will have to remain flexible in order to adapt to these changes. Meeting DoD mission needs will drive them to do so.

B. AREAS FOR FUTURE RESEARCH

This study has highlighted areas for further study listed below:

- An exclusive assessment of the process factor in the AEO Measurement Model, specifically interviewing DARPA program managers to provide further fidelity to the Model.
- Exploring a more comprehensive list of technology transition indices to attempt to find better predictors of technology transition with input from DARPA on their organizational definition of what constitutes transition.
- Interviewing DARPA program managers to ascertain the elements of the transition success map from their perspective in order to compare with the one included in this study.
- A multi-case study between the top technologies found with the transition indices used in this study.
- A detailed comparison and analysis of the three most successful transitions as defined by DARPA.
- Refinement of the database included in this study to include adding or deleting metrics or reevaluating all 116 technologies.
- Further statistical analysis of the database in attempt to discover other significant metrics of technology transition or further explain the significant factors discovered in this study.

C. CONCLUSION

In conclusion, measuring technology transition remains a very complicated problem. Where most organizations look outward for appropriate measures to apply to their situation, others rely completely on the traditional measures-cost, schedule, and performance-without ever questioning whether or not those measures accurately evaluate their programs. Given the multidimensional nature of transition, measurement systems should be approached from an internal review of the measurable data available and considered for which metrics would be most appropriate to their circumstances rather than approaching it with a “one size fits all” mentality. The efforts of this study have attempted to offer a tailored set of measure that might be well suited to DARPA AEO’s mission based on the PCR analysis.

APPENDIX A. REGRESSION OUTPUT FOR ALL METRICS & INDICES

Regression Statistics	
Multiple R	**0.69828**
R Square	**0.48760**
Adjusted R Square	**0.43066**
Standard Error	**17.77675**
Observations	**101**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**10**	**27064.34**	**2706.43**	**8.56**	**0.00**
Residual	**90**	**28441.15**	**316.01**		
Total	**100**	**55505.49**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #1	**-45.53039**	**14.81275**	**-3.07373**	**0.00280**	**-74.95850**	**-16.10227**	**-74.95850**	**-16.10227**
Continuous vs. Disruptive	**2.01044**	**1.69734**	**1.18447**	**0.23935**	**-1.36161**	**5.38250**	**-1.36161**	**5.38250**
Rev. Capability	**-1.56525**	**2.01855**	**-0.77544**	**0.44011**	**-5.57545**	**2.44494**	**-5.57545**	**2.44494**
Tech Maturity	**4.84370**	**1.49209**	**3.24626**	**0.00164**	**1.87941**	**7.80799**	**1.87941**	**7.80799**
Mission Fit	**5.86064**	**2.01817**	**2.90393**	**0.00464**	**1.85119**	**9.87010**	**1.85119**	**9.87010**
Immediate W/F Need	**-0.70909**	**1.79001**	**-0.39614**	**0.69294**	**-4.26525**	**2.84707**	**-4.26525**	**2.84707**
User Safety	**0.70394**	**1.06449**	**0.66129**	**0.51012**	**-1.41086**	**2.81874**	**-1.41086**	**2.81874**
Job Satisfaction	**0.63679**	**1.17006**	**0.54424**	**0.58762**	**-1.68773**	**2.96132**	**-1.68773**	**2.96132**
Future W/F Need	**0.43812**	**1.69156**	**0.25900**	**0.79622**	**-2.92246**	**3.79870**	**-2.92246**	**3.79870**
Perceived Usefulness	**2.75306**	**2.22831**	**1.23549**	**0.21986**	**-1.67387**	**7.17998**	**-1.67387**	**7.17998**
Legacy Technology	**-0.57356**	**1.17660**	**-0.48748**	**0.62711**	**-2.91108**	**1.76395**	**-2.91108**	**1.76395**

Regression Statistics	
Multiple R	**0.68113**
R Square	**0.46393**
Adjusted R Square	**0.40437**
Standard Error	**17.14192**
Observations	**101**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**10**	**22887.46**	**2288.75**	**7.79**	**0.00**
Residual	**90**	**26446.07**	**293.85**		
Total	**100**	**49333.54**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #2	**-36.31400**	**14.28377**	**-2.54233**	**0.01272**	**-64.69119**	**-7.93681**	**-64.69119**	**-7.93681**
Continuous vs. Disruptive	**2.66495**	**1.63672**	**1.62822**	**0.10697**	**-0.58669**	**5.91658**	**-0.58669**	**5.91658**
Rev. Capability	**-2.40395**	**1.94646**	**-1.23504**	**0.22003**	**-6.27094**	**1.46303**	**-6.27094**	**1.46303**
Tech Maturity	**4.89046**	**1.43880**	**3.39898**	**0.00101**	**2.03202**	**7.74889**	**2.03202**	**7.74889**
Mission Fit	**7.14593**	**1.94610**	**3.67192**	**0.00041**	**3.27965**	**11.01220**	**3.27965**	**11.01220**
Immediate W/F Need	**-1.87557**	**1.72608**	**-1.08660**	**0.28011**	**-5.30474**	**1.55360**	**-5.30474**	**1.55360**
User Safety	**0.59411**	**1.02648**	**0.57878**	**0.56418**	**-1.44517**	**2.63338**	**-1.44517**	**2.63338**
Job Satisfaction	**0.08049**	**1.12827**	**0.07134**	**0.94329**	**-2.16102**	**2.32200**	**-2.16102**	**2.32200**
Future W/F Need	**0.93641**	**1.63115**	**0.57408**	**0.56735**	**-2.30417**	**4.17698**	**-2.30417**	**4.17698**
Perceived Usefulness	**1.19319**	**2.14873**	**0.55530**	**0.58007**	**-3.07564**	**5.46202**	**-3.07564**	**5.46202**
Legacy Technology	**0.04949**	**1.13458**	**0.04362**	**0.96530**	**-2.20455**	**2.30354**	**-2.20455**	**2.30354**

Regression Statistics	
Multiple R	**0.65121**
R Square	**0.42407**
Adjusted R Square	**0.36008**
Standard Error	**21.90836**
Observations	**101**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**10**	**31807.60**	**3180.76**	**6.63**	**0.00**
Residual	**90**	**43197.84**	**479.98**		
Total	**100**	**75005.45**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #5	**-42.70894**	**18.25548**	**-2.33951**	**0.02152**	**-78.97663**	**-6.44125**	**-78.97663**	**-6.44125**
Continuous vs. Disruptive	**1.71968**	**2.09183**	**0.82210**	**0.41320**	**-2.43610**	**5.87546**	**-2.43610**	**5.87546**
Rev. Capability	**-2.39676**	**2.48769**	**-0.96345**	**0.33790**	**-7.33899**	**2.54547**	**-7.33899**	**2.54547**
Tech Maturity	**4.38986**	**1.83887**	**2.38725**	**0.01907**	**0.73661**	**8.04310**	**0.73661**	**8.04310**
Mission Fit	**7.48293**	**2.48723**	**3.00854**	**0.00340**	**2.54161**	**12.42425**	**2.54161**	**12.42425**
Immediate W/F Need	**-1.98039**	**2.20603**	**-0.89771**	**0.37173**	**-6.36306**	**2.40229**	**-6.36306**	**2.40229**
User Safety	**1.72536**	**1.31190**	**1.31516**	**0.19180**	**-0.88096**	**4.33167**	**-0.88096**	**4.33167**
Job Satisfaction	**0.86743**	**1.44200**	**0.60155**	**0.54899**	**-1.99734**	**3.73221**	**-1.99734**	**3.73221**
Future W/F Need	**0.20163**	**2.08471**	**0.09672**	**0.92316**	**-3.94000**	**4.34327**	**-3.94000**	**4.34327**
Perceived Usefulness	**2.79178**	**2.74620**	**1.01660**	**0.31207**	**-2.66403**	**8.24759**	**-2.66403**	**8.24759**
Legacy Technology	**-0.68576**	**1.45006**	**-0.47292**	**0.63742**	**-3.56655**	**2.19504**	**-3.56655**	**2.19504**

APPENDIX A. REGRESSION OUTPUT FOR ALL METRICS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.67743**
R Square	**0.45891**
Adjusted R Square	**0.39879**
Standard Error	**16.52333**
Observations	**101**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**10**	**20840.12**	**2084.01**	**7.63**	**0.00**
Residual	**90**	**24571.84**	**273.02**		
Total	**100**	**45411.96**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #7	**-37.46530**	**13.76832**	**-2.72112**	**0.00781**	**-64.81847**	**-10.11213**	**-64.81847**	**-10.11213**
Continuous vs. Disruptive	**3.60855**	**1.57766**	**2.28728**	**0.02452**	**0.47426**	**6.74285**	**0.47426**	**6.74285**
Rev. Capability	**-1.96158**	**1.87622**	**-1.04550**	**0.29859**	**-5.68902**	**1.76586**	**-5.68902**	**1.76586**
Tech Maturity	**5.41947**	**1.38688**	**3.90767**	**0.00018**	**2.66419**	**8.17476**	**2.66419**	**8.17476**
Mission Fit	**7.11782**	**1.87588**	**3.79440**	**0.00027**	**3.39107**	**10.84457**	**3.39107**	**10.84457**
Immediate W/F Need	**-1.70900**	**1.66380**	**-1.02717**	**0.30709**	**-5.01442**	**1.59642**	**-5.01442**	**1.59642**
User Safety	**-0.41998**	**0.98944**	**-0.42446**	**0.67224**	**-2.38567**	**1.54571**	**-2.38567**	**1.54571**
Job Satisfaction	**-0.45289**	**1.08756**	**-0.41643**	**0.67809**	**-2.61351**	**1.70773**	**-2.61351**	**1.70773**
Future W/F Need	**2.07485**	**1.57229**	**1.31963**	**0.19030**	**-1.04878**	**5.19848**	**-1.04878**	**5.19848**
Perceived Usefulness	**-0.42012**	**2.07119**	**-0.20284**	**0.83972**	**-4.53490**	**3.69467**	**-4.53490**	**3.69467**
Legacy Technology	**0.80272**	**1.09364**	**0.73399**	**0.46486**	**-1.36998**	**2.97542**	**-1.36998**	**2.97542**

APPENDIX B. REGRESSION OUTPUT FOR WORTHINESS METRICS & INDICES

Regression Statistics	
Multiple R	**0.59040**
R Square	**0.34857**
Adjusted R Square	**0.32883**
Standard Error	**19.25005**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**3**	**19630.06**	**6543.35**	**17.66**	**0.00**
Residual	**99**	**36685.86**	**370.56**		
Total	**102**	**56315.92**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #1	**-42.39943**	**9.68208**	**-4.37916**	**0.00003**	**-61.61078**	**-23.18808**	**-61.61078**	**-23.18808**
Tech. Maturity	**8.60264**	**1.30249**	**6.60474**	**0.00000**	**6.01821**	**11.18708**	**6.01821**	**11.18708**
Continuous vs. Disruptive	**1.12274**	**1.72044**	**0.65259**	**0.51553**	**-2.29098**	**4.53646**	**-2.29098**	**4.53646**
Revolutionary Capability	**2.11834**	**1.96922**	**1.07573**	**0.28466**	**-1.78902**	**6.02571**	**-1.78902**	**6.02571**

APPENDIX B. REGRESSION OUTPUT FOR WORTHINESS METRICS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.57137**
R Square	**0.32646**
Adjusted R Square	**0.30605**
Standard Error	**18.62033**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**3**	**16637.29**	**5545.76**	**16.00**	**0.00**
Residual	**99**	**34324.97**	**346.72**		
Total	**102**	**50962.26**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #2	**-33.57882**	**9.36536**	**-3.58543**	**0.00052**	**-52.16172**	**-14.99591**	**-52.16172**	**-14.99591**
Tech. Maturity	**8.10011**	**1.25989**	**6.42923**	**0.00000**	**5.60022**	**10.60000**	**5.60022**	**10.60000**
Continuous vs. Disruptive	**1.86767**	**1.66416**	**1.12229**	**0.26445**	**-1.43438**	**5.16972**	**-1.43438**	**5.16972**
Revolutionary Capability	**0.58631**	**1.90481**	**0.30781**	**0.75888**	**-3.19324**	**4.36586**	**-3.19324**	**4.36586**

Regression Statistics	
Multiple R	**0.51924**
R Square	**0.26961**
Adjusted R Square	**0.24747**
Standard Error	**23.74034**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**3**	**20595.96**	**6865.32**	**12.18**	**0.00**
Residual	**99**	**55796.75**	**563.60**		
Total	**102**	**76392.72**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #5	**-43.45820**	**11.94054**	**-3.63955**	**0.00044**	**-67.15081**	**-19.76558**	**-67.15081**	**-19.76558**
Tech. Maturity	**8.93619**	**1.60632**	**5.56316**	**0.00000**	**5.74891**	**12.12347**	**5.74891**	**12.12347**
Continuous vs. Disruptive	**0.68095**	**2.12175**	**0.32094**	**0.74893**	**-3.52906**	**4.89096**	**-3.52906**	**4.89096**
Revolutionary Capability	**2.21581**	**2.42857**	**0.91239**	**0.36378**	**-2.60300**	**7.03461**	**-2.60300**	**7.03461**

APPENDIX B. REGRESSION OUTPUT FOR WORTHINESS METRICS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.56607**
R Square	**0.32044**
Adjusted R Square	**0.29984**
Standard Error	**18.02616**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**3**	**15168.79**	**5056.26**	**15.56**	**0.00**
Residual	**99**	**32169.31**	**324.94**		
Total	**102**	**47338.10**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #7	**-29.27908**	**9.06651**	**-3.22937**	**0.00168**	**-47.26901**	**-11.28916**	**-47.26901**	**-11.28916**
Tech. Maturity	**7.56858**	**1.21968**	**6.20536**	**0.00000**	**5.14847**	**9.98870**	**5.14847**	**9.98870**
Continuous vs. Disruptive	**2.90847**	**1.61106**	**1.80532**	**0.07406**	**-0.28821**	**6.10516**	**-0.28821**	**6.10516**
Revolutionary Capability	**-0.28510**	**1.84402**	**-0.15461**	**0.87745**	**-3.94404**	**3.37385**	**-3.94404**	**3.37385**

APPENDIX C. REGRESSION OUTPUT FOR DOD MARKET FACTORS & INDICES

Regression Statistics	
Multiple R	**0.57453**
R Square	**0.33008**
Adjusted R Square	**0.31668**
Standard Error	**19.42349**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**2**	**18588.72**	**9294.36**	**24.64**	**0.00**
Residual	**100**	**37727.20**	**377.27**		
Total	**102**	**56315.92**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #1	**-9.84864**	**4.52163**	**-2.17812**	**0.03175**	**-18.81942**	**-0.87786**	**-18.81942**	**-0.87786**
Immediate W/F Need	**-0.76856**	**1.69805**	**-0.45261**	**0.65181**	**-4.13745**	**2.60033**	**-4.13745**	**2.60033**
Mission Fit	**9.06554**	**1.84781**	**4.90610**	**0.00000**	**5.39954**	**12.73155**	**5.39954**	**12.73155**

APPENDIX C. REGRESSION OUTPUT FOR DOD MARKET FACTORS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.55604**
R Square	**0.30918**
Adjusted R Square	**0.29536**
Standard Error	**18.76323**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**2**	**15756.37**	**7878.19**	**22.38**	**0.00**
Residual	**100**	**35205.88**	**352.06**		
Total	**102**	**50962.26**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #2	**-3.78844**	**4.36792**	**-0.86733**	**0.38784**	**-12.45428**	**4.87739**	**-12.45428**	**4.87739**
Immediate W/F Need	**-2.57549**	**1.64033**	**-1.57010**	**0.11955**	**-5.82986**	**0.67888**	**-5.82986**	**0.67888**
Mission Fit	**9.68757**	**1.78500**	**5.42722**	**0.00000**	**6.14619**	**13.22896**	**6.14619**	**13.22896**

APPENDIX C. REGRESSION OUTPUT FOR DOD MARKET FACTORS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.54185**
R Square	**0.29360**
Adjusted R Square	**0.27947**
Standard Error	**23.23007**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**2**	**22429.11**	**11214.55**	**20.78**	**0.00**
Residual	**100**	**53963.61**	**539.64**		
Total	**102**	**76392.72**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #5	**-13.01213**	**5.40777**	**-2.40619**	**0.01796**	**-23.74099**	**-2.28328**	**-23.74099**	**-2.28328**
Immediate W/F Need	**-1.50960**	**2.03083**	**-0.74334**	**0.45902**	**-5.53872**	**2.51952**	**-5.53872**	**2.51952**
Mission Fit	**10.46487**	**2.20994**	**4.73536**	**0.00001**	**6.08041**	**14.84932**	**6.08041**	**14.84932**

APPENDIX C. REGRESSION OUTPUT FOR DOD MARKET FACTORS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.51369**
R Square	**0.26388**
Adjusted R Square	**0.24915**
Standard Error	**18.66726**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**2**	**12491.44**	**6245.72**	**17.92**	**0.00**
Residual	**100**	**34846.66**	**348.47**		
Total	**102**	**47338.10**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #7	**2.69140**	**4.34558**	**0.61934**	**0.53710**	**-5.93011**	**11.31292**	**-5.93011**	**11.31292**
Immediate W/F Need	**-3.61686**	**1.63194**	**-2.21629**	**0.02894**	**-6.85458**	**-0.37913**	**-6.85458**	**-0.37913**
Mission Fit	**9.42008**	**1.77587**	**5.30450**	**0.00000**	**5.89681**	**12.94335**	**5.89681**	**12.94335**

APPENDIX D. REGRESSION OUTPUT FOR COMBINED METRICS & INDICES

Regression Statistics	
Multiple R	**0.67484**
R Square	**0.45541**
Adjusted R Square	**0.42734**
Standard Error	**17.78138**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**5**	**25646.70**	**5129.34**	**16.22**	**0.00**
Residual	**97**	**30669.22**	**316.18**		
Total	**102**	**56315.92**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #1	**-38.52435**	**9.02652**	**-4.26791**	**0.00005**	**-56.43949**	**-20.60921**	**-56.43949**	**-20.60921**
Tech. Maturity	**6.02120**	**1.34100**	**4.49008**	**0.00002**	**3.35969**	**8.68272**	**3.35969**	**8.68272**
Continuous vs. Disruptive	**1.91268**	**1.60616**	**1.19084**	**0.23662**	**-1.27511**	**5.10047**	**-1.27511**	**5.10047**
Revolutionary Capability	**-0.57231**	**1.93296**	**-0.29608**	**0.76780**	**-4.40871**	**3.26409**	**-4.40871**	**3.26409**
Immediate W/F Need	**-0.34699**	**1.56405**	**-0.22186**	**0.82489**	**-3.45120**	**2.75721**	**-3.45120**	**2.75721**
Mission Fit	**6.04881**	**1.84111**	**3.28541**	**0.00142**	**2.39472**	**9.70291**	**2.39472**	**9.70291**

APPENDIX D. REGRESSION OUTPUT FOR COMBINED METRICS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.66127**
R Square	**0.43727**
Adjusted R Square	**0.40827**
Standard Error	**17.19440**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**5**	**22284.45**	**4456.89**	**15.08**	**0.00**
Residual	**97**	**28677.81**	**295.65**		
Total	**102**	**50962.26**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #2	**-29.01337**	**8.72855**	**-3.32396**	**0.00125**	**-46.33712**	**-11.68962**	**-46.33712**	**-11.68962**
Tech. Maturity	**5.66252**	**1.29673**	**4.36676**	**0.00003**	**3.08887**	**8.23618**	**3.08887**	**8.23618**
Continuous vs. Disruptive	**2.43968**	**1.55314**	**1.57080**	**0.11949**	**-0.64288**	**5.52224**	**-0.64288**	**5.52224**
Revolutionary Capability	**-1.68039**	**1.86916**	**-0.89901**	**0.37087**	**-5.39015**	**2.02936**	**-5.39015**	**2.02936**
Immediate W/F Need	**-2.08746**	**1.51242**	**-1.38021**	**0.17069**	**-5.08920**	**0.91427**	**-5.08920**	**0.91427**
Mission Fit	**7.01458**	**1.78033**	**3.94004**	**0.00015**	**3.48111**	**10.54805**	**3.48111**	**10.54805**

APPENDIX D. REGRESSION OUTPUT FOR COMBINED METRICS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.61560**
R Square	**0.37896**
Adjusted R Square	**0.34695**
Standard Error	**22.11559**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**5**	**28950.08**	**5790.02**	**11.84**	**0.00**
Residual	**97**	**47442.64**	**489.10**		
Total	**102**	**76392.72**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #5	**-38.53968**	**11.22673**	**-3.43285**	**0.00088**	**-60.82164**	**-16.25773**	**-60.82164**	**-16.25773**
Tech. Maturity	**5.89478**	**1.66787**	**3.53431**	**0.00063**	**2.58452**	**9.20504**	**2.58452**	**9.20504**
Continuous vs. Disruptive	**1.54391**	**1.99767**	**0.77286**	**0.44149**	**-2.42090**	**5.50873**	**-2.42090**	**5.50873**
Revolutionary Capability	**-0.84758**	**2.40412**	**-0.35255**	**0.72519**	**-5.61910**	**3.92395**	**-5.61910**	**3.92395**
Immediate W/F Need	**-1.09417**	**1.94529**	**-0.56247**	**0.57509**	**-4.95503**	**2.76668**	**-4.95503**	**2.76668**
Mission Fit	**7.63401**	**2.28988**	**3.33380**	**0.00121**	**3.08923**	**12.17879**	**3.08923**	**12.17879**

APPENDIX D. REGRESSION OUTPUT FOR COMBINED METRICS & INDICES (CONTINUED)

Regression Statistics	
Multiple R	**0.64242**
R Square	**0.41270**
Adjusted R Square	**0.38243**
Standard Error	**16.92966**
Observations	**103**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	**5**	**19536.59**	**3907.32**	**13.63**	**0.00**
Residual	**97**	**27801.51**	**286.61**		
Total	**102**	**47338.10**			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Adoption Index #7	**-24.87572**	**8.59415**	**-2.89449**	**0.00469**	**-41.93274**	**-7.81870**	**-41.93274**	**-7.81870**
Tech. Maturity	**5.60366**	**1.27677**	**4.38894**	**0.00003**	**3.06963**	**8.13769**	**3.06963**	**8.13769**
Continuous vs. Disruptive	**3.23079**	**1.52923**	**2.11269**	**0.03719**	**0.19569**	**6.26589**	**0.19569**	**6.26589**
Revolutionary Capability	**-1.89363**	**1.84038**	**-1.02894**	**0.30607**	**-5.54627**	**1.75901**	**-5.54627**	**1.75901**
Immediate W/F Need	**-3.08690**	**1.48913**	**-2.07295**	**0.04083**	**-6.04242**	**-0.13138**	**-6.04242**	**-0.13138**
Mission Fit	**6.69400**	**1.75292**	**3.81877**	**0.00024**	**3.21494**	**10.17307**	**3.21494**	**10.17307**

APPENDIX E. DARPA TECHNOLOGY DATABASE

Scale	TECHNOLOGIES 1-30	Technology fielded to warfighter	Receiving service/ organization	Program transition to DoD POR	Tech spin offs to DoD S&T	Tech spin offs into other DARPA projects	Spin offs into commercial	Not transitioned
		Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0
ID No.	Program	TW	TORG	TPOR	TST	TOD	TOTH	TZ
1	Wasp Micro Air Vehicle	1	USAF, USMC, OGA	1	1	1	1	0
2	Ultra-Wideband Multifunction Photonic Transmit/Receive Module (ULTRA-T/R)	0	(PT) NIOC	0	0	1	0	0
3	DARPA Agent Markup Language (DAML)	0		0	1	1	1	0
4	Air-Collection and Enrichment System (ACES)	0		0	0	0	0	1
5	Wide Area All Terrain Change Indication and Tomography (WATCH-IT)	0	NGA	1	1	0	0	0
6	Micro Adaptive Flow Control (MAFC)	0		1	1	0	0	0
7	Radiological Decontamination Program	0	DHS, HSARPA	0	1	0	1	0
8	Optimum Design of Tailored Topological Armors for Blast and Ballistic Threat Defeat	0	ARL	1	1	0	0	0
9	Joint Air Ground Operations: Unified, Adaptive Re-Planning (JAGUAR)	0	USAF	0	1	0	0	0
10	Combat Zones That See (CZTS)	0		0	0	0	0	0
11	Advanced Tactical Targeting Technology (AT3)	0	USAF	1	1	0	1	0
12	Airborne-Gunshot Detection and Localization System	0		0	0	0	0	1
13	Dynamic Optical Tags (DOTS)	1	Classified	0	0	0	0	0
14	Vaporization Cooled Turbine Demonstration	0		0	1	0	0	0
15	Acoustic Array for Torpedo Defense (Electric Curtain)	0		0	0	0	0	1
16	XMONARCH (eXtended MOrphable Networked microARCHitecture)	0		0	1	0	1	0
17	A160 Engine Development Program	0	Contractor	0	0	0	1	0
18	X-ray Sourced-Based Navigation for Autonomous Position Determination (XNAV)	0		0	0	0	0	1
19	Adaptive Cognition-Enhanced Radio Teams (ACERT)	0		0	0	0	0	1
20	Advanced Precision Optical Oscillators (aPROPOS)	0		0	1	1	1	0
21	Architectures for Cognitive Information Processing (ACIP)	0		0	0	0	0	1
22	Active Templates	1	USSOCOM	1	1	0	1	0
23	Aluminum Combuster Power System	0		0	0	0	0	1
24	Analog Optical Signal Processing (AOSP)	0	Contractor	0	0	0	1	0
25	Adaptable Reliable Middleware Systems (ARMS)	0	Contractor	0	0	0	1	0
26	All Weather Sniper Scope (AWSS)	0	MTO	0	1	0	0	0
27	Buoyancy Assisted Lift Air Vehicle (BAAV)	0		1	1	0	0	0
28	Biologically Inspired Cognitive Architecture (BICA)	0		0	0	0	0	0
29	Boomerang	1	US Army	0	0	0	0	0
30	Biodynotics	0	USMC	0	1	1	0	0

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 1-30 (CONTINUED)	Transition speed	Major/core aspect of project	Minor/trivial aspect of project	PCR word count	Money obligated for further development	Technically baffling report	Test environment
Scale			Yes = 1 No = 0	Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Lab = 1 Field = 2 Other = 3
ID No.	Program	TS	TC	TM	PWC	DUOM	TBR	TE
1	Wasp Micro Air Vehicle	60	1	0	3,274	1	0	2
2	Ultra-Wideband Multifunction Photonic Transmit/Receive Module (ULTRA-T/R)	UKN	0	1	2,629	1	1	1
3	DARPA Agent Markup Language (DAML)	UKN	0	1	1,376	0	1	1
4	Air-Collection and Enrichment System (ACES)	N/A	0	0	2,449	0	0	1
5	Wide Area All Terrain Change Indication and Tomography (WATCH-IT)	UKN	1	0	3,694	1	0	3
6	Micro Adaptive Flow Control (MAFC)	UKN	1	0	2,387	0	0	3
7	Radiological Decontamination Program	UKN	1	0	1,187	0	0	1
8	Optimum Design of Tailored Topological Armors for Blast and Ballistic Threat Defeat	14	1	0	1,579	1	0	1
9	Joint Air Ground Operations: Unified, Adaptive Re-Planning (JAGUAR)	66	1	0	1,736	1	0	3
10	Combat Zones That See (CZTS)	N/A	0	0	962	0	0	2
11	Advanced Tactical Targeting Technology (AT3)	92	1	0	1,219	1	0	3
12	Airborne-Gunshot Detection and Localization System	N/A	0	0	750	0	0	1
13	Dynamic Optical Tags (DOTS)	UKN	1	0	1,300	1	0	3
14	Vaporization Cooled Turbine Demonstration	27	0	1	1,436	0	0	1
15	Acoustic Array for Torpedo Defense (Electric Curtain)	N/A	0	0	3,682	0	1	3
16	XMONARCH (eXtended MOrphable Networked microARCHitecture)	42	1	0	2,369	0	0	1
17	A160 Engine Development Program	UKN	1	0	2,527	0	0	1
18	X-ray Sourced-Based Navigation for Autonomous Position Determination (XNAV)	N/A	0	0	1,406	0	0	1
19	Adaptive Cognition-Enhanced Radio Teams (ACERT)	N/A	0	0	720	0	0	1
20	Advanced Precision Optical Oscillators (aPROPOS)	UKN	1	0	5,097	0	1	1
21	Architectures for Cognitive Information Processing (ACIP)	N/A	0	0	1,565	0	0	1
22	Active Templates	UKN	1	1	4,470	1	0	3
23	Aluminum Combuster Power System	N/A	0	0	2,174	0	0	1
24	Analog Optical Signal Processing (AOSP)	UKN	0	1	1,081	0	0	1
25	Adaptable Reliable Middleware Systems (ARMS)	UKN	0	1	796	0	0	1
26	All Weather Sniper Scope (AWSS)	17	1	0	1,235	1	0	1
27	Buoyancy Assisted Lift Air Vehicle (BAAV)	UKN	0	1	663	0	0	1
28	Biologically Inspired Cognitive Architecture (BICA)	N/A	0	0	4,879	0	0	1
29	Boomerang	UKN	1	0	815	1	0	3
30	Biodynotics	68	1	0	1,703	0	0	3

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 1-30 (CONTINUED)	Improves warfighter safety	Improves warfighter job satisfaction	Addresses immediate warfighter need	Addresses future warfighter need	Tech. maturity
Scale		1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 not at all = 1 significantly = 7	1 to 7 not at all = 1 significantly = 7	1 to 9 Based on TRLs
ID No.	Program	PIWS	PIWJS	PIWN	PFWN	PTM
1	Wasp Micro Air Vehicle	5	6	7	3	9
2	Ultra-Wideband Multifunction Photonic Transmit/Receive Module (ULTRA-T/R)	1	5	4	5	3
3	DARPA Agent Markup Language (DAML)	1	4	3	3	3
4	Air-Collection and Enrichment System (ACES)	1	1	2	4	4
5	Wide Area All Terrain Change Indication and Tomography (WATCH-IT)	4	5	5	5	6
6	Micro Adaptive Flow Control (MAFC)	1	2	3	5	5
7	Radiological Decontamination Program	5	3	2	3	6
8	Optimum Design of Tailored Topological Armors for Blast and Ballistic Threat Defeat	7	5	6	5	3
9	Joint Air Ground Operations: Unified, Adaptive Re-Planning (JAGUAR)	1	5	3	4	7
10	Combat Zones That See (CZTS)	6	6	3	4	4
11	Advanced Tactical Targeting Technology (AT3)	6	3	4	4	6
12	Airborne-Gunshot Detection and Localization System	6	5	5	4	2
13	Dynamic Optical Tags (DOTS)	6	6	6	2	8
14	Vaporization Cooled Turbine Demonstration	1	1	2	3	3
15	Acoustic Array for Torpedo Defense (Electric Curtain)	6	2	2	4	3
16	XMONARCH (eXtended MOrphable Networked microARCHitecture)	1	5	4	5	5
17	A160 Engine Development Program	1	1	3	3	6
18	X-ray Sourced-Based Navigation for Autonomous Position Determination (XNAV)	1	1	1	5	2
19	Adaptive Cognition-Enhanced Radio Teams (ACERT)	1	6	2	4	3
20	Advanced Precision Optical Oscillators (aPROPOS)	4	4	5	6	TBR
21	Architectures for Cognitive Information Processing (ACIP)	1	6	3	5	3
22	Active Templates	3	6	5	3	6
23	Aluminum Combuster Power System	1	1	3	4	4
24	Analog Optical Signal Processing (AOSP)	1	4	4	5	4
25	Adaptable Reliable Middleware Systems (ARMS)	1	1	2	4	3
26	All Weather Sniper Scope (AWSS)	1	5	4	4	5
27	Buoyancy Assisted Lift Air Vehicle (BAAV)	1	1	1	1	3
28	Biologically Inspired Cognitive Architecture (BICA)	1	5	1	1	1
29	Boomerang	7	7	7	3	8
30	Biodynotics	1	6	5	4	6

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 1-30 (CONTINUED)	Perceived usefulness	Continuous vs. disruptive	Game changing/ revolutionary capability	Enhances legacy technology's performance	Prepares DoD for the future
Scale		1 to 7 not useful = 1 very useful = 7	1 to 7 continuous = 1 disruptive = 7	1 to 7 not rev. = 1 exceptionally rev. = 7	1 to 7 no enhance. = 1 complete enhance. = 7	1 to 7 not at all = 1 exceptionally so = 7
ID No.	Program	PEU	PCD	PREV	PLTP	PDF
1	Wasp Micro Air Vehicle	7	7	7	1	7
2	Ultra-Wideband Multifunction Photonic Transmit/Receive Module (ULTRA-T/R)	TBR	TBR	TBR	TBR	TBR
3	DARPA Agent Markup Language (DAML)	TBR	TBR	TBR	TBR	TBR
4	Air-Collection and Enrichment System (ACES)	5	6	6	1	6
5	Wide Area All Terrain Change Indication and Tomography (WATCH-IT)	5	3	3	5	5
6	Micro Adaptive Flow Control (MAFC)	5	5	6	5	6
7	Radiological Decontamination Program	6	7	6	1	6
8	Optimum Design of Tailored Topological Armors for Blast and Ballistic Threat Defeat	7	2	4	5	5
9	Joint Air Ground Operations: Unified, Adaptive Re-Planning (JAGUAR)	5	6	6	1	6
10	Combat Zones That See (CZTS)	5	6	6	2	5
11	Advanced Tactical Targeting Technology (AT3)	5	7	6	5	5
12	Airborne-Gunshot Detection and Localization System	5	3	4	3	4
13	Dynamic Optical Tags (DOTS)	7	7	7	1	5
14	Vaporization Cooled Turbine Demonstration	3	3	4	5	5
15	Acoustic Array for Torpedo Defense (Electric Curtain)	2	5	6	1	5
16	XMONARCH (eXtended MOrphable Networked microARCHitecture)	5	5	6	5	6
17	A160 Engine Development Program	4	4	4	6	5
18	X-ray Sourced-Based Navigation for Autonomous Position Determination (XNAV)	4	5	7	3	5
19	Adaptive Cognition-Enhanced Radio Teams (ACERT)	5	6	5	1	6
20	Advanced Precision Optical Oscillators (aPROPOS)	TBR	TBR	TBR	TBR	TBR
21	Architectures for Cognitive Information Processing (ACIP)	6	4	3	5	4
22	Active Templates	6	5	5	2	5
23	Aluminum Combuster Power System	5	6	5	3	5
24	Analog Optical Signal Processing (AOSP)	4	5	6	5	5
25	Adaptable Reliable Middleware Systems (ARMS)	4	4	4	3	4
26	All Weather Sniper Scope (AWSS)	5	3	2	6	3
27	Buoyancy Assisted Lift Air Vehicle (BAAV)	5	4	2	1	4
28	Biologically Inspired Cognitive Architecture (BICA)	6	7	6	5	5
29	Boomerang	7	6	7	1	5
30	Biodynotics	5	7	5	1	5

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 1-30 (CONTINUED)	Mission fit (right tech, place, & time)	Flexibility in mission use	Adaptive to user needs	Interoperability w/existing technologies	Saves gov't/user resources
Scale		1 to 7 no fit = 1 great fit = 7	1 to 7 not flexible = 1 very flexible = 7	1 to 7 not adaptable = 1 very adaptable = 7	1 to 7 not interoperable = 1 very interoperable = 7	1 to 7 no savings = 1 significant savings = 7
ID No.	Program	PMF	PFMU	PAUN	PINT	PSAV
1	Wasp Micro Air Vehicle	7	6	6	N/A	6
2	Ultra-Wideband Multifunction Photonic Transmit/Receive Module (ULTRA-T/R)	N/A	N/A	N/A	N/A	N/A
3	DARPA Agent Markup Language (DAML)	N/A	N/A	N/A	N/A	N/A
4	Air-Collection and Enrichment System (ACES)	N/A	N/A	N/A	N/A	5
5	Wide Area All Terrain Change Indication and Tomography (WATCH-IT)	5	3	4	5	1
6	Micro Adaptive Flow Control (MAFC)	N/A	N/A	N/A	3	1
7	Radiological Decontamination Program	3	N/A	N/A	N/A	7
8	Optimum Design of Tailored Topological Armors for Blast and Ballistic Threat Defeat	7	N/A	N/A	N/A	7
9	Joint Air Ground Operations: Unified, Adaptive Re-Planning (JAGUAR)	2	N/A	5	5	4
10	Combat Zones That See (CZTS)	2	N/A	N/A	N/A	5
11	Advanced Tactical Targeting Technology (AT3)	4	1	1	5	5
12	Airborne-Gunshot Detection and Localization System	1	N/A	N/A	N/A	5
13	Dynamic Optical Tags (DOTS)	6	6	6	N/A	3
14	Vaporization Cooled Turbine Demonstration	2	N/A	N/A	N/A	3
15	Acoustic Array for Torpedo Defense (Electric Curtain)	2	N/A	N/A	N/A	2
16	XMONARCH (eXtended MOrphable Networked microARCHitecture)	5	6	6	5	6
17	A160 Engine Development Program	2	N/A	N/A	5	5
18	X-ray Sourced-Based Navigation for Autonomous Position Determination (XNAV)	2	N/A	N/A	N/A	N/A
19	Adaptive Cognition-Enhanced Radio Teams (ACERT)	1	N/A	N/A	N/A	1
20	Advanced Precision Optical Oscillators (aPROPOS)	TBR	TBR	TBR	TBR	TBR
21	Architectures for Cognitive Information Processing (ACIP)	1	4	5	N/A	5
22	Active Templates	5	4	5	5	5
23	Aluminum Combuster Power System	3	N/A	N/A	5	5
24	Analog Optical Signal Processing (AOSP)	3	5	N/A	N/A	5
25	Adaptable Reliable Middleware Systems (ARMS)	2	N/A	N/A	N/A	2
26	All Weather Sniper Scope (AWSS)	2	1	1	3	1
27	Buoyancy Assisted Lift Air Vehicle (BAAV)	1	5	5	N/A	1
28	Biologically Inspired Cognitive Architecture (BICA)	N/A	N/A	N/A	N/A	N/A
29	Boomerang	7	5	6	N/A	3
30	Biodynotics	4	6	6	N/A	2

APPENDIX E.   DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 31-60	Technology fielded to warfighter	Receiving service/ organization	Program transition to DoD POR	Tech spin offs to DoD S&T	Tech spin offs into other DARPA projects	Spin offs into commercial	Not transitioned
Scale		Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0
ID No.	Program	TW	TORG	TPOR	TST	TOD	TOTH	TZ
31	Bio-Optic Synthetic Systems (BOSS)	0		0	0	0	1	0
32	Cross Border Tunnel (CBT)	0		0	0	0	0	1
33	Coherent Communications, Imaging, and Targeting (CCIT)	0		0	0	0	1	0
34	Clockless, Logical, Analysis, Synthesis, and Systems (CLASS)	0		0	0	0	1	0
35	Compact Military Engine (CME)	0		0	0	0	0	1
36	Connectionless Networks (CN)	0		0	0	1	0	0
37	Chip Scale Wavelength Division Multiplexing (CS-WDM)	0		0	1	0	1	0
38	DARPA Automated Competence Assessment and Alarms for Teams (DARCAAT)	0	US Army	0	1	0	0	0
40	Defense Against Cyber Attacks on Mobile Ad-Hoc Network Systems (DCAMANETS)	0	US Army	0	1	0	0	0
41	Deep View	0		1	1	0	0	0
42	DARPA Network Archive (DNA)	0		0	0	0	0	1
43	Direct Thermal to Electric Conversion (DTEC)	0		1	1	1	0	0
44	Dynamic Tactical Targeting (DTT): Tactical Exercises and System Testing (TEST)	0	USAF	0	1	1	0	0
45	Exploitation of 3D Data (E3D)	0		0	0	0	0	1
46	Electromagnetic Mortar (EMM)	0	ONR	0	1	0	0	0
47	Energy Starved Electronics (ESE)	0		0	1	0	0	0
48	Exoskeleton (Exo)	0	NSRDEC	0	1	0	0	0
49	Explosive Handling Detection	0		0	0	0	0	1
50	Fast Connectivity for Coalitions and Agents Project (Fast C2AP)	1	USN, NATO	0	1	0	1	0
51	Femtosecond Adaptive Spectroscopy Techniques for Remote Agent Detection (FASTREAD)	0	DOE, DHS	0	1	0	0	0
52	Future Combat Systems Communications/Network Centric Radio System	0	USSOCOM	1	0	0	0	0
53	Friction Drag Reduction	0		0	1	0	0	0
54	High-Frequency Active Auroral Project (HAARP) Instrument Completion	0	AFRL, ONR	1	1	1	0	0
55	Handheld Isothermal Silver Standard Sensor	0	DTRA	0	1	0	0	0
56	High Performance Corrosion Resistant Materials (HPCRM)	0	NAAC	0	1	1	1	0
57	High Power Fiber Lasers (HPFL)	0		0	0	0	1	0
58	High Precision Long-Range Laser Designator (HPLD)	0		0	0	1	0	0
59	Hypersonic Collaborative Australia/United States Experiment (HyCAUSE)	0		0	1	1	0	0
60	Intelligent RF Front Ends (IRFFE)	0		0	0	1	1	0

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 31-60 (CONTINUED)	Transition speed	Major/core aspect of project	Minor/trivial aspect of project	PCR word count	Money obligated for further development	Technically baffling report	Test environment
Scale			Yes = 1 No = 0	Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Lab = 1 Field = 2 Other = 3
ID No.	Program	TS	TC	TM	PWC	DUOM	TBR	TE
31	Bio-Optic Synthetic Systems (BOSS)	71	0	1	1,082	0	1	3
32	Cross Border Tunnel (CBT)	N/A	0	0	1,442	0	0	1
33	Coherent Communications, Imaging, and Targeting (CCIT)	UKN	0	1	1,563	0	1	1
34	Clockless, Logical, Analysis, Synthesis, and Systems (CLASS)	72	0	1	1,971	0	0	1
35	Compact Military Engine (CME)	N/A	0	0	2,757	0	0	1
36	Connectionless Networks (CN)	66	1	0	1,279	0	0	1
37	Chip Scale Wavelength Division Multiplexing (CS-WDM)	UKN	1	0	2,933	0	0	3
38	DARPA Automated Competence Assessment and Alarms for Teams (DARCAAT)	16.5	1	0	833	0	0	3
40	Defense Against Cyber Attacks on Mobile Ad-Hoc Network Systems (DCAMANETS)	UKN	1	0	1,005	0	0	1
41	Deep View	N/A	0	1	1,830	0	0	1
42	DARPA Network Archive (DNA)	N/A	0	0	2,313	0	0	1
43	Direct Thermal to Electric Conversion (DTEC)	53	1	0	963	1	0	1
44	Dynamic Tactical Targeting (DTT): Tactical Exercises and System Testing (TEST)	26	1	0	1,839	0	0	3
45	Exploitation of 3D Data (E3D)	N/A	0	0	2,253	0	0	1
46	Electromagnetic Mortar (EMM)	45	0	1	932	0	0	1
47	Energy Starved Electronics (ESE)	19	1	0	2,393	0	1	1
48	Exoskeleton (Exo)	36	1	0	1,275	1	0	3
49	Explosive Handling Detection	N/A	0	0	1,045	0	0	2
50	Fast Connectivity for Coalitions and Agents Project (Fast C2AP)	UKN	1	0	1,827	1	0	3
51	Femtosecond Adaptive Spectroscopy Techniques for Remote Agent Detection (FASTREAD)	N/A	0	1	633	1	0	1
52	Future Combat Systems Communications/Network Centric Radio System	58	1	0	2,962	0	0	3
53	Friction Drag Reduction	UKN	0	1	2,320	0	1	1
54	High-Frequency Active Auroral Project (HAARP) Instrument Completion	45	1	0	1,639	0	0	3
55	Handheld Isothermal Silver Standard Sensor	N/A	0	1	1,866	0	0	1
56	High Performance Corrosion Resistant Materials (HPCRM)	34	1	0	1,124	0	0	1
57	High Power Fiber Lasers (HPFL)	UKN	1	0	2,117	0	0	1
58	High Precision Long-Range Laser Designator (HPLD)	18	0	1	883	0	0	2
59	Hypersonic Collaborative Australia/United States Experiment (HyCAUSE)	UKN	0	1	1,605	0	0	3
60	Intelligent RF Front Ends (IRFFE)	UKN	1	0	1,503	1	0	1

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 31-60 (CONTINUED)	Improves warfighter safety	Improves warfighter job satisfaction	Addresses immediate warfighter need	Addresses future warfighter need	Tech. maturity
Scale		1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 not at all = 1 significantly = 7	1 to 7 not at all = 1 significantly = 7	1 to 9 Based on TRLs
ID No.	Program	PIWS	PIWJS	PIWN	PFWN	PTM
31	Bio-Optic Synthetic Systems (BOSS)	1	4	2	4	5
32	Cross Border Tunnel (CBT)	6	2	5	4	4
33	Coherent Communications, Imaging, and Targeting (CCIT)	1	5	3	4	TBR
34	Clockless, Logical, Analysis, Synthesis, and Systems (CLASS)	1	5	2	6	4
35	Compact Military Engine (CME)	1	5	4	4	5
36	Connectionless Networks (CN)	1	3	2	3	5
37	Chip Scale Wavelength Division Multiplexing (CS-WDM)	1	1	2	5	5
38	DARPA Automated Competence Assessment and Alarms for Teams (DARCAAT)	5	3	2	4	6
40	Defense Against Cyber Attacks on Mobile Ad-Hoc Network Systems (DCAMANETS)	5	5	7	7	5
41	Deep View	1	1	2	5	5
42	DARPA Network Archive (DNA)	1	2	2	2	6
43	Direct Thermal to Electric Conversion (DTEC)	1	1	4	6	5
44	Dynamic Tactical Targeting (DTT): Tactical Exercises and System Testing (TEST)	3	6	5	3	6
45	Exploitation of 3D Data (E3D)	5	5	5	3	6
46	Electromagnetic Mortar (EMM)	3	6	3	5	6
47	Energy Starved Electronics (ESE)	1	3	6	5	5
48	Exoskeleton (Exo)	3	6	4	2	6
49	Explosive Handling Detection	5	1	5	5	6
50	Fast Connectivity for Coalitions and Agents Project (Fast C2AP)	2	6	5	3	8
51	Femtosecond Adaptive Spectroscopy Techniques for Remote Agent Detection (FASTREAD)	4	3	2	5	3
52	Future Combat Systems Communications/Network Centric Radio System	3	6	6	2	7
53	Friction Drag Reduction	1	1	2	5	3
54	High-Frequency Active Auroral Project (HAARP) Instrument Completion	1	3	2	5	8
55	Handheld Isothermal Silver Standard Sensor	5	2	2	5	5
56	High Performance Corrosion Resistant Materials (HPCRM)	1	2	2	5	6
57	High Power Fiber Lasers (HPFL)	5	1	6	2	4
58	High Precision Long-Range Laser Designator (HPLD)	2	6	5	2	5
59	Hypersonic Collaborative Australia/United States Experiment (HyCAUSE)	1	1	4	4	6
60	Intelligent RF Front Ends (IRFFE)	1	2	2	4	4

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 31-60 (CONTINUED)	Perceived usefulness	Continuous vs. disruptive	Game changing/ revolutionary capability	Enhances legacy technology's performance	Prepares DoD for the future
Scale		1 to 7 not useful = 1 very useful = 7	1 to 7 continuous = 1 disruptive = 7	1 to 7 not rev. = 1 exceptionally rev. = 7	1 to 7 no enhance. = 1 complete enhance. = 7	1 to 7 not at all = 1 exceptionally so = 7
ID No.	Program	PEU	PCD	PREV	PLTP	PDF
31	Bio-Optic Synthetic Systems (BOSS)	4	5	6	4	5
32	Cross Border Tunnel (CBT)	N/A	6	6	1	5
33	Coherent Communications, Imaging, and Targeting (CCIT)	TBR	TBR	TBR	TBR	TBR
34	Clockless, Logical, Analysis, Synthesis, and Systems (CLASS)	6	6	6	6	6
35	Compact Military Engine (CME)	6	3	4	1	3
36	Connectionless Networks (CN)	5	5	5	2	4
37	Chip Scale Wavelength Division Multiplexing (CS-WDM)	6	3	3	5	5
38	DARPA Automated Competence Assessment and Alarms for Teams (DARCAAT)	4	6	5	1	5
40	Defense Against Cyber Attacks on Mobile Ad-Hoc Network Systems (DCAMANETS)	6	6	6	6	6
41	Deep View	4	2	2	5	5
42	DARPA Network Archive (DNA)	5	3	2	1	5
43	Direct Thermal to Electric Conversion (DTEC)	5	6	6	3	5
44	Dynamic Tactical Targeting (DTT): Tactical Exercises and System Testing (TEST)	6	6	6	6	6
45	Exploitation of 3D Data (E3D)	5	3	4	5	5
46	Electromagnetic Mortar (EMM)	6	6	7	1	6
47	Energy Starved Electronics (ESE)	6	5	6	3	5
48	Exoskeleton (Exo)	6	6	5	1	4
49	Explosive Handling Detection	6	3	5	1	2
50	Fast Connectivity for Coalitions and Agents Project (Fast C2AP)	7	5	7	5	5
51	Femtosecond Adaptive Spectroscopy Techniques for Remote Agent Detection (FASTREAD)	5	5	5	1	5
52	Future Combat Systems Communications/Network Centric Radio System	6	6	5	3	4
53	Friction Drag Reduction	5	6	4	5	3
54	High-Frequency Active Auroral Project (HAARP) Instrument Completion	5	5	5	1	6
55	Handheld Isothermal Silver Standard Sensor	4	5	4	1	3
56	High Performance Corrosion Resistant Materials (HPCRM)	5	3	3	6	4
57	High Power Fiber Lasers (HPFL)	6	7	6	2	6
58	High Precision Long-Range Laser Designator (HPLD)	5	3	5	2	4
59	Hypersonic Collaborative Australia/United States Experiment (HyCAUSE)	6	6	5	1	5
60	Intelligent RF Front Ends (IRFFE)	4	5	4	5	4

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 31-60 (CONTINUED)	Mission fit (right tech, place, & time)	Flexibility in mission use	Adaptive to user needs	Interoperability w/existing technologies	Saves gov't/user resources
Scale		1 to 7 no fit = 1 great fit = 7	1 to 7 not flexible = 1 very flexible = 7	1 to 7 not adaptable = 1 very adaptable = 7	1 to 7 not interoperable = 1 very interoperable = 7	1 to 7 no savings = 1 significant savings = 7
ID No.	Program	PMF	PFMU	PAUN	PINT	PSAV
31	Bio-Optic Synthetic Systems (BOSS)	3	4	N/A	N/A	3
32	Cross Border Tunnel (CBT)	5	N/A	N/A	N/A	N/A
33	Coherent Communications, Imaging, and Targeting (CCIT)	N/A	TBR	TBR	TBR	TBR
34	Clockless, Logical, Analysis, Synthesis, and Systems (CLASS)	3	6	5	6	5
35	Compact Military Engine (CME)	3	6	6	N/A	5
36	Connectionless Networks (CN)	3	2	N/A	5	2
37	Chip Scale Wavelength Division Multiplexing (CS-WDM)	5	2	N/A	5	5
38	DARPA Automated Competence Assessment and Alarms for Teams (DARCAAT)	2	1	N/A	4	1
40	Defense Against Cyber Attacks on Mobile Ad-Hoc Network Systems (DCAMANETS)	6	2	6	6	2
41	Deep View	2	1	2	4	2
42	DARPA Network Archive (DNA)	2	5	5	5	6
43	Direct Thermal to Electric Conversion (DTEC)	3	2	4	5	6
44	Dynamic Tactical Targeting (DTT): Tactical Exercises and System Testing (TEST)	5	7	7	6	4
45	Exploitation of 3D Data (E3D)	3	5	4	4	2
46	Electromagnetic Mortar (EMM)	4	2	2	1	6
47	Energy Starved Electronics (ESE)	4	2	6	6	6
48	Exoskeleton (Exo)	4	4	6	3	5
49	Explosive Handling Detection	3	1	1	1	2
50	Fast Connectivity for Coalitions and Agents Project (Fast C2AP)	6	2	6	4	7
51	Femtosecond Adaptive Spectroscopy Techniques for Remote Agent Detection (FASTREAD)	2	1	N/A	2	3
52	Future Combat Systems Communications/Network Centric Radio System	5	2	6	7	5
53	Friction Drag Reduction	2	1	1	1	1
54	High-Frequency Active Auroral Project (HAARP) Instrument Completion	3	3	4	4	1
55	Handheld Isothermal Silver Standard Sensor	2	1	2	1	5
56	High Performance Corrosion Resistant Materials (HPCRM)	3	2	6	N/A	6
57	High Power Fiber Lasers (HPFL)	5	6	4	N/A	6
58	High Precision Long-Range Laser Designator (HPLD)	2	5	5	1	5
59	Hypersonic Collaborative Australia/United States Experiment (HyCAUSE)	2	1	2	N/A	5
60	Intelligent RF Front Ends (IRFFE)	4	2	5	5	5

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 61-90	Technolog y fielded to warfighter	Receiving service/ organization	Program transition to DoD POR	Tech spin offs to DoD S&T	Tech spin offs into other DARPA projects	Spin offs into commercia l	Not transitione d
Scal e		Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0
ID No.	Program	TW	TORG	TPOR	TST	TOD	TOTH	TZ
61	Innovative Space-Based Radar Antenna Technology (ISAT)	0		0	0	1	0	0
62	Improving Warfighters Information Intake Under Stress (IWIIUS)	0	US Army, USN, USMC	1	0	0	1	0
63	Passive Cellular Core Jet Blaster Deflector (JBD)	0	ONR	0	1	1	0	0
64	Jigsaw	0	NVESD	0	1	0	1	0
65	Learning Applied to Ground Robotics (LAGR)	0		0	0	1	0	0
66	Language and Speech Exploitation Resources (LASER) POR	1	JFCOM, PEO IEW&S	0	0	1	0	0
67	Low-Cost Cruise Missile Defense (LCCMD)	0	SMDC, AMRDEC	1	1	0	0	0
68	Long View	0	AFRL	0	1	0	0	0
69	Low Friction Engine Development Program	0		0	0	0	0	1
70	Low Temperature Colossal Super-Saturation (LTCSS)	0		0	0	0	0	1
71	Morphing Aircraft Structures (MAS) III	0		0	0	0	0	1
72	Micro Air Vehicle Advanced Concept Technology Demonstration (MAV ACTD)	1	US Army, USN	0	0	0	0	0
73	Multicell and Dismounted Command and Control (M&DC2)	0	US Army, Joint, DRMO	1	0	0	0	0
74	Meso-Scale Steam Engine Generator (MSEG) Program	0		0	1	0	0	0
75	Model-Based Integration of Embedded Software (MoBIES)	0	USAF	1	0	0	0	0
76	Project Mobius: A Study on the Feasibility of Learning by Reading	0		0	0	1	0	0
77	Applications of Molecular Electronics (MoleApps)	0		0	0	0	1	0
78	Mission Specific Processing (MSP)	0	Contractor	0	0	0	1	0
79	Network Embedded Systems Technology (NEST)	0	Contractor	0	1	0	1	0
80	National Tactical Exploitation Program (NTEX)	0	NGA	1	0	0	0	0
81	Optical Code Division Multiple Access (O-CDMA)	0	Contractor	0	0	0	1	0
82	Optically Designated Attack Munitions (ODAM)	0		0	0	0	0	1
83	Orbital Express (OE) Space Operations Architecture	0		0	0	0	0	1
84	Oblique Flying Wing (OFW)	0		0	0	0	1	0
85	Optical and Radio Frequency (RF) Combined Link Experiment (ORCLE)	0		0	0	1	0	0
86	Program Composition for Embedded Systems (PCES)	0	US Army, USN, USAF	1	1	0	1	0
88	Radar Scope	1	US Army, SOCOM, USMC	0	1	0	0	0
89	Reversible Barriers Program (ReBar)	0		0	0	0	0	1
90	Synthetic Aperture LADAR for Tactical Imaging (SALTI)	0		0	0	1	1	0

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 61-90 (CONTINUED)	Transition speed	Major/core aspect of project	Minor/trivial aspect of project	PCR word count	Money obligated for further development	Technically baffling report	Test environment
Scale			Yes = 1 No = 0	Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Lab = 1 Field = 2 Other = 3
ID No.	Program	TS	TC	TM	PWC	DUOM	TBR	TE
61	Innovative Space-Based Radar Antenna Technology (ISAT)	54	0	1	1,956	0	0	1
62	Improving Warfighters Information Intake Under Stress (IWIIUS)	61	1	0	1,033	1	0	3
63	Passive Cellular Core Jet Blaster Deflector (JBD)	UKN	0	1	2,535	0	0	1
64	Jigsaw	81	1	0	1,504	0	0	3
65	Learning Applied to Ground Robotics (LAGR)	44	1	0	1,415	0	0	1
66	Language and Speech Exploitation Resources (LASER) POR	48	1	0	843	0	0	3
67	Low-Cost Cruise Missile Defense (LCCMD)	UKN	1	0	1,720	1	0	1
68	Long View	23.5	1	0	4,009	0	0	1
69	Low Friction Engine Development Program	N/A	0	0	603	0	0	1
70	Low Temperature Colossal Super-Saturation (LTCSS)	N/A	0	0	2,536	0	0	1
71	Morphing Aircraft Structures (MAS) III	N/A	0	0	873	0	0	1
72	Micro Air Vehicle Advanced Concept Technology Demonstration (MAV ACTD)	57	1	0	1,622	1	0	3
73	Multicell and Dismounted Command and Control (M&DC2)	UKN	1	0	1,521	1	0	1
74	Meso-Scale Steam Engine Generator (MSEG) Program	50	1	0	1,203	0	0	1
75	Model-Based Integration of Embedded Software (MoBIES)	45	1	0	1,659	0	0	1
76	Project Mobius: A Study on the Feasibility of Learning by Reading	26.5	1	0	1,698	0	0	1
77	Applications of Molecular Electronics (MoleApps)	45	1	0	2,277	0	0	1
78	Mission Specific Processing (MSP)	UKN	1	0	2,110	0	0	3
79	Network Embedded Systems Technology (NEST)	70.5	1	0	10,269	0	0	3
80	National Tactical Exploitation Program (NTEX)	48	1	0	456	1	0	3
81	Optical Code Division Multiple Access (O-CDMA)	UKN	1	0	604	0	1	1
82	Optically Designated Attack Munitions (ODAM)	N/A	0	0	2,282	0	0	1
83	Orbital Express (OE) Space Operations Architecture	N/A	0	0	1,000	0	0	3
84	Oblique Flying Wing (OFW)	N/A	0	1	2,179	0	0	1
85	Optical and Radio Frequency (RF) Combined Link Experiment (ORCLE)	UKN	1	0	2,380	0	0	3
86	Program Composition for Embedded Systems (PCES)	UKN	1	0	3,411	0	0	3
88	Radar Scope	19	1	0	1,370	0	0	3
89	Reversible Barriers Program (ReBar)	N/A	0	0	1,272	0	0	1
90	Synthetic Aperture LADAR for Tactical Imaging (SALTI)	80	1	0	3,068	0	0	3

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 61-90 (CONTINUED)	Improves warfighter safety	Improves warfighter job satisfaction	Addresses immediate warfighter need	Addresses future warfighter need	Tech. maturity
Scale		1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 not at all = 1 significantly = 7	1 to 7 not at all = 1 significantly = 7	1 to 9 Based on TRLs
ID No.	Program	PIWS	PIWJS	PIWN	PFWN	PTM
61	Innovative Space-Based Radar Antenna Technology (ISAT)	1	1	2	6	5
62	Improving Warfighters Information Intake Under Stress (IWIIUS)	5	5	2	6	6
63	Passive Cellular Core Jet Blaster Deflector (JBD)	1	4	1	5	5
64	Jigsaw	5	2	2	6	6
65	Learning Applied to Ground Robotics (LAGR)	2	5	2	6	5
66	Language and Speech Exploitation Resources (LASER) POR	3	5	6	2	6
67	Low-Cost Cruise Missile Defense (LCCMD)	4	2	5	2	5
68	Long View	1	1	2	6	4
69	Low Friction Engine Development Program	1	2	4	4	3
70	Low Temperature Colossal Super-Saturation (LTCSS)	1	2	5	2	3
71	Morphing Aircraft Structures (MAS) III	1	1	1	4	2
72	Micro Air Vehicle Advanced Concept Technology Demonstration (MAV ACTD)	7	6	6	2	6
73	Multicell and Dismounted Command and Control (M&DC2)	3	2	1	4	6
74	Meso-Scale Steam Engine Generator (MSEG) Program	1	4	2	6	4
75	Model-Based Integration of Embedded Software (MoBIES)	1	2	4	4	6
76	Project Mobius: A Study on the Feasibility of Learning by Reading	1	1	2	5	2
77	Applications of Molecular Electronics (MoleApps)	3	2	1	6	3
78	Mission Specific Processing (MSP)	2	3	2	5	4
79	Network Embedded Systems Technology (NEST)	7	4	6	2	6
80	National Tactical Exploitation Program (NTEX)	5	6	2	5	6
81	Optical Code Division Multiple Access (O-CDMA)	6	6	2	6	4
82	Optically Designated Attack Munitions (ODAM)	6	6	5	3	5
83	Orbital Express (OE) Space Operations Architecture	2	6	1	6	7
84	Oblique Flying Wing (OFW)	4	4	1	5	3
85	Optical and Radio Frequency (RF) Combined Link Experiment (ORCLE)	2	6	2	5	6
86	Program Composition for Embedded Systems (PCES)	1	6	3	5	7
88	Radar Scope	6	6	6	2	7
89	Reversible Barriers Program (ReBar)	6	6	6	2	5
90	Synthetic Aperture LADAR for Tactical Imaging (SALTI)	2	5	2	6	6

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 61-90 (CONTINUED)	Perceived usefulness	Continuous vs. disruptive	Game changing/ revolutionary capability	Enhances legacy technology's performance	Prepares DoD for the future
Scale		1 to 7 not useful = 1 very useful = 7	1 to 7 continuous = 1 disruptive = 7	1 to 7 not rev. = 1 exceptionally rev. = 7	1 to 7 no enhance. = 1 complete enhance. = 7	1 to 7 not at all = 1 exceptionally so = 7
ID No.	Program	PEU	PCD	PREV	PLTP	PDF
61	Innovative Space-Based Radar Antenna Technology (ISAT)	4	6	5	4	6
62	Improving Warfighters Information Intake Under Stress (IWIIUS)	5	6	6	1	6
63	Passive Cellular Core Jet Blaster Deflector (JBD)	4	2	2	5	5
64	Jigsaw	6	6	6	1	5
65	Learning Applied to Ground Robotics (LAGR)	6	3	3	5	5
66	Language and Speech Exploitation Resources (LASER) POR	7	6	6	1	6
67	Low-Cost Cruise Missile Defense (LCCMD)	6	6	5	2	5
68	Long View	3	5	5	1	5
69	Low Friction Engine Development Program	6	3	4	6	6
70	Low Temperature Colossal Super-Saturation (LTCSS)	6	3	5	6	3
71	Morphing Aircraft Structures (MAS) III	5	4	6	1	5
72	Micro Air Vehicle Advanced Concept Technology Demonstration (MAV ACTD)	6	4	6	2	3
73	Multicell and Dismounted Command and Control (M&DC2)	5	6	3	2	5
74	Meso-Scale Steam Engine Generator (MSEG) Program	6	6	4	2	5
75	Model-Based Integration of Embedded Software (MoBIES)	6	4	4	2	3
76	Project Mobius: A Study on the Feasibility of Learning by Reading	6	6	5	1	5
77	Applications of Molecular Electronics (MoleApps)	4	6	5	4	5
78	Mission Specific Processing (MSP)	5	3	4	3	5
79	Network Embedded Systems Technology (NEST)	6	5	5	2	5
80	National Tactical Exploitation Program (NTEX)	6	3	4	2	5
81	Optical Code Division Multiple Access (O-CDMA)	6	TBR	TBR	6	6
82	Optically Designated Attack Munitions (ODAM)	5	4	5	6	4
83	Orbital Express (OE) Space Operations Architecture	7	3	6	6	6
84	Oblique Flying Wing (OFW)	6	5	6	1	5
85	Optical and Radio Frequency (RF) Combined Link Experiment (ORCLE)	5	2	4	5	5
86	Program Composition for Embedded Systems (PCES)	6	5	5	6	6
88	Radar Scope	7	5	6	1	5
89	Reversible Barriers Program (ReBar)	6	3	5	1	2
90	Synthetic Aperture LADAR for Tactical Imaging (SALTI)	5	4	5	5	6

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 61-90 (CONTINUED)	Mission fit (right tech, place, & time)	Flexibility in mission use	Adaptive to user needs	Interoperability w/existing technologies	Saves gov't/user resources
Scale		1 to 7 no fit = 1 great fit = 7	1 to 7 not flexible = 1 very flexible = 7	1 to 7 not adaptable = 1 very adaptable = 7	1 to 7 not interoperable = 1 very interoperable = 7	1 to 7 no savings = 1 significant savings = 7
ID No.	Program	PMF	PFMU	PAUN	PINT	PSAV
61	Innovative Space-Based Radar Antenna Technology (ISAT)	2	1	N/A	N/A	1
62	Improving Warfighters Information Intake Under Stress (IWIIUS)	3	4	6	4	2
63	Passive Cellular Core Jet Blaster Deflector (JBD)	1	1	1	N/A	4
64	Jigsaw	5	2	4	4	1
65	Learning Applied to Ground Robotics (LAGR)	2	4	6	5	1
66	Language and Speech Exploitation Resources (LASER) POR	5	3	6	1	3
67	Low-Cost Cruise Missile Defense (LCCMD)	5	2	2	4	5
68	Long View	2	1	1	N/A	1
69	Low Friction Engine Development Program	5	2	5	5	3
70	Low Temperature Colossal Super-Saturation (LTCSS)	5	1	1	N/A	5
71	Morphing Aircraft Structures (MAS) III	1	5	3	N/A	1
72	Micro Air Vehicle Advanced Concept Technology Demonstration (MAV ACTD)	6	5	6	2	4
73	Multicell and Dismounted Command and Control (M&DC2)	3	5	5	5	5
74	Meso-Scale Steam Engine Generator (MSEG) Program	3	1	6	5	3
75	Model-Based Integration of Embedded Software (MoBIES)	5	6	6	5	4
76	Project Mobius: A Study on the Feasibility of Learning by Reading	2	5	5	N/A	5
77	Applications of Molecular Electronics (MoleApps)	2	3	5	4	3
78	Mission Specific Processing (MSP)	3	6	6	5	5
79	Network Embedded Systems Technology (NEST)	6	5	4	5	4
80	National Tactical Exploitation Program (NTEX)	4	6	4	5	4
81	Optical Code Division Multiple Access (O-CDMA)	4	5	2	6	4
82	Optically Designated Attack Munitions (ODAM)	2	2	3	4	5
83	Orbital Express (OE) Space Operations Architecture	2	5	5	5	6
84	Oblique Flying Wing (OFW)	2	5	2	2	5
85	Optical and Radio Frequency (RF) Combined Link Experiment (ORCLE)	2	5	2	6	2
86	Program Composition for Embedded Systems (PCES)	5	6	5	5	6
88	Radar Scope	6	2	2	N/A	2
89	Reversible Barriers Program (ReBar)	5	2	6	N/A	6
90	Synthetic Aperture LADAR for Tactical Imaging (SALTI)	2	5	2	5	2

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 91-116	Technology fielded to warfighter	Receiving service/ organization	Program transition to DoD POR	Tech spin offs to DoD S&T	Tech spin offs into other DARPA projects	Spin offs into commercial	Not transitioned
Scale		Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0	Yes = 1 No = 0
ID No.	Program	TW	TORG	TPOR	TST	TOD	TOTH	TZ
91	Shape Charge Armor	0		1	0	1	0	0
92	Super High Efficiency Diode Sources (SHEDS)	0		0	0	0	1	0
94	Stochastic and Perturbation Methods in PDE Systems (SPM)	0		0	0	0	0	1
95	Sticky Flare	0		0	1	0	0	0
96	Small Uninhabited Air Vehicle Engine (SUAVE)	0		0	0	0	0	1
97	Polymorphous Computing Architectures (PCA)	0		0	0	1	1	0
98	Quantum Information Science and Technology (QuIST)	0		0	0	0	0	1
99	Real-Time Adversarial Intelligence and Decision-Making (RAID)	1	US Army	1	1	0	0	0
100	Real World Reasoning (REAL)	0		0	0	0	0	1
101	Robust Integrated Power Electronics (RIPE)	0		0	0	0	0	1
102	Self Decontaminating Surfaces (SDS) Program	0		1	1	0	1	0
103	Software-Enabled Control (SEC)	0		0	0	0	0	1
104	Sensing and Patrolling Enablers Yielding Enhanced SASO (SPEYES)	1	US Army, USMC	0	0	0	0	0
105	Spectral Sensing of Bio-Aerosols (SSBA)	0		0	0	0	0	1
106	Superconducting Hybrid Power Electronics (SuperHyPE)	0		0	0	0	0	1
107	Sub-Millimeter Wave Imaging Focal-Plane Technology (SWIFT)	0		0	0	1	0	0
108	Technology for Efficient, Agile Microsystems (TEAM)	0	USAF	1	1	1	0	0
109	Tactical Targeting Network Technology (TTNT)	0	USAF	1	1	0	0	0
110	UltraLog	0	US Army	1	1	0	1	0
111	UrbanScape	0	US Army	1	0	0	0	0
112	Unique Signature Detection	0		0	0	0	0	1
113	Virtual Autopsy Program	1		0	0	0	0	0
114	Waveforms for Active Sensing (WAS)	0		0	0	0	0	1
115	Ocean Wave Energy Harvesting Program	0		0	0	0	1	0
116	Video Verification of Identity Program (VIVID)	1	USAF, US Army	1	1	0	0	0

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 91-116 (CONTINUED)	Transition speed	Major/core aspect of project	Minor/trivial aspect of project	PCR word count	Money obligated for further development	Technically baffling report	Test environment
Scale			Yes = 1 No = 0	Yes = 1 No = 0		Yes = 1 No = 0	Yes = 1 No = 0	Lab = 1 Field = 2 Other = 3
ID No.	Program	TS	TC	TM	PWC	DUOM	TBR	TE
91	Shape Charge Armor	9	1	0	2,357	0	0	1
92	Super High Efficiency Diode Sources (SHEDS)	UKN	1	0	1,403	0	0	1
94	Stochastic and Perturbation Methods in PDE Systems (SPM)	N/A	0	0	1,816	0	1	1
95	Sticky Flare	6	1	0	920	0	0	1
96	Small Uninhabited Air Vehicle Engine (SUAVE)	N/A	0	0	1,121	0	0	1
97	Polymorphous Computing Architectures (PCA)	84	1	0	2,732	0	0	1
98	Quantum Information Science and Technology (QuIST)	N/A	0	0	1,068	0	0	1
99	Real-Time Adversarial Intelligence and Decision-Making (RAID)	41	1	0	1,094	0	0	1
100	Real World Reasoning (REAL)	N/A	0	0	1,422	0	0	1
101	Robust Integrated Power Electronics (RIPE)	N/A	0	0	604	0	0	1
102	Self Decontaminating Surfaces (SDS) Program	36	1	1	3,735	0	0	1
103	Software-Enabled Control (SEC)	N/A	0	0	1,819	0	0	1
104	Sensing and Patrolling Enablers Yielding Enhanced SASO (SPEYES)	19	1	0	1,711	0	0	3
105	Spectral Sensing of Bio-Aerosols (SSBA)	N/A	0	0	939	0	0	1
106	Superconducting Hybrid Power Electronics (SuperHyPE)	N/A	0	0	631	0	0	1
107	Sub-Millimeter Wave Imaging Focal-Plane Technology (SWIFT)	34	1	0	4,833	0	1	1
108	Technology for Efficient, Agile Microsystems (TEAM)	UKN	1	0	2,422	0	1	1
109	Tactical Targeting Network Technology (TTNT)	N/A	1	0	1,910	0	0	3
110	UltraLog	50	1	0	3,188	0	0	1
111	UrbanScape	43	1	0	2,643	0	0	1
112	Unique Signature Detection	N/A	0	0	1,340	0	0	1
113	Virtual Autopsy Program	19	1	0	1,862	0	0	3
114	Waveforms for Active Sensing (WAS)	N/A	0	0	708	0	1	1
115	Ocean Wave Energy Harvesting Program	65	1	0	2,201	0	0	3
116	Video Verification of Identity Program (VIVID)	27	1	1	3,895	0	0	1

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 91-116 (CONTINUED)	Improves warfighter safety	Improves warfighter job satisfaction	Addresses immediate warfighter need	Addresses future warfighter need	Tech. maturity
Scale		1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 no imprv. = 1 vastly imprv. = 7	1 to 7 not at all = 1 significantly = 7	1 to 7 not at all = 1 significantly = 7	1 to 9 Based on TRLs
ID No.	Program	PIWS	PIWJS	PIWN	PFWN	PTM
91	Shape Charge Armor	7	2	6	3	7
92	Super High Efficiency Diode Sources (SHEDS)	2	4	1	4	6
94	Stochastic and Perturbation Methods in PDE Systems (SPM)	1	1	1	2	N/A
95	Sticky Flare	5	2	3	4	5
96	Small Uninhabited Air Vehicle Engine (SUAVE)	1	2	2	6	5
97	Polymorphous Computing Architectures (PCA)	1	6	2	6	7
98	Quantum Information Science and Technology (QuIST)	4	4	2	6	4
99	Real-Time Adversarial Intelligence and Decision-Making (RAID)	6	4	2	6	6
100	Real World Reasoning (REAL)	2	6	1	5	6
101	Robust Integrated Power Electronics (RIPE)	1	5	3	5	5
102	Self Decontaminating Surfaces (SDS) Program	3	5	2	5	6
103	Software-Enabled Control (SEC)	1	5	2	6	6
104	Sensing and Patrolling Enablers Yielding Enhanced SASO (SPEYES)	7	5	6	2	7
105	Spectral Sensing of Bio-Aerosols (SSBA)	6	3	2	4	5
106	Superconducting Hybrid Power Electronics (SuperHyPE)	1	4	3	5	4
107	Sub-Millimeter Wave Imaging Focal-Plane Technology (SWIFT)	1	4	2	5	5
108	Technology for Efficient, Agile Microsystems (TEAM)	1	6	2	6	6
109	Tactical Targeting Network Technology (TTNT)	3	6	2	5	6
110	UltraLog	3	6	3	5	6
111	UrbanScape	5	5	5	2	5
112	Unique Signature Detection	1	3	1	4	3
113	Virtual Autopsy Program	5	5	2	4	7
114	Waveforms for Active Sensing (WAS)	5	4	3	4	4
115	Ocean Wave Energy Harvesting Program	1	4	4	5	6
116	Video Verification of Identity Program (VIVID)	3	6	6	4	6

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 91-116 (CONTINUED)	Perceived usefulness	Continuous vs. disruptive	Game changing/ revolutionary capability	Enhances legacy technology's performance	Prepares DoD for the future
Scale		1 to 7 not useful = 1 very useful = 7	1 to 7 continuous = 1 disruptive = 7	1 to 7 not rev. = 1 exceptionally rev. = 7	1 to 7 no enhance. = 1 complete enhance. = 7	1 to 7 not at all = 1 exceptionally so = 7
ID No.	Program	PEU	PCD	PREV	PLTP	PDF
91	Shape Charge Armor	6	3	5	5	2
92	Super High Efficiency Diode Sources (SHEDS)	3	3	5	1	6
94	Stochastic and Perturbation Methods in PDE Systems (SPM)	N/A	TBR	TBR	TBR	TBR
95	Sticky Flare	6	4	5	1	2
96	Small Uninhabited Air Vehicle Engine (SUAVE)	5	3	4	6	5
97	Polymorphous Computing Architectures (PCA)	6	4	5	6	5
98	Quantum Information Science and Technology (QuIST)	5	6	5	5	5
99	Real-Time Adversarial Intelligence and Decision-Making (RAID)	8	6	6	2	6
100	Real World Reasoning (REAL)	6	5	5	3	5
101	Robust Integrated Power Electronics (RIPE)	6	3	3	5	5
102	Self Decontaminating Surfaces (SDS) Program	6	6	6	N/A	5
103	Software-Enabled Control (SEC)	4	2	2	6	4
104	Sensing and Patrolling Enablers Yielding Enhanced SASO (SPEYES)	7	5	7	2	2
105	Spectral Sensing of Bio-Aerosols (SSBA)	5	3	4	1	4
106	Superconducting Hybrid Power Electronics (SuperHyPE)	6	6	6	5	5
107	Sub-Millimeter Wave Imaging Focal-Plane Technology (SWIFT)	3	6	5	5	5
108	Technology for Efficient, Agile Microsystems (TEAM)	5	6	5	5	5
109	Tactical Targeting Network Technology (TTNT)	6	3	5	4	2
110	UltraLog	6	5	5	5	5
111	UrbanScape	5	6	6	1	3
112	Unique Signature Detection	5	7	7	1	3
113	Virtual Autopsy Program	6	5	3	1	4
114	Waveforms for Active Sensing (WAS)	5	TBR	TBR	TBR	TBR
115	Ocean Wave Energy Harvesting Program	6	6	5	2	5
116	Video Verification of Identity Program (VIVID)	6	3	5	6	3

APPENDIX E. DARPA TECHNOLOGY DATABASE (CONTINUED)

	TECHNOLOGIES 91-116 (CONTINUED)	Mission fit (right tech, place, & time)	Flexibility in mission use	Adaptive to user needs	Interoperability w/existing technologies	Saves gov't/user resources
Scale		1 to 7 no fit = 1 great fit = 7	1 to 7 not flexible = 1 very flexible = 7	1 to 7 not adaptable = 1 very adaptable = 7	1 to 7 not interoperable = 1 very interoperable = 7	1 to 7 no savings = 1 significant savings = 7
ID No.	Program	PMF	PFMU	PAUN	PINT	PSAV
91	Shape Charge Armor	6	1	1	2	3
92	Super High Efficiency Diode Sources (SHEDS)	2	6	6	N/A	5
94	Stochastic and Perturbation Methods in PDE Systems (SPM)	TBR	TBR	TBR	TBR	TBR
95	Sticky Flare	2	2	2	5	3
96	Small Uninhabited Air Vehicle Engine (SUAVE)	2	2	4	4	4
97	Polymorphous Computing Architectures (PCA)	3	6	6	5	4
98	Quantum Information Science and Technology (QuIST)	2	4	6	5	5
99	Real-Time Adversarial Intelligence and Decision-Making (RAID)	3	5	6	N/A	5
100	Real World Reasoning (REAL)	3	5	5	5	4
101	Robust Integrated Power Electronics (RIPE)	2	3	6	5	5
102	Self Decontaminating Surfaces (SDS) Program	2	4	6	N/A	6
103	Software-Enabled Control (SEC)	2	2	6	5	4
104	Sensing and Patrolling Enablers Yielding Enhanced SASO (SPEYES)	6	6	6	N/A	4
105	Spectral Sensing of Bio-Aerosols (SSBA)	2	2	2	N/A	2
106	Superconducting Hybrid Power Electronics (SuperHyPE)	3	2	5	5	5
107	Sub-Millimeter Wave Imaging Focal-Plane Technology (SWIFT)	2	5	5	5	4
108	Technology for Efficient, Agile Microsystems (TEAM)	2	2	5	5	3
109	Tactical Targeting Network Technology (TTNT)	4	5	6	5	2
110	UltraLog	4	2	6	5	5
111	UrbanScape	5	2	5	4	6
112	Unique Signature Detection	1	1	1	N/A	4
113	Virtual Autopsy Program	3	1	3	4	5
114	Waveforms for Active Sensing (WAS)	TBR	TBR	TBR	TBR	TBR
115	Ocean Wave Energy Harvesting Program	4	1	7	5	7
116	Video Verification of Identity Program (VIVID)	6	4	5	6	2

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