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Project Portfolio Management: An Investigation of One Air Force Product Center

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PROJECT PORTFOLIO MANAGEMENT:

AN INVESTIGATION OF ONE AIR FORCE PRODUCT CENTER

THESIS

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Abstract

Over the last two decades, reducing product development times in the DoD has been the focus of many committees, commissions, and research efforts. Despite the implementation of numerous recommendations, the DoD still struggles with long acquisition cycle times. This research is part of the Air Force Cycle Time Reduction Research Program (CTRRP), which grew out of the Cycle Time Reduction Action Plan, developed in 1998. This research focuses on the portfolio management (project selection and resource allocation) part of the CTRRP.

The purpose of this research effort was to investigate of the use of portfolio management within the Air Force. Specifically, this thesis sought to assess how portfolio management is used in Air Force acquisition and to compare the Air Force's practices to commercial best practices. A comprehensive review of commercial portfolio management literature was conducted. To identify Air Force practices, semi-structured interviews were conducted at one Air Force product center. Personnel in positions most likely to use portfolio management, or have knowledge of its use, were interviewed at the center, wing, and direct reporting group levels.

The research found that top performing commercial firms with an effective portfolio management process focus primarily on project selection activities at the front end of the development process, while the Air Force focuses primarily on program execution activities at the back end of the process. Recommendations to make portfolio management more effective in the Air Force are discussed.

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PROJECT PORTFOLIO MANAGEMENT:
AN INVESTIGATION OF ONE AIR FORCE PRODUCT CENTER

I. Motivation

Long Acquisition Cycle Times in the DoD

The Department of Defense (DoD) is one of the largest product development organizations in the world. The DoD acquisition budget for FY2005, which includes money allocated for research, development, test, evaluation, and procurement of new systems, totaled $143.8B. The Air Force's portion of that budget was $53.7B, more than any other service (DoD, 2004:1-2). It is through these acquisition activities that the Air Force equips its forces with the tools needed to accomplish its mission. The Air Force must have an effective product development system in order to provide the right equipment to its forces at the right time.

Acquisition cycle time is a critical component that drives product development times in the Air Force. Acquisition cycle time is defined as the time from official program initiation to initial operating capability (DoD, 2001:1). In the 1960s, the average acquisition cycle time in the DoD was 84 months. By 1996, the average cycle time had grown to 132 months (DoD, 2001:2). In 2002, the Air Force Acquisition Chief, Dr. Marvin Sambur, addressed his concerns with long cycle times when he stated:

> On average, Air Force programs' cycle times run about 10 years, and that's only the average; some programs take up to 25 years to get to the field. When it takes so long, it just can't be state-of-the-art. (Paone, 2002)

Portfolio management is a tool that can be used to address the problem of long acquisition cycle times. In 1998, McNutt conducted research into the role of the schedule development process in reducing DoD product development time. McNutt (1998) found that 77% of projects' schedules were limited by funding, not technology. Lack of adequate funding was found to be the strongest barrier to reducing cycle time. The recommendations of McNutt (1998) are summarized in the Cycle Time Reduction Action Plan (CTRAP) shown in Figure 1. This research will build upon the research in McNutt (1998) by focusing on the "Project Selection and Resource Allocation" part of Phase 3 of the CTRAP.

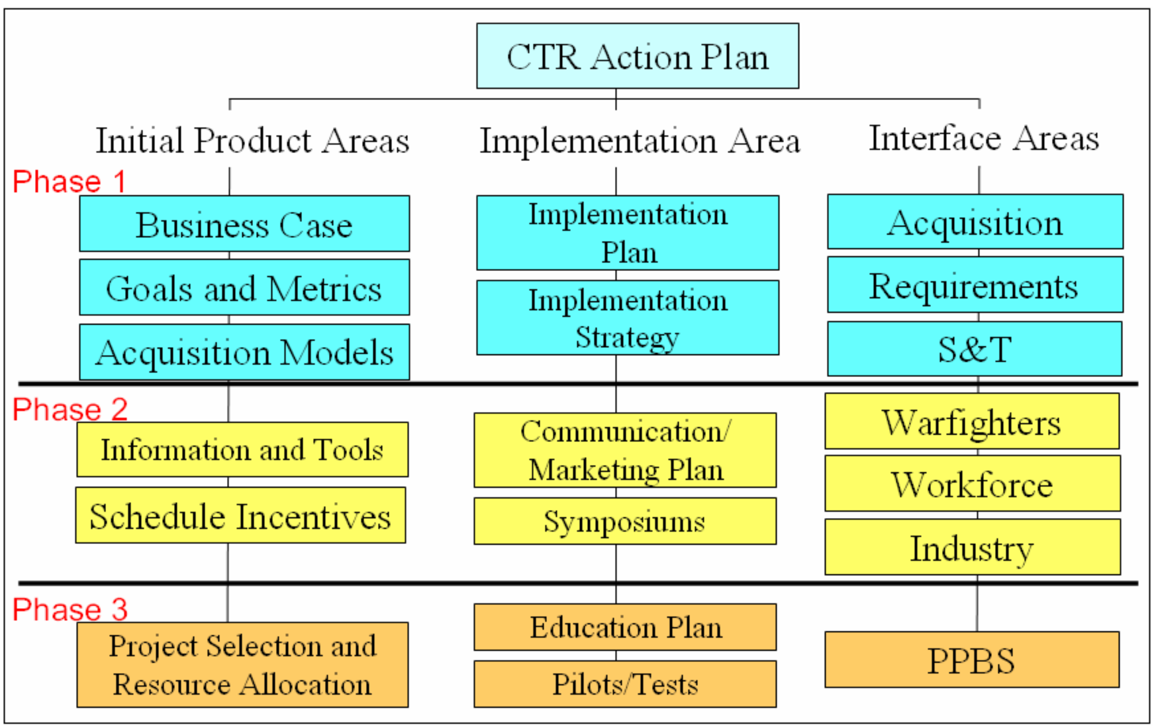

Figure 1 – Cycle Time Reduction Action Plan (McNutt, 2004)

Impact of Long Acquisition Cycle Times

The DoD has long recognized that increasing acquisition cycle times is a problem. In 1985, the President's Blue Ribbon Commission on Defense Management (also known as the Packard Commission) was established, in part, to evaluate the defense acquisition system and determine ways to acquire products with lower costs and shorter development times (Packard Commission, 1986:1). In its final report, the Packard Commission concluded:

> …a much more serious result of this management environment is an unreasonably long acquisition cycle—ten to fifteen years for our major weapon systems. This is a central problem from which most other acquisition problems stem. (Packard Commission, 1986:8)

The commission thought it would be possible to cut DoD's acquisition cycle time in half by streamlining acquisition organization and procedures, using technology to reduce costs, balancing cost and performance, stabilizing programs, expanding the use of commercial products, increasing competition, and enhancing the quality of acquisition personnel (Packard Commission, 1986:15-27). The commission's recommendations quickly became law but did little to correct the problem because the goal of cutting development time was not internalized by the DoD (McNutt, 1998:52).

The DoD continues to struggle with the problem of long cycle times today, as evidenced by a statement in 2002 from the Director of the U.S. Office of Transformation, VADM (Ret.) Arthur Cebrowski:

> If program managers want their program to survive, they must solve and resolve the riddle of why commercial cycle times are measured in weeks, months or just a few years, while DoD's cycle time is measured in decades. (Griffard, 2002:1)

Long cycle times not only delay the delivery of the proper tools to our warfighters, they also cause many other problems. As the Packard Commission stated in its final report, long acquisition cycle times are the cause of most other acquisition problems.

Systems Not Ready When Needed.

Long cycle times lead to systems not being ready when needed. McNutt (1998) identified seven systems[1] that had been in development for at least 7 years prior to the start of Desert Storm. Had these systems been ready, they would have satisfied many critical needs in the early part of the war (McNutt, 1998:40).

Systems Not Meeting Current Needs.

Long cycle times lead to systems not meeting current needs when they are fielded. With a cycle time of 10-15 years, the current military and political environment will have changed, perhaps drastically, while a system is under development. Many times when a system is finally delivered, the requirements for that system have changed or the system is no longer needed (McNutt, 1998:41). Air combat studies conducted by the Air Force in the late 1970s and early 1980s revealed that the Soviet Union was developing two aircraft, the Fulcrum and the Flanker that could outperform the F-15. In 1981, the Air Force developed a requirement for an Advanced Tactical Fighter, which would become the F-22. Eight years later, the Soviet Union, which was the primary threat the F-22 was designed to counter, collapsed with the fall of the Berlin Wall. In an attempt to have the F-22 meet more current needs and make it more cost effective, the Air Force changed the

---

[1] The seven systems were the C-17, MILSTAR communications satellite, LANTIRN Precision Targeting Pod, Joint Tactical Information Distribution System, Global Positioning System, Advanced Medium Range Air-to-Air Missile, and Sensor-Fuzed Weapon wide-area anti-tank capability (McNutt, 1998).

designation of the F-22 to F/A-22. There is also an F/B-22 bomber concept on the shelf for future consideration (F/A-22, 2003).

Systems Fielded with Outdated Technology.

Long cycle times lead to systems being fielded with outdated technology. Often times, technology that is current at the start of a program is obsolete or out of production by the time the system is fielded (McNutt, 1998:41). For example, computer processing technology is advancing very rapidly. According to Moore's Law, the number of transistors per integrated circuit doubles every 2-4 years (Moore, 1965). This doubling results in dramatic increases in the number of instructions per second that a processor can execute (see Figure 2). Imagine fielding a system today that began development 15 years ago, based on 486-processor technology. Today's home computers have processors that are on the order of one thousand times faster. If the Air Force ever wants to field a system with current technology, then it must reduce acquisition cycle times.

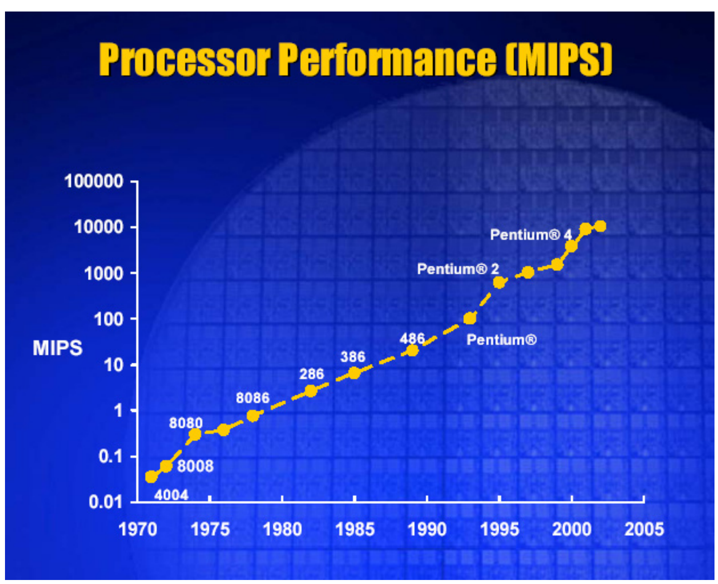

Figure 2 – Computer processor performance in millions of instructions per second (Moore, 2003)

Slow Response to Emerging Threats.

Long cycle times reduce our ability to respond to new and emerging threats. This leaves our forces vulnerable while we are developing a new system to counter the threat. One example is the AIM-9X off-boresight missile. The Soviet Union fielded an off-boresight missile on their aircraft in 1985 (McNutt, 1998:43). Eighteen years after identifying the threat, the U.S. finally deployed a counter-system when the AIM-9X reached initial operating capability (IOC) in 2003 (Navy, 2003).

Increased Costs.

Long cycle times cost more than short cycle times. In its report, the Packard Commission stated, "time is money, and experience argues that a ten-year acquisition cycle is clearly more expensive than a five-year cycle" (Packard Commission, 1986:8). Programs with higher development costs will then have less money available for production, which translates to fewer systems in warfighters' hands (McNutt, 1998:45). Longer cycle times also increase sustainment costs by delaying the replacement of systems that have higher operating costs (McNutt, 1998:49).

Increased Program Instability.

Long cycle times increase the uncertainty in the planning process. According to McNutt (1998), programs taking less than 7 years to reach IOC exceed their initial budget estimates by an average of 15%, compared to programs taking more than 14 years to reach IOC that exceed initial estimates by an average of 42% (McNutt, 1998:47). Also, with military members changing positions on average every 3-4 years, long cycle times lead to a high rate of management turnover. This high turnover increases the instability in the program.

Previous Efforts to Reduce Cycle Times

As previously stated, the DoD has long recognized the importance of reducing acquisition cycle times. This section summarizes several cycle time reduction efforts conducted within the Air Force over the last 10 years.

Air Force Lightning Bolt #10 Initiative.

The Air Force Lightning Bolt #10 Initiative originally proposed to cut in half the time from initial effort to satisfy a requirement until delivery of the product or service (Air Force, 1996). However, once underway, the initiative's scope was quickly changed to reducing the time from initial effort until contract award (McNutt, 1998:53). The Lighting Bolt group developed a toolbox of best practices and then disbanded (Air Force, 1997).

Advanced Concept Technology Demonstrations (ACTDs).

ACTDs are a way for users to evaluate a new technology's military utility without committing to a development effort. ACTDs do not fall within the formal acquisition process and have much more flexibility with their contracts. Once accepted, ACTDs are allowed to proceed immediately to low-rate initial production. While ACTDs effectively get new technology into warfighters' hands quickly, they do not solve the problem of long development times. They are simply a way to circumvent the traditional development process (McNutt, 1998:54-55).

Lean Aerospace Initiative.

The Lean Aerospace Initiative is an ongoing effort "to reduce cost, development, and production time for military products by half by infusing commercial lean practices throughout the defense aerospace industry" (McNutt, 1998:55). The initiative, led by the

Massachusetts Institute of Technology, consists of a consortium of government, industry, academia, and labor participants conducting research into the development and manufacturing process (McNutt, 1998:55).

Warfighter Rapid Acquisition Process (WRAP).

Air Force leadership directed implementation of the WRAP at the CORONA conference in November 1999. The process was designed as a way to quickly initiate and fund a limited number of high value projects each year that are not within the scope of an existing program. Major commands (MAJCOMs) are allowed to nominate programs for WRAP funding, but must agree to fully fund the follow-on program. WRAP allows rapid transition and fielding of the most successful warfighter experiments, Battlelab initiatives, science and technology efforts, ACTDs, and other novel ideas (McNutt, 2000b).

Cycle Time Reduction Action Plan (CTRAP).

The Air Force Cycle Time Reduction Team was chartered in 1997 by the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) and the Air Force Deputy Chief of Staff for Installations and Logistics (AF/IL). By May 1998, the team had developed a comprehensive action plan, laying out the steps necessary to achieve dramatic reductions in development times for Air Force and DoD products. Their plan was approved by the Vice Chief of Staff in August 1999. Figure 1 presented above shows a summary of the CTRAP. The plan has three phases. Phase one includes building awareness of the problem and quantifying its impacts. Phase two includes building the necessary infrastructure and tools necessary to fix the problem. Phase three involves mitigating funding based constraints to fixing the problem. The CTRAP has now evolved into the

Cycle Time Reduction Research Program, of which this research effort is a part (McNutt, 2000a).

Agile Acquisition.

In March 2002, Secretary of the Air Force James Roche and Air Force Chief of Staff General John Jumper issued a mandate to the Air Force acquisition community that they must change the way they do business in order to more rapidly deliver capability to the warfighter. In a policy memo dated 4 February 2003, Air Force Acquisition Chief Dr. Marvin Sambur implemented Agile Acquisition with two overarching objectives: decrease acquisition cycle time and increase credibility in execution. Dr. Sambur stated that his goal was to reduce our average acquisition cycle time by a factor of 4:1. To achieve this goal, the Air Force adopted evolutionary acquisition and spiral development as a standard practice. Evolutionary acquisition is a process designed to deliver capabilities to the warfighter faster than a traditional single-step acquisition approach. Spiral development is another process, typically used in conjunction with evolutionary acquisition, which places a strong emphasis on program risk reduction. Both processes were first used in DoD software acquisition. In order to build credibility in program execution, the Air Force focused on three concepts: collaborative requirements—the warfighter, acquirer, and tester working together throughout the requirements generation and development process; seamless verification—merging developmental and operational testing into one seamless verification process; and focused technology—focusing limited science and technology funding on programs that directly support a warfighting capability and bringing technology into more mature programs (Sambur, 2003).

Portfolio Management: A Cycle Time Reduction Tool

A project portfolio is a list of a company's active projects. One group of experts defines portfolio management in the following manner:

> Portfolio management is a dynamic decision process, whereby a business's list of active new product (and R&D) projects is constantly updated and revised. In this process, new projects are evaluated, selected, and prioritized; existing projects may be accelerated, killed, or deprioritized; and resources are allocated and reallocated to the active projects. The portfolio decision process encompasses or overlaps a number of decision making processes within the business, including periodic reviews of the total portfolio of all projects (looking at the entire set of projects, and comparing all projects against each other); making Go/Kill decisions on individual projects on an ongoing basis; and developing a new product strategy for the business, complete with strategic resource allocation decisions. (Cooper *et al.*, 1998:3)

Managing a project portfolio is similar to managing a financial portfolio. Portfolio management is a decision-making process used to balance risk and reward in order to maximize an organization's return on investment.

Over the last 35 years, the average acquisition cycle time for an Air Force program has grown from just under 60 months to over 120 months (McNutt, 2004). During the same period, commercial industries have made dramatic reductions in their product development times (McNutt, 1998:60). Figure 3 shows examples of some of these reductions. Portfolio management is one of the key tools companies have used to accomplish these reductions. Researchers have studied portfolio management in the commercial world for many years. However, very little research has been done into the application of portfolio management to government new product development. Recognized or not, there is a strong need for this type of research in the DoD. Figure 4 shows how acquisition cycle times have grown in the DoD since 1969.

Industry	Old Time	Current	Goal
Automobile	84 months	24 months	<18 months
Commercial Aircraft	8-10 years	5 years	2 1/2 years
Commercial Spacecraft	8 years	18 months	12 months
Consumer Electronics	2 years	6 months	

Figure 3 – Commercial reductions in cycle times (McNutt, 1998:66)

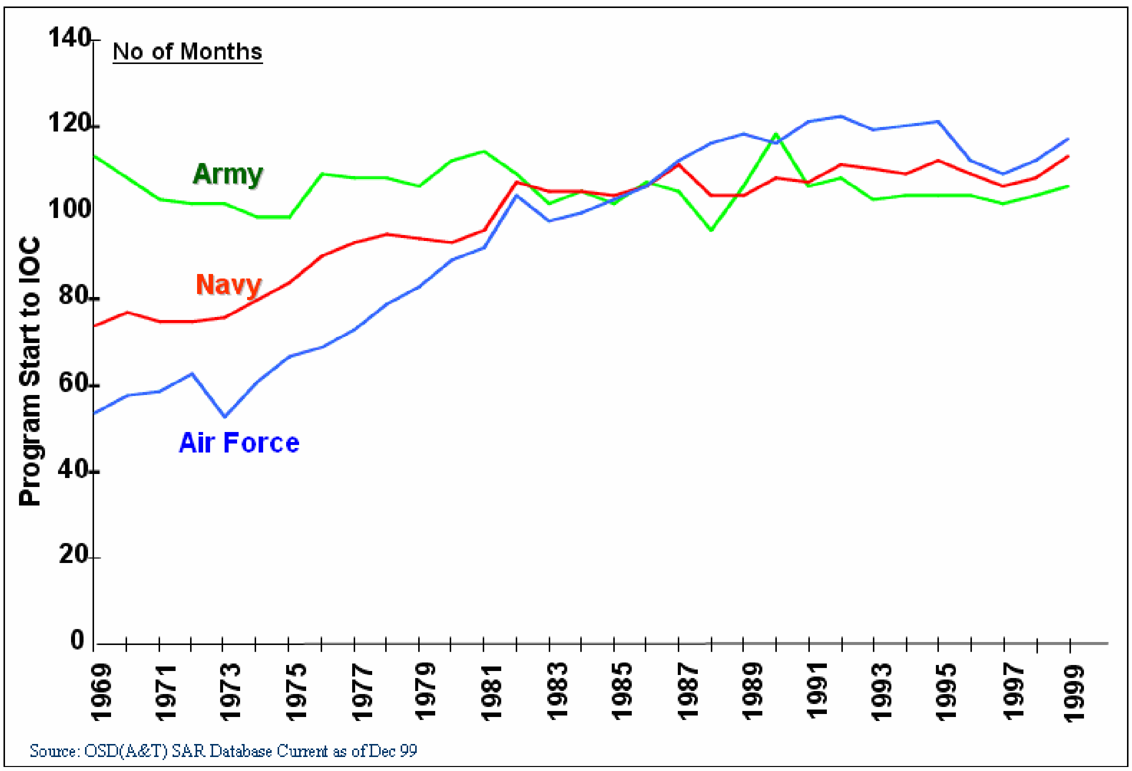

Figure 4 – Average DoD acquisition cycle times (McNutt, 2004)

Research Objectives

The objective of this research was to assess the use of portfolio management in the Air Force acquisition process. This was accomplished through an in-depth, exploratory investigation of one Air Force product center. Semi-structured interviews were conducted with personnel in key positions at the center, wing, and direct reporting group (DRG) levels. Data from the interviews was used to answer several questions: 1) Does the Air Force use portfolio management?, 2) If so, how do they use it?, 3) How do the Air Force's activities compare to commercial portfolio management best practices?, and 4) What should the Air Force do to improve the effectiveness of its portfolio management activities? This research does have some limitations. It does not address the use of portfolio management by other product centers, other acquisition organizations, or the corporate level Air Force. The research also does not address modernization programs within the major commands (MAJCOMs).

II. Literature Review

One of the difficulties in portfolio management is that the concept means something different to everyone in an organization. Some see portfolio management as building a strategically correct portfolio—one where all of the projects directly support the organization's strategy. Some think portfolio management is about the most effective way to allocate resources. Others focus on building a portfolio of projects that will lead to future breakthroughs in technology. Still others look to portfolio management as a way to ensure the organization only starts projects that will provide immediate financial gains. In reality, portfolio management encompasses all of these goals.

Research into Commercial Portfolio Management Activities

According to Poolton and Barclay (1998), many researchers have investigated the question of how best to manage a portfolio of projects. They have discovered that there is more than one answer to that question. After nearly five decades of research, there still is not a single one size fits all model that explains new product development success. Prior to the 1970s, most research focused on identifying factors associated with successful projects and identifying factors associated with failed projects. Since then, research has shifted to comparing successful endeavors with those that are unsuccessful. Researchers have taken a generic approach to the problem, trying to identify best practices that should be adopted by every business, regardless of the size or complexity of its new product development (Poolton and Barclay, 1998:199).

Griffin conducted a survey in 1997 to update the Product Development and Management Association's 1990 survey of commercial new product development best practices. The survey results indicated that process was the strongest differentiator between top performing firms and the rest. The most successful companies operated under a formal new product development process based on the organization's overall strategy. They were also more likely to have used their process longer than lower performing firms. Finally, the top performing companies were found to focus on improving performance in all aspects of their new product development as opposed to just one aspect (Griffin, 1997).

Scott (2000) approached his research a bit differently. He used a three-questionnaire DELPHI methodology to rank the top 24 management issues involved in high-tech new product development. The primary issue identified by the academia and industry participants was "strategic planning for technology products." Most participants agreed that companies have a difficult time implementing and following through with a long-term technology strategy. Even when firms do have a well-structured plan in place, they often abandon it for short-term opportunities that arise. Other issues ranked in the top five were new project selection, organizational learning, core competencies, and cycle time reduction (Scott, 2000).

More recently, Jeffery and Leliveld (2004) conducted a survey of 130 Fortune 1000 companies. The survey was designed to 1) measure the adoption of information technology portfolio management (ITPM), 2) identify ITPM implementation hurdles, 3) assess the benefits of ITPM, 4) define ITPM best practices, and 5) build strategies for success. The major result of their efforts was the IT Portfolio Management Maturity Model (see Figure 5), which is used to assess ITPM best practices. Jeffery and Leliveld's (2004) findings indicate that only 17% of the companies surveyed are operating at the synchronized level, despite the fact that 65% of chief information officers (CIOs) believe that adopting ITPM would yield significant value (Jeffery and Leliveld, 2004).

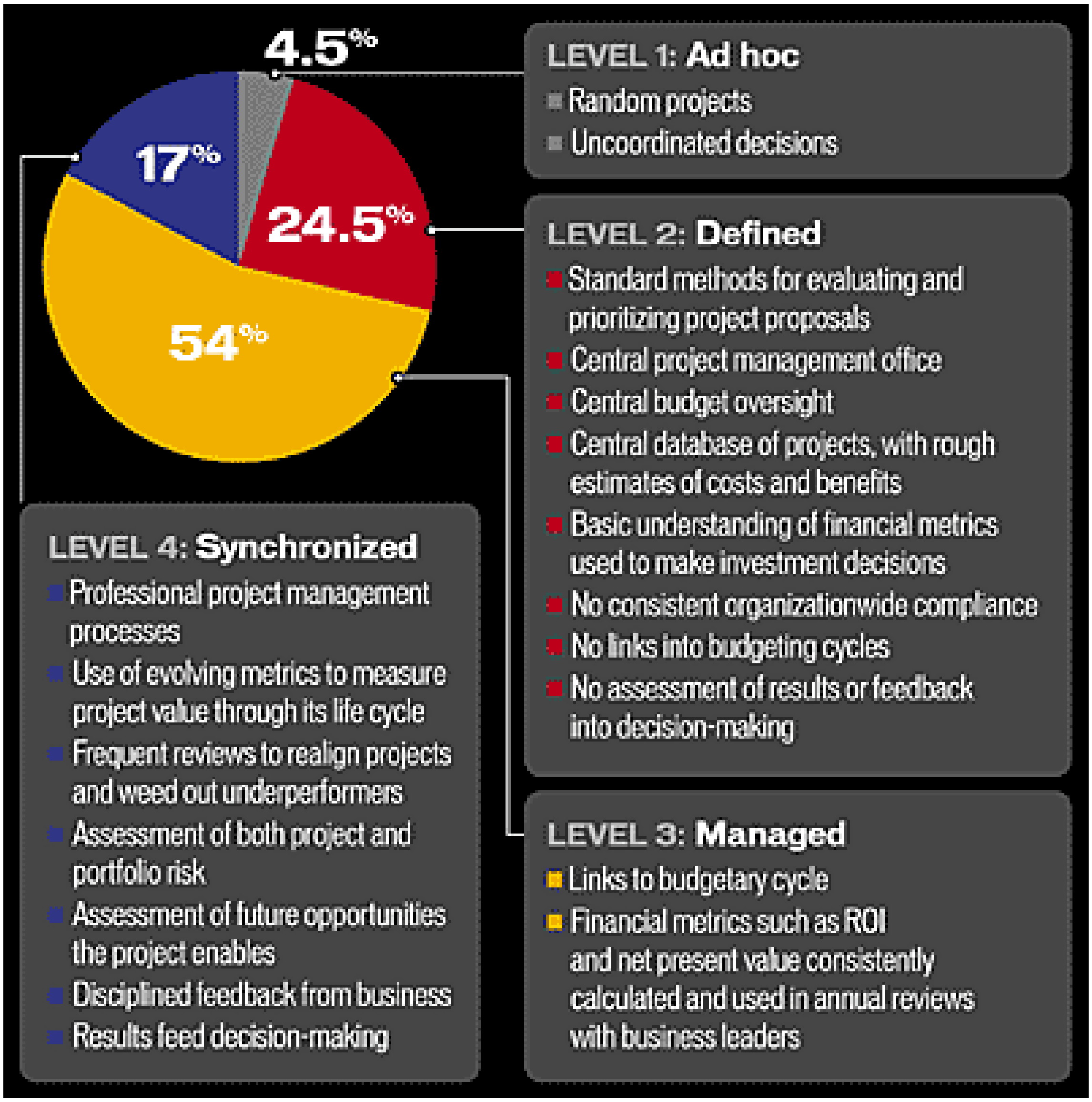

Figure 5 – The IT Portfolio Management Maturity Model (Melymuka, 2004)

Portfolio Management Goals and Tools.

By far, the most extensive research into new product development and portfolio management has been conducted by Cooper, Edgett, and Kleinschmidt. Over several decades, they surveyed hundreds of corporations and conducted hundreds of case studies on new product developments. They discovered that the most successful firms do not rely on a single approach to portfolio management. In their book *Portfolio Management for New Products*, Cooper *et al.* (1998) give a very comprehensive definition of portfolio management by discussing three goals of portfolio management and the tools that support them. The three goals are maximizing value, achieving balance, and establishing a strong link to strategy.

Maximizing Value.

According to Cooper *et al.* (1998), the first goal of many firms is to maximize the value of the projects in their portfolio in terms of a given business objective, such as profitability, return on investment, likelihood of success, or some other strategic objective. There are a number of tools (financial methods, scoring models, etc.) used to support this goal. The result of each tool is a prioritized list of projects, with projects at the top of the list ranking highest in terms of the specific objective. The challenge for the business is to determine the appropriate tool and criteria with which to rank their projects (Cooper *et al.*, 1998: 23-54).

Achieving Balance.

The second goal of many firms is to achieve a balanced portfolio. Balance can be defined in terms of a number of parameters: long-term versus short-term, high-risk versus low-risk, different markets the business is involved in, different technologies, and different project types. Visual charts are the most popular way of displaying project balance. These charts include portfolio maps (or bubble diagrams) that map projects on risk versus reward, ease of implementation versus market attractiveness, ease versus importance, and market risk versus technology risk. Other types of charts used are traditional histograms, bar charts and pie charts (Cooper *et al.*, 1998: 55-81).

Strong Link to Strategy.

Regardless of all other considerations, a firm's final portfolio of projects must match its overall strategy. Firms implement strategy by spending money; therefore, strategy and resource allocation are intimately connected. The companies studied by Cooper *et al.* (1998) used three approaches to ensure strategic alignment: top-down, bottom-up, and a combination of both. The top-down approach is also called the strategic buckets model. Management decides the strategy for the firm, determines where to spend the firm's resources, and then allocates the appropriate amount of funds into buckets. Projects are then prioritized within the buckets. In the bottom-up approach, the emphasis is placed on project selection. Strategic criteria are built into the selection process so that the resulting portfolio of projects will be on strategy and strategically important. In the final approach, the top-down and bottom-up methods are combined. This approach begins just like the top-down approach with management determining the strategy and tentative spending targets across different categories. Then, the method moves to bottom-up, where all existing and potential projects are ranked in a single, prioritized list. The breakdown of proposed spending is subsequently computed from this prioritized list of projects and compared to the tentative targets set by management. If gaps exist, management may reprioritize active projects or activate projects that are on hold (Cooper *et al.*, 1998: 83-105).

The Stage-Gate Process.

For any of these three goals (maximizing value, achieving balance, and a strong link to strategy) to be attained, a firm must first have a robust stage-gate process in place. The stage-gate process calls for management to make difficult go/kill decisions on projects at different points (gates) in the development process. The stage-gate system breaks the development process up into a pre-determined discrete set of stages, each of which is preceded by a gate. Gates serve several purposes in the process. First, they are quality control checkpoints where each project is reviewed in detail to ensure high quality execution. Second, gates are go/kill decision points that allow funneling of development projects—only the best projects are allowed to proceed to the next stage. Finally, gates are the points where the game plan and resource commitments for the next stage are determined. One key concept for an effective stage-gate process is that of flexibility. A firm must be able to tailor the process to fit the size and complexity of the project (Cooper *et al.*, 1998: 209-212). Figure 6 shows how one firm used three versions of the stage-gate process. Figure 7 shows another way to represent the stage-gate process. A funnel is used to highlight the fact that the number of projects in the development process decreases from one phase to the next. Different portfolio tools and activities are also shown on the funnel.

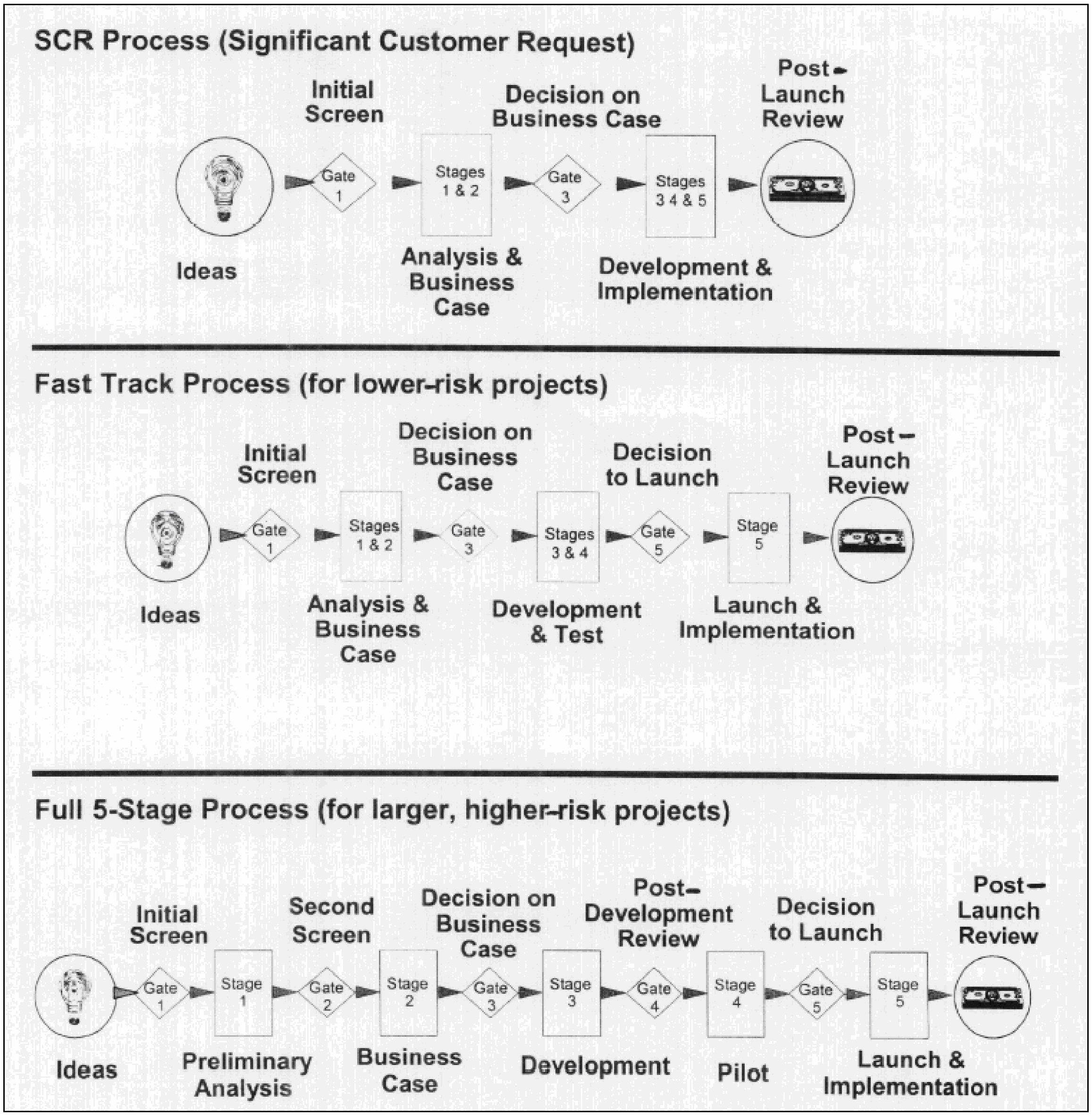

Figure 6 – Tailored Stage-Gate Process (Cooper et al., 2002:45)

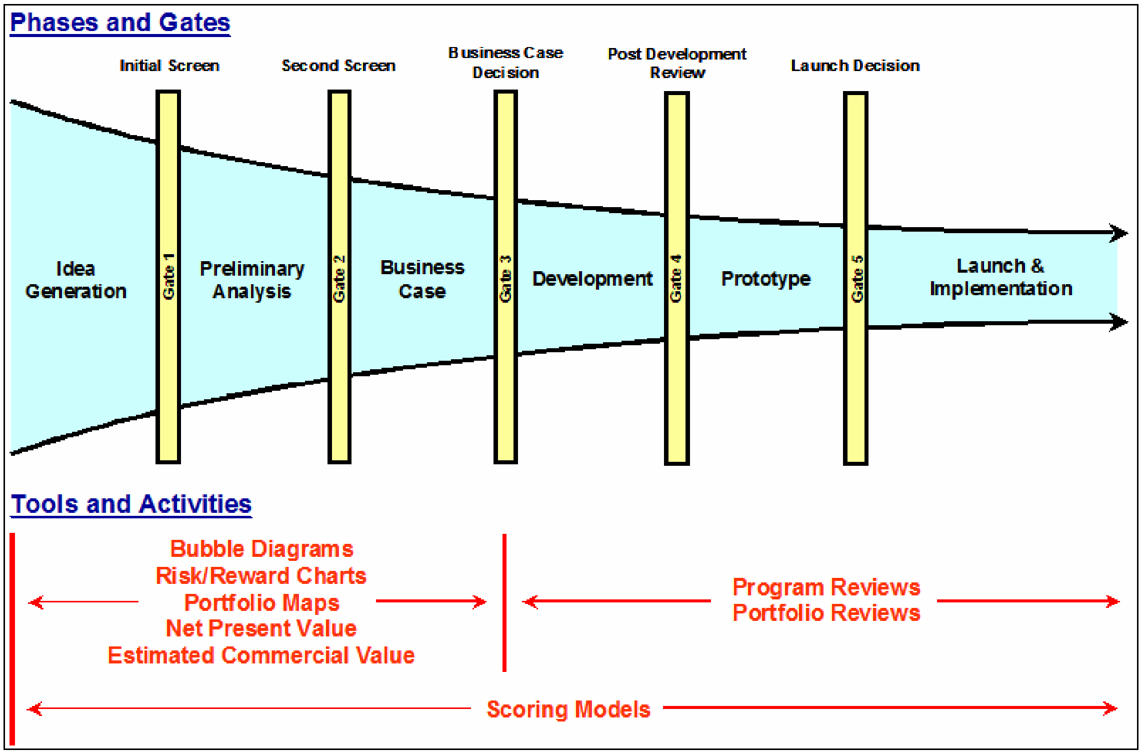

Figure 7 – The Development Funnel (Cooper et al., 1998; Wheelwright and Clark, 1992)

Once a firm has a stage-gate process in place, it must integrate its portfolio management tools into that process. Cooper *et al.* (2000) describe two different approaches to integration. In the first approach, the gates dominate the process. Emphasis is placed on sharpening the criteria used to allow projects to proceed through the gates. As long as good project decisions are made at the gates, the portfolio will take care of itself. In the second approach, a portfolio review dominates the process. One of the gates is replaced with a portfolio review where all projects are rated against one another. Go/kill decisions are made to ensure the portfolio remains balanced and tied to the firm's strategy. Here, the gates are merely used as checkpoints for projects to ensure they are on schedule and remain financially sound (Cooper *et al.*, 2000). The first approach has a project-level focus, while the second approach has a portfolio-level focus.

Cooper *et al.* (2000) continued their research and discovered a heightened interest in portfolio management in both the technical community and the CEO's office. Their survey of Industrial Research Institute member companies found that companies turned to portfolio management for several reasons: to maximize return on research, development, and technology investments; to maintain competitive advantage; to help allocate limited resources; to link project selection with business strategy; to achieve the right balance of projects; to achieve stronger focus; to improve horizontal and vertical communication within the organization; and to provide more objectivity in project selection.

Cooper *et al.* (2000) also found that many companies were having trouble implementing an effective portfolio management process. They found four main problem areas in the application of portfolio management. First, most firms suffer from project gridlock—too many projects and not enough resources to complete them. This problem stems not only from a lack of resources but also a lack of will on management's part to scale down the number of projects. Second, management does not prioritize projects against one another. Projects are usually rated against objective criteria so they all end up looking good. If projects are force-ranked against one another, then management simply needs to start allocating resources at the top of the list until the resources run out. Those projects that do not receive funding are then put on hold or are cancelled. Third, management makes too many go/kill decisions without solid project information. The up-front homework on projects is not done well and management, in turn, makes difficult investment decisions with poor quality information. Finally, most firms have too many minor projects in their portfolio. A certain amount of resources must be committed to ambitious projects that promise breakthroughs in technology or a change in the basis of competition. In other words, these firms fail to maintain the right balance of projects in their portfolios. Figure 8 shows the effect that all of these problems can have on a firm's performance (Cooper *et al.*, 2000).

Cooper *et al.* (2004) served as subject matter experts for the American Productivity and Quality Center's study on performance and best practices in new product development (NPD). They reported the results in a series of articles, highlighting what differentiated the top performing businesses from the rest. The study focused on all aspects of NPD, including portfolio management. Figure 9 lists some portfolio management best practices identified by Cooper *et al.* (2004) and how the businesses fared in each area. The best practices are listed in decreasing order of impact, with high-value projects having the strongest correlation with NPD performance. The results indicate that, despite an increased emphasis on portfolio management, most firms still have a long way to go in terms of implementing these best practices (Cooper *et al.*, 2004).

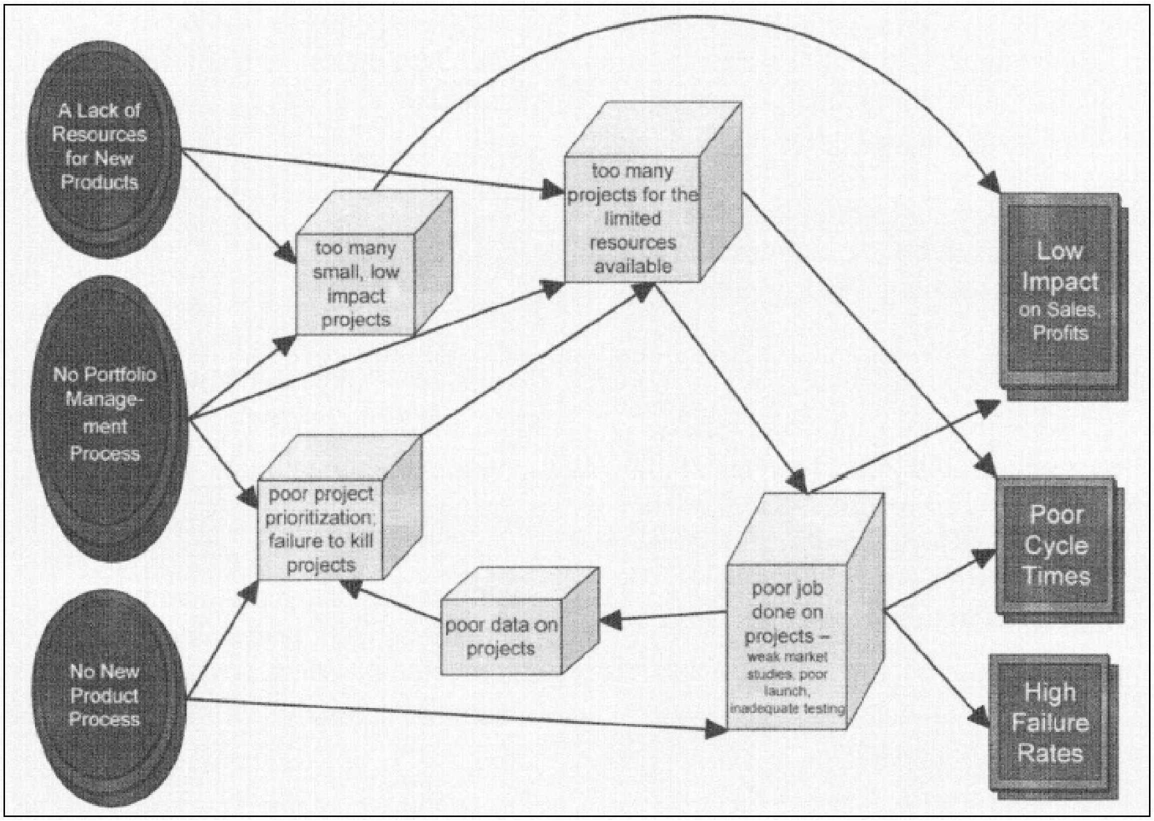

Figure 8 – Effect of poor portfolio management on business performance (Cooper et al., 2000)

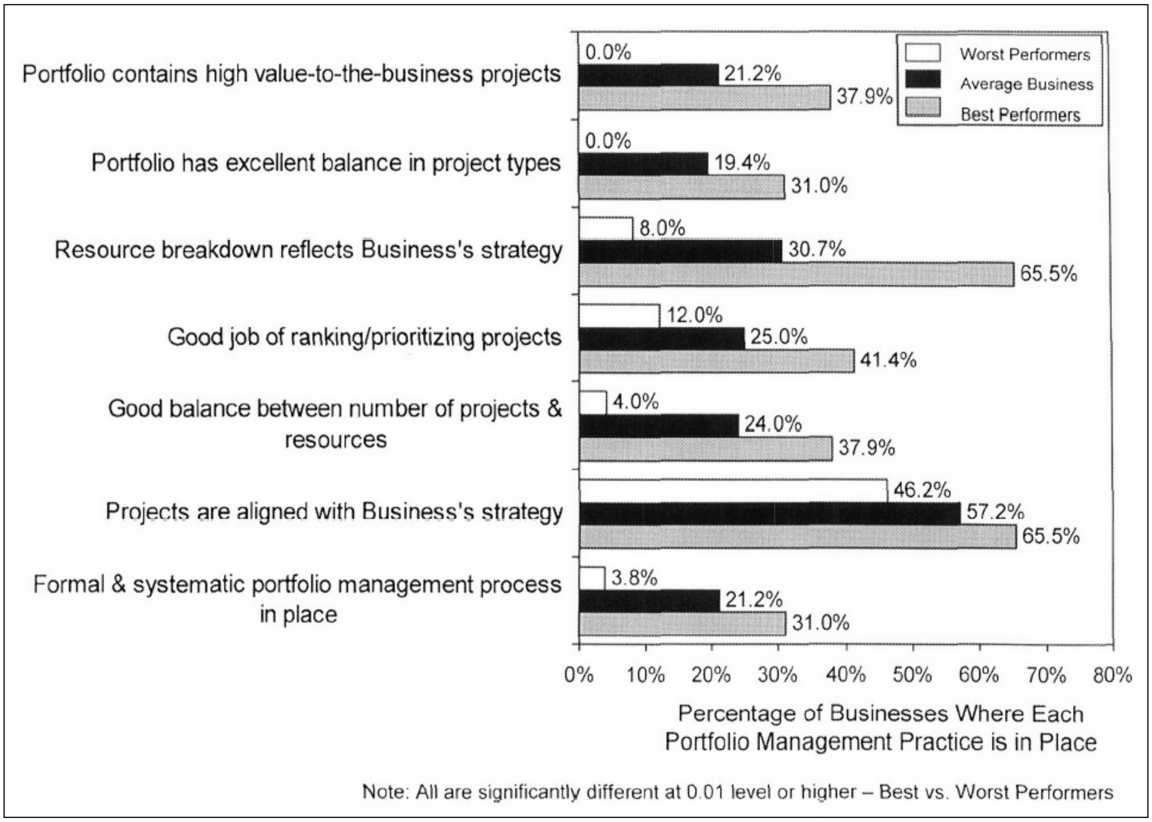

Figure 9 – Impact on performance of portfolio management best practices (Cooper et al., 2004)

Research into Government Portfolio Management Activities

While an extensive amount of research has been completed in commercial new product development and portfolio management, very little has been accomplished in assessing how portfolio management applies to government organizations.

Brandon (2004) suggests that there are two barriers to implementing portfolio management in a government organization. First, he states that many government organizations attempt to apply portfolio management before they even have a standardized project management process. It is extremely difficult to manage a portfolio of projects, when each project uses different tools or no tools at all. Second, Brandon concludes that the public sector's lack of control of which projects to implement hinders effective portfolio management. Most projects are dictated either by law or by political influence. Therefore, portfolio management activities in a government organization are primarily limited to resource allocation (Brandon, 2004).

Greiner *et al.* (2002) conducted an assessment of Air Force development portfolio management practices. Their research consisted of a survey of 25 respondents who were involved in the Air Force Corporate Structure decision-making process. The survey was divided into several sections: strategic alignment, organizational communication, decision support tools, feedback processes, risk and uncertainty identification, weapon system value, and the effects of schedule. Survey results were compared to an ideal model of commercial best practices derived from previous research. The study found a serious disconnect between Air Force portfolio management practices and commercial best practices. Table 1 summarizes the study's findings (Greiner *et al.*, 2002).

Table 1 – Comparison of Air Force and Commercial Best Practices (Greiner et al., 2002)

Success Factors	Commercial Best Practices	Air Force Portfolio Management Practices
Strategic Focus (Cooper et al., 1998b; Danila, 1989; De Maio et al., 1994; Griffin, 1997; Hall & Naudia, 1990; Lester, 1998; Liberatore, 1987; Souder & Mandakovic, 1986; Weber et al., 1990; Wheelwright & Clark, 1992)	Corporate goals, objectives, and strategies must be the basis for portfolio selection.	Perception that no process in place to measure project's alignment with strategic goals.
Senior Management Support (Calantone et al., 1995; Cooper et al., 1998b; Danila, 1989; Gupta et al., 2000; Hall & Naudia, 1990; Lester, 1998; Liberatore, 1987; Poolton & Barclay, 1998; Scott, 2000)	Senior management must be closely involved in R&D project selection decisions.	Senior leadership support perceived as a must for development project survival.
Communication (Cooper et al., 1998b; Danila, 1989; Gupta et al., 2000; Poolton & Barclay, 1998; Souder & Mandakovic, 1986)	Must establish good communication links, both internal and external.	Multiple established paths for flow of strategic policy information.
Portfolio Methods and Use (Cooper et al., 1998b; De Maio et al., 1994; Hall & Naudia, 1990; Weber et al., 1990)	Multiple methods incorporated — used to gain insight into each project.	Little to no decision support processes implemented. Primarily budgetary focus.
Flexibility (Calantone et al., 1995; Cooper et al., 1998b; De Maio et al., 1994; Scott, 2000; Weber et al., (1990); Wheelwright & Clark, 1992)	Able to address resource, benefit, and outcome interactions. Adapt to changes in goals, requirements, and project characteristics.	Perceived lack of assessment as to the impacts that portfolio management decisions have on other weapon systems.
Decision Making at Different Levels (Cooper et al., 1998b; Liberatore, 1987; Wheelwright & Clark, 1992)	Must be able to address the organizational structure and the decision-making process involved at each level.	Not directly assessed. Limited decision-making information available and compressed decision-making time frame.
Risk (Cooper et al., 1998b; Wind & Mahajan, 1988)	Risk and uncertainty must be addressed within the selection process.	Perception that risk and uncertainty not adequately addressed during portfolio management process.
Multi-functional Approach (Calantone et al., 1995; Griffin, 1997; Gupta et al., 2000; Lester, 1998; Scott, 2000)	Effective implementation of multi-functional teams in the portfolio management process.	Multi-function evaluation groups at each level of the AFCS. Perception of stovepiping at lower levels (Panels/IPTs).
Customer Focus (Calantone et al., 1995; Gupta et al., 2000; Lester, 1998; Poolton & Barclay, 1998; Scott, 2000)	Needs and requirements of the User assessed during the project selection process.	User's validated need or requirement key driver in portfolio management process.

Summary

The literature clearly shows that portfolio management is a key component of a successful new product development process. Lack of an effective portfolio management process can lead to increased cycle times. Top performing companies are those that have a robust stage-gate process in place. They use portfolio management tools that enable them to maximize the value of their projects, maintain the right balance of project types, and ensure a strong link between their projects and overall strategy. They focus most of their time and efforts on the front end of the development process, ensuring that they select only the best projects and that they allocate resources properly. Firms that have an effective portfolio management process in place achieve better results on a number of key performance metrics, including faster cycle times. The lack of literature on portfolio management in government new product development indicates that more research is needed in this area.

III. Methodology

Research Goals

The primary goal of this research was to paint a clear picture of the types of portfolio management activities used by the Air Force. The research attempted to answer several questions: 1) Does the Air Force use portfolio management?, 2) If so, how do they use it?, 3) How do the Air Force's activities compare to commercial portfolio management best practices?, and 4) What should the Air Force do to improve the effectiveness of its portfolio management activities? This research is follow-on to McNutt (1998) and is one piece of the larger Cycle Time Reduction Research Program.

The recent realignment of the Air Force Program Executive Officer (PEO) structure provides a window of opportunity for recommendations from this research to be implemented. Figure 10 shows the PEO structure prior to 1 January 2004. In some cases, program managers reported to a PEO, and in other cases, they reported to a product center commander. Figure 11 shows the current PEO structure. Under the old structure, the dual reporting system made commanders' responsibilities unclear. It was very difficult to determine who the portfolio manager was for a particular program. Figure 12 shows the reality of the reporting process for a typical acquisition program under the old structure. The PEO realignment attempted to address this problem. Each product center commander is now dual-hatted as a PEO in charge of a particular portfolio. A window of opportunity exists because product centers are still in the process of changing the way they do business to fit the new system.

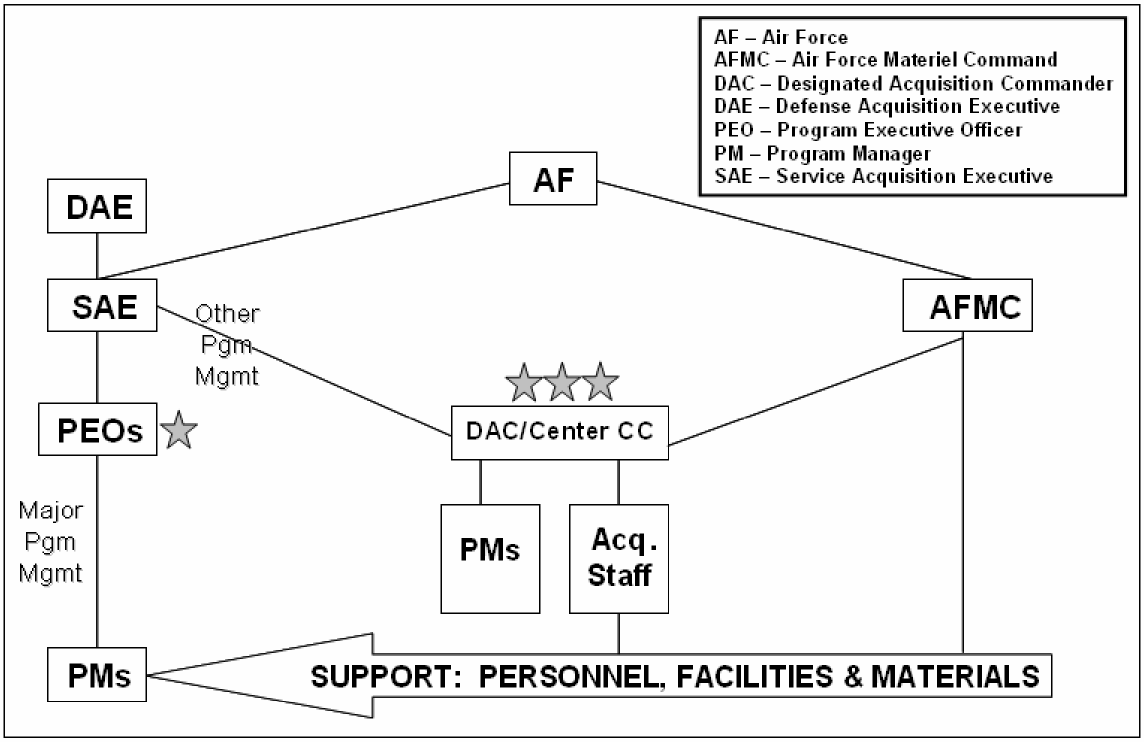

Figure 10 – Air Force PEO structure prior to 1 January 2004 (Looney, 2004)

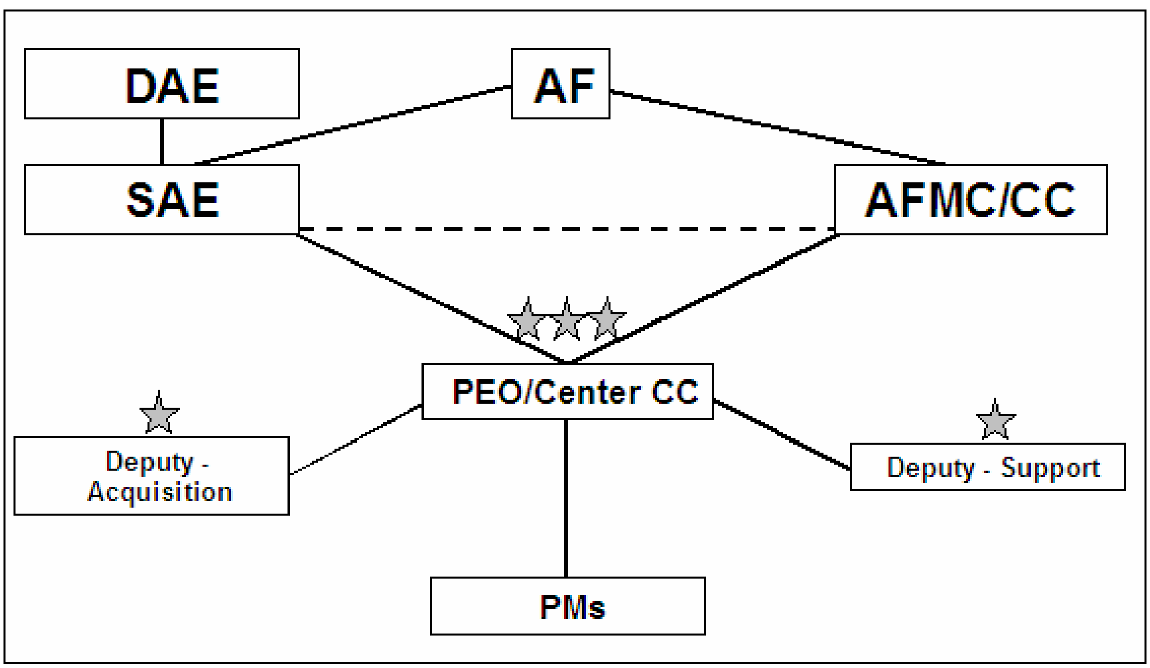

Figure 11 – Current Air Force PEO structure (Looney, 2004)

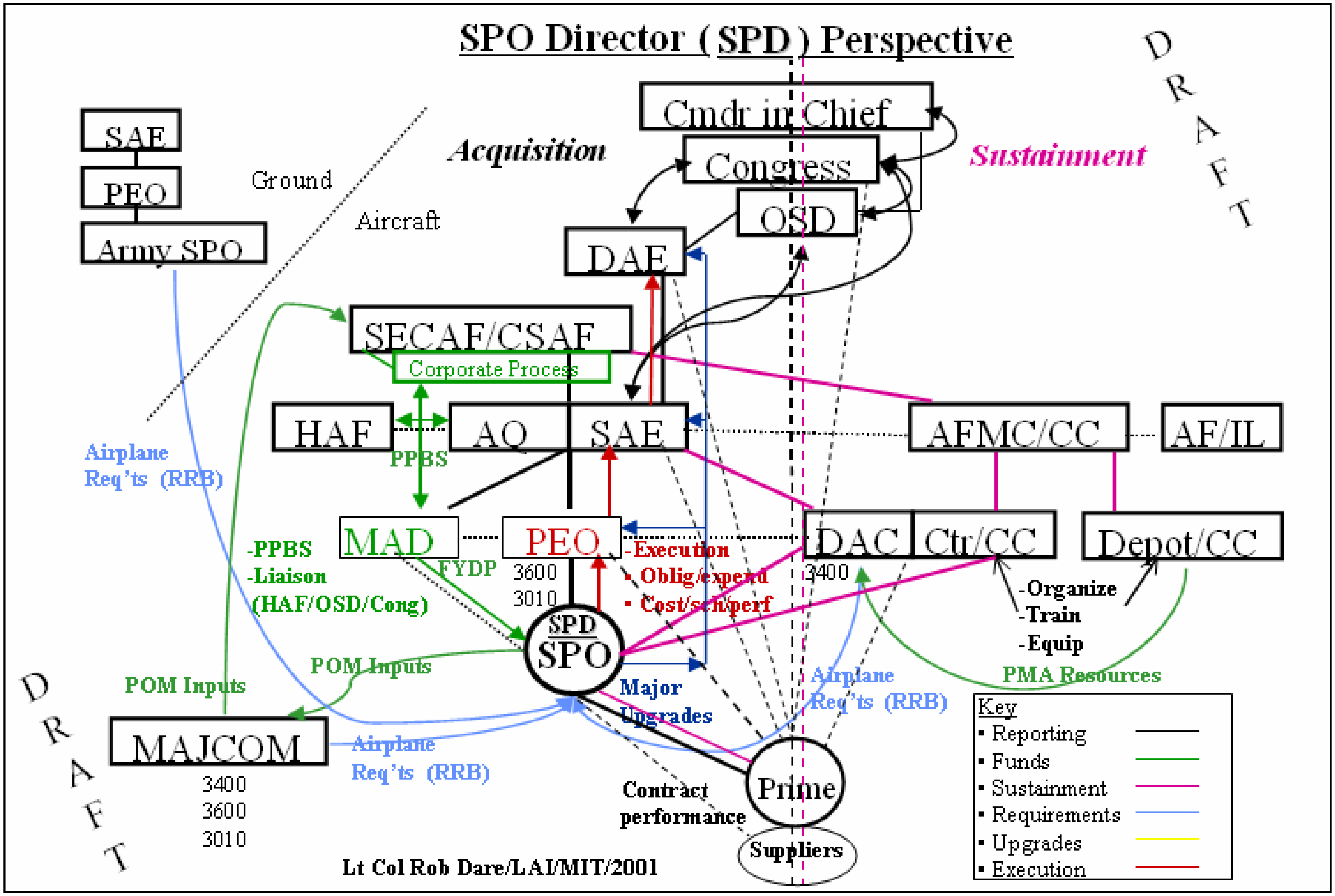

Figure 12 – Reporting process for typical program under old PEO structure (McNutt, 2004)

Research Method

An in-depth, inductive, exploratory investigation of how an Air Force product center applies portfolio management was conducted. Semi-structured interviews were conducted with personnel in leadership and other key positions at different levels throughout the center. From the interviews, three types of data were collected: historical – what they have done in the past; current – what they are doing now; and opinion – what their plans are for the future. Personnel were chosen in positions most likely to use portfolio management or have knowledge of its use. These positions included positions in the Center Commander's Program Execution Group and the commanders and deputy directors of each wing and direct reporting group (DRG). These positions were chosen based on the review of commercial literature and on the researcher's understanding of portfolio management. Other personnel suggested by the interviewees were also interviewed. These personnel included members of the Plans and Programs Division and the Capability Planning Division. Sample interview questions are listed in the Appendix.

Information Source

The Aeronautical Systems Center (ASC) at Wright-Patterson AFB was chosen as the data source. ASC was selected for four reasons: 1) it is the largest product center in the Air Force; 2) it is the most essential to the mission of the Air Force—the majority of major weapon systems acquisition in the Air Force is done at ASC and the ASC Commander is also the PEO in charge of the aircraft portfolio; 3) it was accessible because of its proximity to the researcher; and 4) its personnel were accommodating to the researcher. Personnel were interviewed at the Center, Wing, and Direct Reporting Group (DRG) levels. Figure 13 shows the current ASC organizational chart. Figure 14 shows the personnel who were interviewed and where they are located in the organization.

Research Limitations

As with any research effort, this effort has limitations. It only addresses one Air Force Product Center. It also does not address the corporate level Air Force. The reader should keep these two facts in mind as this effort's findings and recommendations may not directly apply to other Air Force organizations.

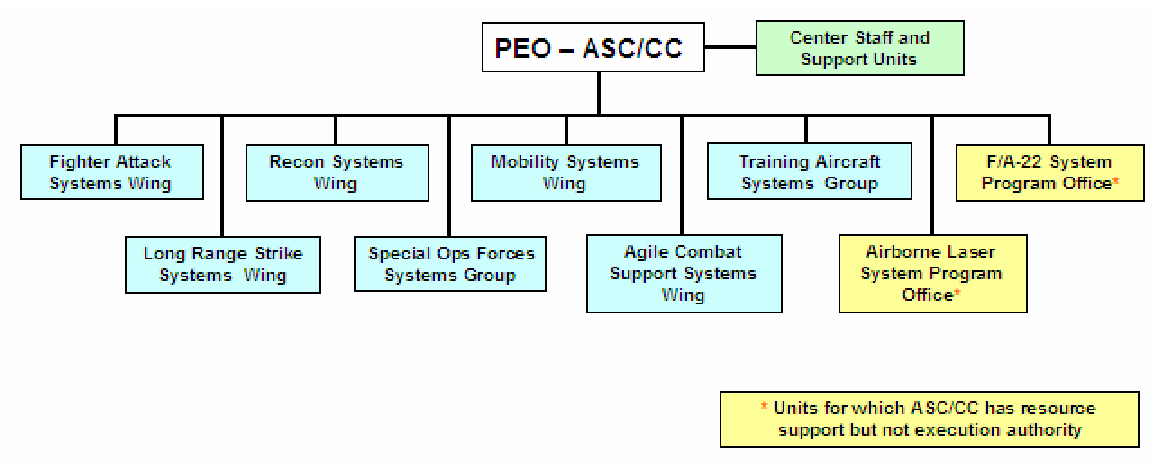

Figure 13 – Current ASC organizational chart

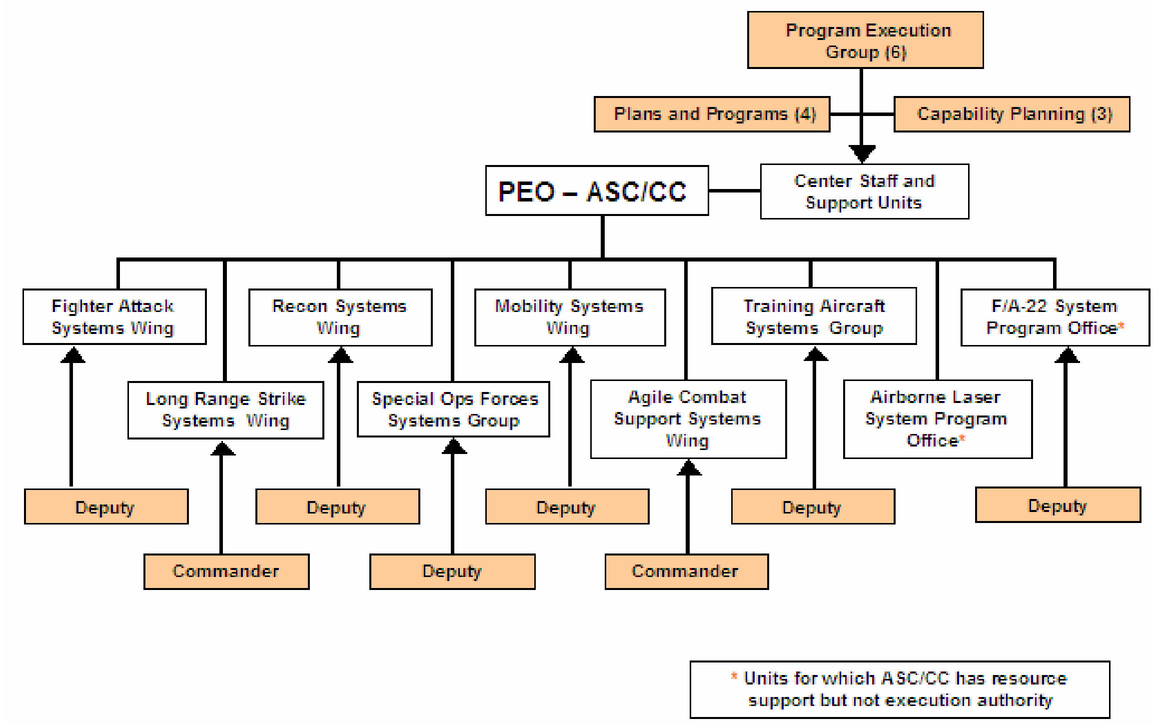

Figure 14 – Personnel interviewed for this research effort

IV. Results

Data was collected from semi-structured interviews with 21 personnel across ASC. This data led to several findings about the practice of portfolio management within ASC. These findings are presented here and the researcher's recommendations are presented in the following chapter.

Finding #1

Most people report to be using portfolio management

The first question asked during each interview was, "Do you use portfolio management?" Out of the 21 people interviewed, 71% (15/21) said they use it. Another 19% (4/21) said they do not use portfolio management because they do not think their job requires it. The last 10% (2/21) said they do not use portfolio management because they feel portfolio management is more appropriate for the major commands (MAJCOMs). These results are summarized in Figure 15.

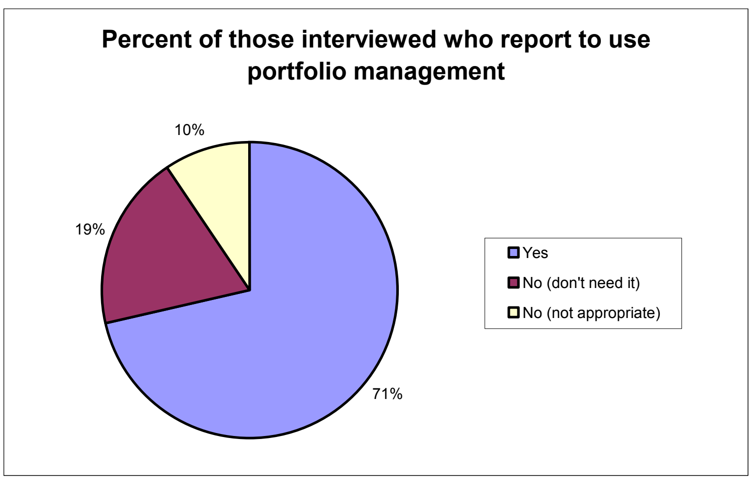

Figure 15 – Percent of personnel reporting to use portfolio management

From the number of comments received from personnel interviewed at all levels, it is also apparent that the ASC Commander has emphasized portfolio management throughout the center. One member of the Commander's Program Execution Group quoted the ASC Commander as saying to his wing commanders, "Take a portfolio perspective; squadrons are responsible for execution." Shortly following the PEO realignment, the ASC Commander established quarterly portfolio reviews with the purpose of looking at the aircraft portfolio from a capabilities perspective instead of a program perspective. Each portfolio review focuses on one or more technologies and how they affect each wing's ability to provide a certain capability. At one portfolio review attended by the researcher, the ASC Commander emphasized the importance of the reviews for looking across capabilities and increasing communication between programs.

Finding #2

At the PEO level, portfolio management activities focus almost entirely on program execution

In order to find out what types of portfolio management activities are being used in ASC, follow-up questions were asked of the 15 people who reported to be using portfolio management. The following is a summary of the activities being conducted:

<u>Portfolio reviews</u> – Held quarterly by the PEO to review entire aircraft portfolio; focus is on how different technologies impact wings' abilities to provide capabilities to the warfighter.

<u>Execution reviews</u> – Held weekly by the PEO to review "hot" program issues identified by wing commanders.

<u>Capability Program Execution Reviews</u> – Semi-annual portfolio review between PEO, Assistant Secretary of the Air Force for Acquisition (SAF/AQ), and MAJCOM.

Program Management Reviews – Quarterly, semi-annual, or annual program specific review held at the wing or DRG level.

Executive Weapon System Reviews – Portfolio review held at the wing or DRG level.

Acquisition Strategy Panels – Review of a specific program's acquisition strategy (or plan of action) by all major program stakeholders.

Financial reviews – Wing or DRG level review of year-to-date status of financial execution.

Requirements and Planning Council (RPC) – Forum between wing and MAJCOM used for prioritization and selection of program initiatives and new requirements.

Program Prioritization Process (PPP) – Wing level process used to prioritize work and make rational resource allocation decisions.

All but one of these activities focus only on the execution of existing programs. Only the RPC gives any consideration to the front end of the development process (i.e., project selection).

Finding #3

There is very little front-end portfolio management work being conducted at the PEO level

During this research effort, no tools were identified at the PEO, wing, or DRG levels that support the front end of the development process. Two of the people interviewed felt that portfolio management consists mainly of project selection activities. The same two people also felt that project selection activities were more appropriate for the MAJCOMs. However, some project selection work is accomplished at the wing level. One wing conducts semi-annual RPCs for each platform. During an RPC, the wing works with the MAJCOM to prioritize and select program initiatives and new requirements. Figure 16 shows how the Air Force acquisition process and ASC's portfolio management activities compare to the commercial development funnel (Figure 7).

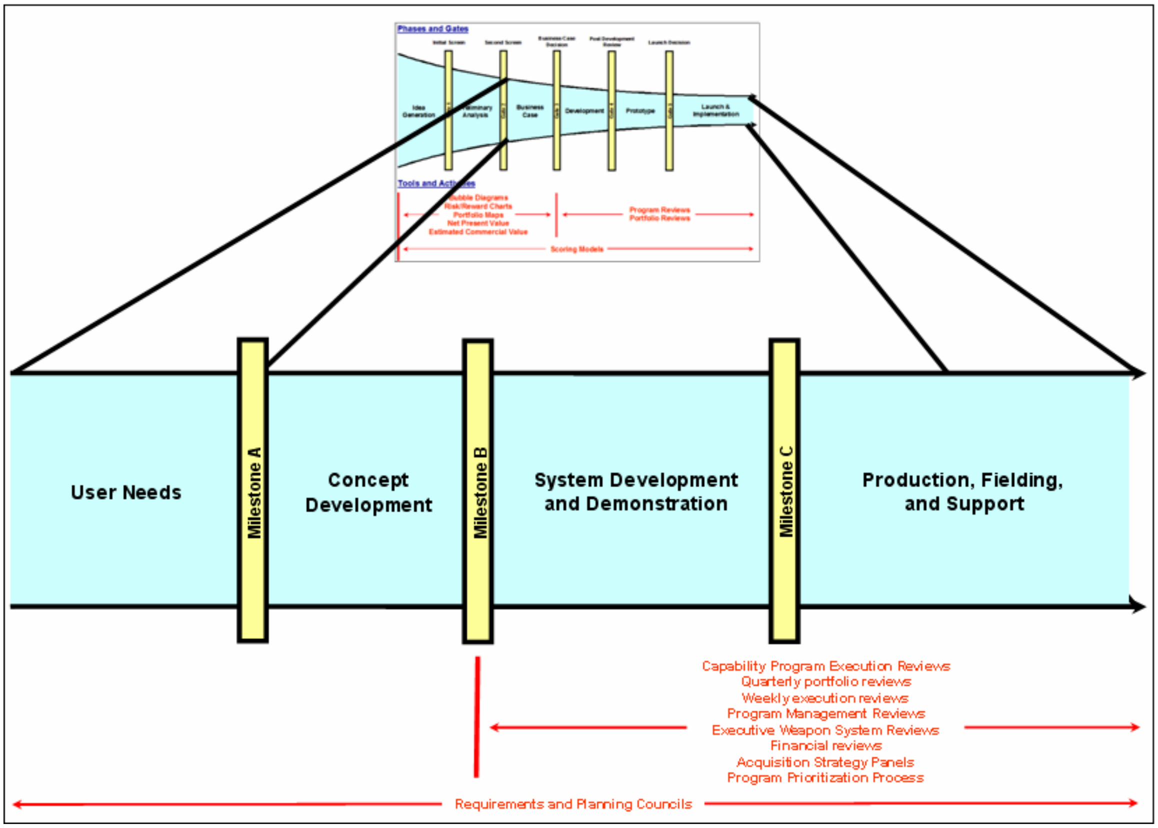

Figure 16 – Air Force acquisition process and ASC portfolio management activities

The Air Force acquisition process is more of a development tunnel than a funnel. This is due to the fact that there are no mechanisms in place to terminate a program. Also, while the majority of activities in the commercial funnel support the front end of the process, the majority of activities in ASC support the back end of the process (program execution). Only one of the center's portfolio management activities supports any front-end work.

Finding #4

There are few effective tools available to support portfolio management

The System Metric and Reporting Tool (SMART) was the only tool found in ASC to support portfolio management. SMART is a common reporting and management tool developed by SAF/AQ and Air Force Materiel Command (AFMC). According to the SMART Concept of Operations (CONOPS),

> SMART is intended to provide program managers a daily management tool with authoritative information and automated reporting to the program execution chain and to provide senior acquisition executives and their staffs reliable insight into program and portfolio health. (ESC, 2004)

All acquisition category (ACAT) I, II, and III programs are listed in SMART. PEOs also have the ability to designate other efforts within their portfolios as programs in SMART. Every program in SMART is assigned to a portfolio, under the authority of a PEO. Through the use of common business rules and metrics, SMART consolidates individual program health and status information into an overall rating for each portfolio (ESC, 2004). Figure 17 shows an example of a portfolio summary screen.

Figure 17 – Portfolio summary screen in SMART

The use of SMART has been mandated by SAF/AQ for all monthly acquisition reporting. SMART is widely used across ASC, but it only supports program execution activities. It is used simply as a reporting tool for existing programs. The researcher was not able to identify any capabilities within SMART that support project selection.

Finding #5

There is no clear consensus in ASC on what defines a *program* and what defines a *project*

Officially, there are 70 programs listed in the aircraft portfolio. Some of those programs are entire platforms (like the B-2). Some platforms have multiple programs in the portfolio (like the B-52). Figure 18 shows the complete listing of programs in the aircraft portfolio.

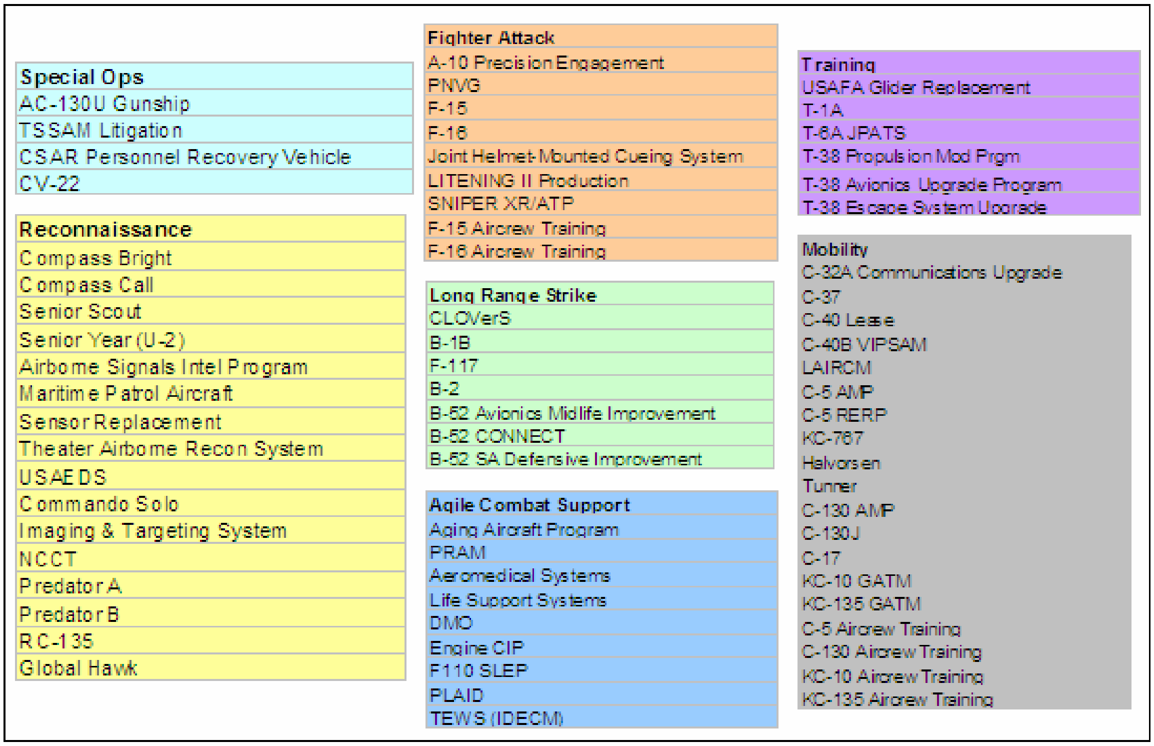

Figure 18 – Official list of programs in the aircraft portfolio (Looney, 2004)

The researcher found no documented rationale for why those 70 programs were chosen. None of the personnel interviewed could state for certain how or why those programs were chosen. Several people thought the programs were most likely based on program size, dollar value, level of oversight, or interest from higher headquarters. Also, several personnel interviewed at the wing level did not agree with the official program list. For example, one wing claims to have well over 100 different programs but less than 10 are on the PEO's list. Another wing claims to have just one program. Other wings claim to have a small number of programs, all of which go to the PEO level. Clearly, there is no consensus across the center as to what level of effort constitutes a program versus a project.

Finding #6

Projects within ASC are not tracked

The PEO has no visibility beyond the 70 programs listed in his portfolio. There are likely to be tens, if not hundreds, of more projects ongoing in the center than programs. Figure 19 shows one example program, the F-15, which has 20 sub-projects within it.

F-15 Projects	
220E Engines	Avionics Control Unit
ALE-58 Countermeasures Dispenser	AESA Radar (MSIP)
APG-63(v)1 Radar	Mode 5 IFF
Digital Video Recorder	Advanced Display Core Processor
Embedded GPS/INS	Air Data Processor
IFF / AAI	ALQ-135 Band 1.5
JHMCS Integration	Programmable Armament Control System
VHF Radios	AESA Radar (E)
OFP Suite 5	TEWS Intermediate Support System TIP
OFP Suite 6	RWR Upgrade

Figure 19 – Current projects within the F-15 program

The PEO has no apparent visibility into these projects. Assuming there are other programs in the portfolio similar to the F-15, then the PEO lacks visibility into the vast majority of work going on in his portfolio. Since there are no clear program or project criteria, there may be multi-million dollar projects ongoing in the center. Since projects are not tracked, the PEO lacks visibility and control over most of his portfolio.

Finding #7

ASC has not taken a leading role with respect to the most essential part of portfolio management

The ability to control and limit the number of development projects in a portfolio is the most essential concept in commercial portfolio management. In ASC, the PEO has little to no control over what he is asked to do or when is he asked to do it. If a MAJCOM has a requirement for a system and funding to support it, then the PEO must execute that program. He has almost no ability to control what programs or projects come into his portfolio. Project selection activities have essentially been left to the MAJCOMs and to the corporate Air Force. The PEO lacks visibility at the project level within the center and has few control mechanisms to manage new projects within existing programs. The PEO is unable to accomplish proper resource allocation. The PEO is limited to minor reprogramming actions and shifts within programs. The PEO also does not appear to have the authority or ability to terminate programs, which is a key concept in commercial portfolio management. The PEO is primarily charged with overseeing program execution and allowing programs to pass to the next phase of the acquisition process.

V. Recommendations

The research findings lead to several recommendations that will serve as a first step toward improving the effectiveness of portfolio management activities within ASC. The recommendations are based on commercial portfolio management best practices, as described in the literature review.

Recommendation #1

Focus more on the front end of the development process

The front end of the commercial development funnel is the most important component. Cooper and Kleinschmidt (1988) found that successful projects spent twice as much money and twice as many man-days on front-end work than projects that failed. Wirthlin (2000) found a strong link between budget instability and poor front-end work. As shown by Figure 20, approximately 80% of a system's total life cycle costs are determined up front and early in the acquisition process.

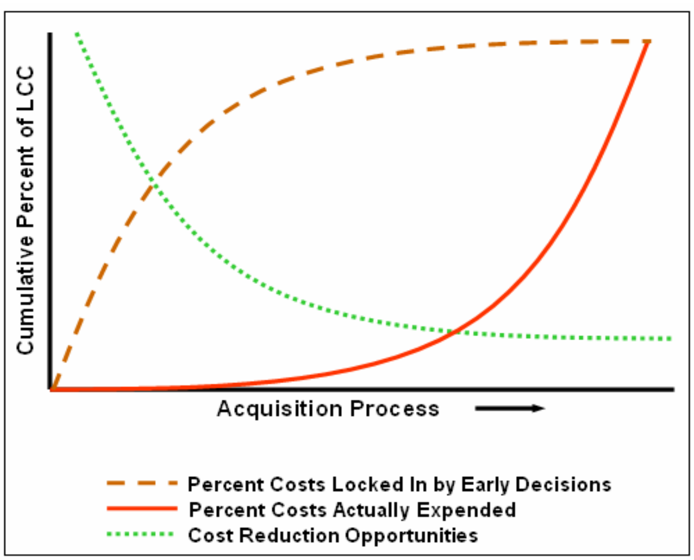

Figure 20 – Distribution of costs over typical program lifecycle (Butler, 2004)

Also, if the Air Force expects a PEO to manage a portfolio, then that PEO must have control over what comes into his portfolio. The new 3-star PEOs, resulting from the recent PEO realignment, should have more control and influence over the project selection process than their predecessors. A key focus of successful corporate CEOs is where their business is going (strategic direction) and how it is going to get there (project selection strategies). This should also be the focus of Air Force PEOs. To help establish this focus, the Requirements and Planning Council concept should be adopted across ASC to foster communication between the wings and the MAJCOMs and provide ASC input into the selection of new projects.

Recommendation #2

PEO must establish and document clear criteria that define a program

Without these criteria, existing programs cannot be effectively prioritized. Effective program prioritization is necessary for proper resource allocation. Most personnel interviewed stated that they had been tasked at one time or another to prioritize their programs for the PEO. Almost all of them said that this was impossible for them to do. There are no criteria or tools in place to prioritize programs with widely varying levels of effort (i.e., the B-2 compared to a B-52 avionics upgrade). Along with clear program criteria, there must be clear project criteria to distinguish between the two.

Recommendation #3

Establish control/insight/visibility into the start of projects at the center, wing, or DRG level

With the majority of work being done at the project level, the PEO must have visibility at the project level in order to effectively manage his portfolio. There must be a data collection method at the project level to provide the appropriate level of insight and visibility. An annual project level data call is one possible way to accomplish this. Along with the data call, the PEO must establish clear criteria that define a project and the requirements for initiating a project.

Recommendation #4

Develop a way to quantify the value of military capability

Maximizing value in terms of a particular business objective is one of the three main goals of commercial portfolio management. Value is fairly easy to measure in the commercial world. It is most often measured with dollars. Therefore, the goal of a firm's portfolio management process might be to maximize profit. In the DoD, value is much more difficult to measure. To a warfighter, military capability is valuable. Currently, there is no method in place to quantitatively measure the capability provided by a particular military system. In order to effectively prioritize programs and to assist with the selection of new programs, the military must establish a way of quantifying the value of military capability.

Cost of Delay Analysis (CoDA) is one tool identified by the researcher that may support this process. CoDA was first developed in the commercial world in 1983 by Don Reinersten. It was adapted for use on military projects in 1998 by SAF/AQ, with the assistance of Mr. Reinersten. CoDA is a tool that quantifies the value of cycle time on specific projects and creates tactical decision rules to assist with making trade-offs between system cost, schedule, and performance. For military projects, CoDA assigns a dollar amount to the value of a system by subtracting the cost of the system from the estimated benefits of the system. Benefits are typically dollarized by multiplying the costs of existing systems by an improvement ratio that accounts for the additional capability of the new system (Butler, 2004).

Recommendation #5

Further investigate the benefits of the capability manager concept

The capability manager (CM) concept is currently being tested at ASC. A CM is a single person responsible for delivering an entire capability to the warfighter. Figure 21 shows some of the top level responsibilities of a CM. A CM would manage cross-cutting capabilities, like Airborne Electronic Attack and Data Links, which touch a number of systems and organizations. A CM would provide a single face to the user for a given capability, rather than multiple faces that each provides only a portion of a capability. A CM would have control over funding for the entire capability so that he or she could make effective and appropriate resource allocation decisions.

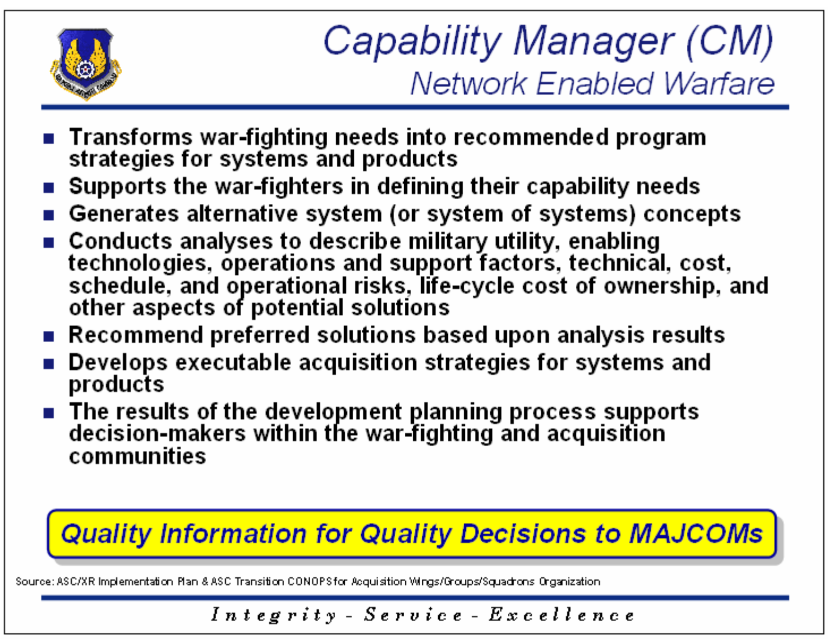

Figure 21 – Capability manager responsibilities (Urschel, 2004)

As the Air Force moves to a capabilities-based acquisition system, a CM may serve as a more appropriate portfolio manager than the current PEOs. According to many of the personnel interviewed, the CM concept has buy-in from the ASC Commander and the Chief of Staff of the Air Force. However, many people within the wings and DRGs in ASC do not understand the benefits of the CM concept. ASC should identify a successful pilot program to demonstrate the benefits of the concept to the workforce.

Conclusion

Portfolio management has been an effective cycle time reduction tool in the commercial world for several decades. Long cycle times have been a problem in the DoD for many years and continue to be a problem today. Previous research identified portfolio management as an essential component of an overall cycle time reduction plan.

This research effort has shown that one product center within the Air Force claims to be using portfolio management. However, data gathered from the interviews suggests that this product center's portfolio management activities focus mainly on program execution at the back end of the development process. In comparison, the activities of successful commercial firms focus mainly on project selection at the front end of the development process. A shift in focus to the front end of the development process, along with other recommendations, will ensure that increasing cycle times do not continue to plague the Air Force acquisition process.

Recommendations for Further Study

To further benefit the Air Force, this research effort should be continued. The use of portfolio management by other Air Force product centers and by the corporate level Air Force should be investigated. The SMART tool should be assessed for its usefulness as a portfolio management tool. Finally, further studies on the implementation of the capability manager (CM) concept should be conducted.

Appendix: Sample Interview Questions

1. Does your organization use portfolio management?
2. How does your organization define an acquisition program?
3. How often do you have program/portfolio reviews?
4. What information is covered at these reviews?
5. Who determines what information is covered?
6. Is there a standard format for displaying program information?
7. Are there any specific tools used to display information (graphs, tables, maps)?
8. Are there different reviews for programs in different acquisition categories?
9. Are reviews used to rank/prioritize projects or are they simply used to provide status updates to senior leaders?
10. Are projects ever terminated at these reviews? If not, is there a process or screen in place to terminate poorly performing projects?
11. Are projects ever prioritized across the portfolio as a whole or just within a given area?
12. How are resources allocated to various projects in your organization?

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14. ABSTRACT
Over the last two decades, reducing product development times in the DoD has been the focus of many committees, commissions, and research efforts. Despite the implementation of numerous recommendations, the DoD still struggles with long acquisition cycle times. This research is part of the Air Force Cycle Time Reduction Research Program (CTRRP), which grew out of the Cycle Time Reduction Action Plan, developed in 1998. This research focuses on the portfolio management (project selection and resource allocation) part of the CTRRP. The purpose of this research effort was to investigate the use of portfolio management within the Air Force. Specifically, this thesis sought to assess how portfolio management is used in Air Force acquisition and to compare the Air Force's practices to commercial best practices. A comprehensive review of commercial portfolio management literature was conducted. To identify Air Force practices, semi-structured interviews were conducted at one Air Force product center. Personnel in positions most likely to use portfolio management, or have knowledge of its use, were interviewed at the center, wing, and direct reporting group levels. The research found that top performing commercial firms with an effective portfolio management process focus primarily on project selection activities at the front end of the development process, while the Air Force focuses primarily on program execution activities at the back end of the process. Recommendations to make portfolio management more effective in the Air Force are discussed.

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