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WHY TRANSITION TO A DIGITAL ENVIRONMENT

The purpose of this chapter is to examine why Program Managers (PMs) should develop and employ integrated digital environments within their acquisition programs. Exploitation of the information age has been the key to many recent successes within the business community, and offers as much potential for the Department of Defense (DoD).

There are two distinct, and somewhat overlapping, reasons for the PM to transition from a paper intensive environment to a digital environment. The first is DoD policy requires movement away from paper-based processes as quickly as possible. As noted in Chapter 2, DoD Regulation 5000.2-R requires all new contracts (starting in FY97) to require on-line access to, or delivery of, their programmatic and technical data in digital form. A more compelling reason—it simply makes good business sense. There is a need for fundamental and radical changes in the DoD acquisition process. Responding to this need, the position of Deputy Under Secretary of Defense (Acquisition Reform) (DUSD(AR)) was created. This office was established "...to be a focal point and catalyst for the development of a coherent practical step-by-step plan to reengineer the acquisition process...."[1] The objectives of reengineering are to achieve substantial cost reductions, decrease cycle time, increase efficiency, and provide higher quality. In short, we need to do our jobs faster, better, smarter, and cheaper. Our research has found that an integrated digital environment (i.e., Acquisition Program's Digital Environment (APDE)) is a necessary precondition to achieving the goals of Acquisition Reform, in general, and reengineering in particular.

Need for Reengineering

The need for reengineering the DoD acquisition process has been well documented. At a time when acquisition budgets have declined by 60 percent in real terms in the last 10 years, DoD can no longer afford a process that results in unique requirements with significantly higher cost and longer design cycles. Design cycles for DoD-related systems are almost twice that of commercial systems.[2] This means that in some areas new systems are verging on technical obsolescence when they are fielded. The added cost of the acquisition process is of equal concern. Overhead, or management and control costs, associated with the DoD acqui-

sition process are about 40 percent of the DoD acquisition budget, as compared to 5 to 15 percent for commercial firms.[3] The cost of the DoD's regulatory maze has been estimated at 15 to 75 billion dollars.[4] Other studies have indicated that DoD contractors incur additional costs on government contracts of about 30 percent over their commercial counterparts for identical items/services.[5]

A key element in DoD's attempt to reengineer the acquisition process is the use of Integrated Product Teams (IPTs) and Integrated Product and Process Development (IPPD) concepts. As DoD 5000.2-R states:

> *The PM shall employ the concept of Integrated Product and Process Development (IPPD) throughout the program design process to the maximum extent practicable. The use of Integrated Product Teams (IPTs) is a key tenet of IPPD.*
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> *The IPPD management process shall integrate all activities from product concept through production and field support, using multidisciplinary teams to simultaneously optimize the product and its manufacturing and supportability to meet cost and performance objectives. It is critical that the processes used to manage, develop, manufacture, verify, test, deploy, operate, support, train people, and eventually dispose of the system be considered during program design.*[6]

Although IPT and IPPD guidance is primarily focused on internal DoD activities and reviews, the need to reengineer the process extends well beyond internal DoD-level activities. The PM must not fail to embrace the entire acquisition team, to include industry stakeholders and acquisition partners, if DoD is to fully realize the benefits of reengineering.

IPPD Successes

This is one area where defense acquisition programs can learn from industry. Many of the recent "success stories" in the media concerning improvement in competitiveness of American firms can be traced to the aggressive use of digital environments and the creation of an IPPD environment. During a recent speech, the Under Secretary of Defense (Acquisition and Technology) (USD(A&T)) highlighted two commercial programs and the benefits that an IPPD environment created:

> *The first is Boeing's use of Computer Aided Three-dimensiona Interactive Applications—CATIA software—for the development of the 777 aircraft. Boeing's management made the decision to change the culture of the company and invest $100 million in a computer aided development capability. The bigger "investment" was in the total corporate commitment to this approach...there was no fall back approach in place.*
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> *As a result, there is no physical mock up for an aircraft with 85,000 components and over four million parts. The goal is to achieve the same number of manufacturing hours as the 767—for an aircraft with 57 percent greater empty weight—by reducing the number of design changes to at least one-half of that experienced on the 767. To date, Boeing is reporting a 93 percent reduction in the number of design changes.*
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> *My second example illustrates the point that computer assisted integrated product development is not just for large corporations. In this case, Kohler's Engine Division is a producer of small 5 to 25 horsepower 4-cycle lawn mower engines.*

This company is a small player in a big field. The business strategy is fairly straight-forward—sell engines by offering superior performance and high reliability at a lower cost.

Kohler has been using state-of-the-art CAD/CAM [computer-aided design/computer-aided manufacturing] tools to introduce new designs that are radically different from earlier versions—quite a departure from the evolutionary change approach traditionally practiced by this industry. At Kohler, manufacturing cycle times have been cut by two years. Physical prototypes are no longer necessary. Kohler offers a 2-year warranty—the longest in the industry.

As a result, John Deere selected Kohler for its line of lawn mowers instead of the previous supplier—Kawasaki. Kohler's market share has continued to grow significantly over the past several years. My point is that the technologies for integrated product development, virtual prototypes, and modeling and simulation are widespread and available to smaller corporations. If correctly managed, transition costs should not present an insurmountable entry barrier to smaller, moderate sized corporations.

Another conclusion I draw from these two examples is that world-class producers across both ends of the manufacturing spectrum—from 777 aircraft to 25 horsepower lawn mower engines—are being driven by market forces and are finding a way to reduce the cost of fielding increasingly complex systems.[7]

Market forces drove the search for better, smarter ways to do business. These forces have been responsible for dramatic shifts in the way many commercial firms conduct business and are organized. Open competition and a market economy have fundamentally altered the structure of many American businesses. These businesses were faced with the alternatives of radical change or extinction. Since DoD acquisition programs are not directly faced with either competition or market forces, they tend to lag behind commercial activities in the way business is conducted.

In these examples, both companies implemented the commercial equivalent of an APDE to exploit an IPPD environment. In the Kohler example it was relatively limited and centered on internal engineering and production activities. The CAD/CAM system allowed cross functional integration of engineering and manufacturing and the development of an internal IPPD. The level of integration represented by the Boeing 777 effort was extremely high, linking design, manufacturing, and support activities of numerous companies located around the world. This was a global scale IPPD. Both companies generated an important competitive advantage and realized significant improvements in efficiency and quality, and reductions in both cycle time and cost. This was made possible through the use of an APDE. The traditional use of prototypes to ensure form, fit, and producability were obviated by the APDE's ability to enable a truly concurrent engineering and development process. This radical improvement in program performance is a clear example of why PMs should embrace the APDE.

Change in Organizational Structures Needed

The basic organizational structure used by most businesses and the DoD have historically been hierarchical in nature. Their design, manage-

ment techniques, and operational philosophies trace their origins to Adam Smith and the publishing of *Wealth of Nations* in 1776. *Wealth of Nations* became a cornerstone for management practices in the industrial age. In his book, *Rebirth of the Corporation*, D. Quinn Mills points out that one of the origins of the hierarchical organization was a lack of communications technology that led to the need for a limited span of control. He also points out that "a hierarchy is handicapped in exploiting new communications and computer technology because its vertical reporting and functional divisions inhibit networking."[8] The industrial age bureaucracy was based on the premise that a limited span of control was required and the limited span of control was necessitated by a limited communications ability.

Currently, DoD is attempting to use management techniques and philosophies from the industrial age in the information age. Industrial age bureaucracies are based on:

- Specialization, which led to economies of scale, as the most efficient way to produce products;
- Rigid lines of authority and reporting;
- Creation of rules or practices to address every contingency, if possible;
- Extensive paperwork to document that appropriate actions occurred;
- Detailed design and "how-to" specifications as the only way to ensure an acceptable product, and to ensure a "level" playing field for competition;
- In-process inspections, audits, and reviews as the most effective means to assure compliance with the system; and
- Programming people to conform to established procedures ensured that systems would be predictable, workable, and safe.[9]

In *Reengineering the Corporation: A Manifesto for Business Revolution*[10] Michael Hammer and James Champy make the point that we must transition from the industrial age practice of breaking down work into the simplest tasks, to the information age where tasks are built into processes. The industrial age task orientation leads to exceptionally fragmented and complex organizations with multiple functional *stove pipes.* The *stove pipes* lead to numerous impediments of information flow and result in an error prone organization where significant delays occur and no one is accountable. The solution to this problem is reengineering.

Reengineering and the APDE

The creation of an integrated digital environment is fundamental to the successful transition from the industrial age to the information age. One of the key benefits in a digital environment is the ability to communicate horizontally as well as vertically. This transformation in how communication flows is at the heart of the information age. By dismantling the *stove pipes*, organizations begin to move into a new environment that allows significant improvements in all aspects of the acquisition process. In order to meet the needs of the warfighter, the DoD acquisition process must move forward into the information age: leaving behind the fragmented stove pipe organizations of the industrial age.

Hammer and Champy offer several examples of radical improvement in performance through reengineering. In all cases an integrated digital environment was a necessary precondition for success; "In reengineering, information technology acts as an *essential enabler*."[11] Two

of the many examples cited by Hammer and Champy are Kodak—who reengineered its product development process, and Ford Motor Company—who reengineered its accounts payable department.

Kodak went from an organization based on serial design and development process to one utilizing integrated, parallel processes. Through the use of an integrated product design database Kodak moved into a concurrent engineering setting. Establishing an integrated product design database allowed immediate insight into the overall effort and ensured that potential problems were detected and remedied early and not during production or final design review. By linking various engineering functions and manufacturing into a common database this effort reduced the concept-to-production cycle time from 70 weeks to 38 weeks (almost 50 percent). An additional benefit was the ability to get the manufacturing and tooling engineers involved earlier which led to a reduction in tooling and manufacturing costs of 25 percent.

Ford Motor company was able to reengineer its entire procurement process using a process oriented digital environment to replace a paper-based system. The net result of this effort was a reduction in the accounts payable department from 500 to 125 personnel. Ford used the power of an integrated environment to achieve a radical reduction in manpower not by automating the existing payment system, but by reengineering the entire procurement process. Instead of a system where accounts due were paid only after receiving documentation, reconciling purchase orders, and processing final invoices; Ford developed a system that did away with invoices entirely. In the new system, when a purchase order is issued the order is entered into an on-line database that is used to match goods received at the receiving dock with goods ordered. If the items received match the database, the system automatically generates payment. If they do not match, they are returned to the vendor. By establishing an integrated digital environment linking purchasing and receiving, Ford is able to drastically reduce the role of the accounts payable department. Ford required digital technology to enable this radical improvement in the procurement process.

A key aspect of the examples used thus far is not the use of technology in and of itself, but rather the use of technology to move from the hierarchical, industrial age organization to a process-oriented information age organization. That is the key to reengineering—leaving behind the vertical stove pipes of the past. Even without reengineering the PM can take advantage of the digital environment to move from serial to parallel processing. An APDE can be established within the existing organizational structure. However, radical improvements in efficiencies will only occur if development of an APDE is accompanied by organizational changes that take advantage of its inherent capabilities. Establishing an APDE with no changes to the organizational structure may actually be counter-productive. One major acquisition program that implemented a Contractor Integrated Technical Information System (CITIS) environment is a case in point. Although all drawings and contract data requirements lists (CDRLs) were available on-line, the government still required paper delivery of originals and maintained a paper-based configuration management system in parallel to the contractors integrated digital design database. In addition, all documents that required government approval had to be submitted in paper for routing through the government approval chain (serial processing in a paper-based organizational structure). Clearly, the organizational structure was not modified to take advantage of the ADPE's inherent capabilities.

Another example involves the circuit breaker division of General Electric (GE).[12] The division had set a goal of 3-days from receipt of order to delivery instead of the normal 3-weeks. GE used what amounted to a two-stage approach. In stage one, GE developed an automated system that allowed a salesperson to input an order into a computer system, the order then was transferred to the production plant where it was automatically programmed into production. This use of technology saved an entire week (leaving GE 11 days short of its goal). As part of this effort GE consolidated six production facilities into one, and developed an automated design system to replace a custom design process. Changing the design process alone reduced the number of parts from 28,000 to 1,200—a factor of almost 24.

Removing the remaining 11 days required what is classically known as reengineering. In the second stage, GE exploited its digital environment, reengineering the production process, reducing worker to management organizational layers from three to one, and removing all line supervisors and quality inspectors. The 129 floor workers were divided into teams of 15 to 20 members. These teams assumed many of the traditional roles of middle management such as quality control, vacation scheduling, and work rule decisions. The net improvements at GE were dramatic. Not only did they reduce the cycle time from 3 weeks to 3 days; but productivity increased 20 percent, while manufacturing costs decreased 30 percent.

The APDE and DoD

In DoD acquisition programs, roughly 80 percent of the total life cycle costs of weapon systems are fixed in the first 20 percent of the program. Figure 3-1 shows this relationship. The

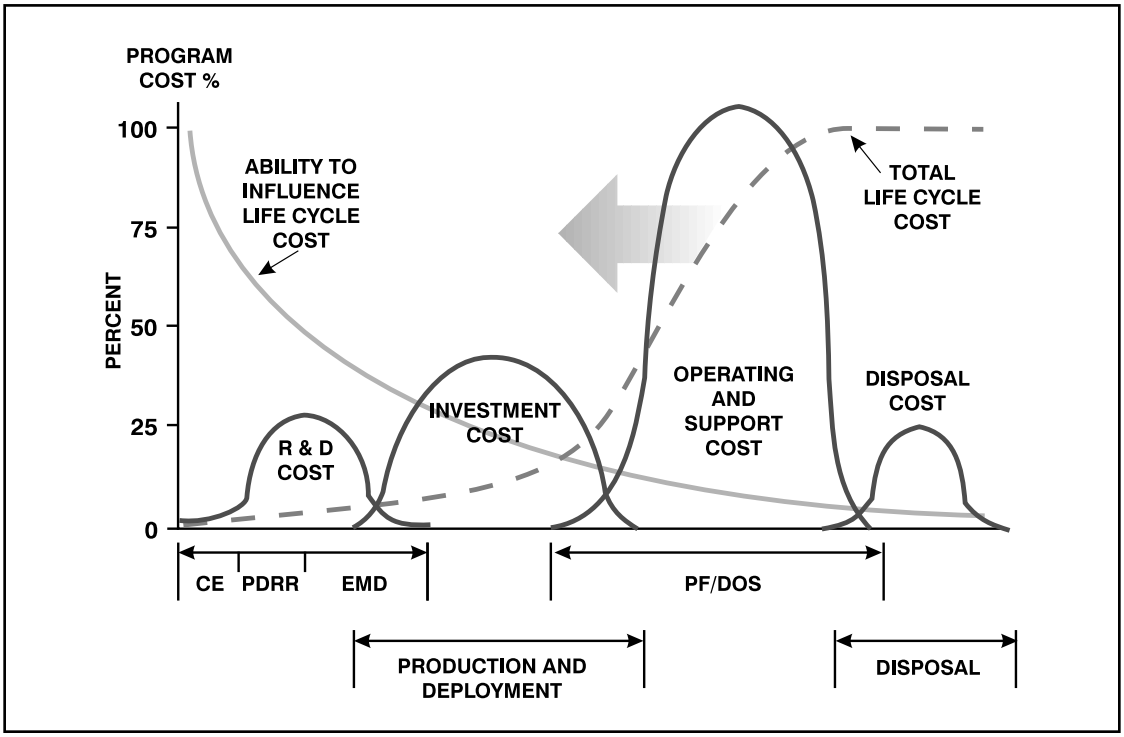

Figure 3-1. Life Cycle Cost vs Program Phase

PM should focus on reducing total life cycle costs early in the development process. The APDE directly enables this to occur by allowing the PM to create an IPPD environment to ensure that all stakeholders are involved, identify data and process requirements up front, and thereby plan for reducing long-term costs.

More importantly, an APDE is central to improvements in the following areas:

- Cost Savings;
- Reduction in cycle time;
- Better life cycle support;
- Increased process and product coordination;
- Better data quality;
- Greater data access; and
- More timely decisions and improved decision making.

In industry, an integrated digital environment provides a key for improving competitive advantage and increasing profits. For the DoD acquisition manager, an APDE is essential if PMOs are to achieve the goals and objectives of acquisition reform. The transition to a digital environment is not an option. The key question becomes what level of an integrated APDE is appropriate for each program. Although there is a lack of DoD acquisition program examples to use in deciding what is appropriate for each program, the results from industry are compelling. It is clear from both commercial experience and Defense policy that the Defense Acquisition Community must begin the transition if they are to indeed operate faster, better, smarter, and cheaper.

Summary

This chapter presented a wide array of industry examples ranging from commercial aircraft to circuit breakers to lawn mower engines. In each case, dramatic improvements in efficiency and program performance were a direct result of developing and exploiting an integrated digital environment. DoD acquisition programs must attempt to make similar transitions if they hope to mirror the process improvement and reengineering successes of industry. For the PM this translates into the need to develop an APDE. Capitalizing on the information age is of fundamental importance if the acquisition community is to provide the warfighters with quality systems and desired quantities in light of reduced or limited funding.

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