CONTRACTING FOR INTEGRATED PRODUCT DEVELOPMENT TEAMS

by

William Kitterman
Naval Air Warfare Center Training Systems Division

and

Robert Coach
Lockheed Martin Information Systems

ABSTRACT

In the spring of 1993, the U.S. Army Simulation, Training, and Instrumentation Command initiated the Advanced Gunnery Training System program for a family of precision gunnery trainers for the M1A2 Abrams Tank, the M2A3 Bradley Fighting Vehicle, and the Armored Gun System. The solicitation and source selection phase of this program was reported on at the 16th Interservice/Industry Training Systems and Education Conference. The solicitation/contract is a sophisticated Fixed Price Incentive (Successive Targets) multiple lot contract type, with range priced flexible options. The development cycle required the use of the Systems Approach to Training, concurrent engineering, and Total Quality Management in a Government/Contractor Integrated Product Development Team (IPDT) environment. The use of the IPDT for all phases of contract performance has necessitated heightened interdisciplinary communication, and the extension of responsibility for all aspects of contract performance to the IPDTs. As the traditional adversarial (divergent interest) legal environment cannot change, the use of the IPDT also requires an unusual degree of trust, understanding and confidence on the part of the program management and contracting authorities, both within the organization, and between organizations. Success has been dependent on the use of effective team training, electronic communications, leadership, and goodwill.

ABOUT THE AUTHORS

WILLIAM KITTERMAN

William Kitterman is a Contracting Officer with the Naval Air Warfare Center. He was part of the (STRICOM/NAWCTSD) acquisition team that developed the acquisition strategy for the Advanced Gunnery Training System, and has continued as the assigned Contracting Officer for the contract. He has 30 years experience in defense industry and DoD. He hold an MBA in Procurement and Contracting from George Washington University. He holds the U.S. Army Commander's Award for Public Service.

ROBERT COACH

Robert Coach has, during his 20 years in the defense industry, led system engineering efforts on multiple space, missile and training programs. These programs involved requirements analysis, preliminary and detailed design, trade studies and management of integrated product teams. In 1994, Mr. Coach joined Lockheed Martin Information Systems, Orlando Florida, as Project Engineer for the U.S. army's Advanced Gunnery Trainer System. In this position, he was responsible for implementation and management of the AGTS IPD Teams and provided technical leadership for this development program.

Prior to this assignment, Mr. Coach was a Senior Member of the Professional Staff for the Martin Marietta National Test Bed program, Falcon Air Force Base, Colorado from 1988 to 1994. His responsibilities included transition of the engineering process from conventional to concurrent engineering/integrated product development. Mr. Coach was the team lead that integrated the contractor team and government team engineering processes. He was also responsible for the development and documentation of system performance and support requirements and the operational analysis.

CONTRACTING FOR INTEGRATED PRODUCT DEVELOPMENT TEAMS

by

William Kitterman
Naval Air Warfare Center Training Systems Division

and

Robert Coach
Lockheed Martin Information Systems

The solicitation and source selection phases of the Advanced Gunnery Training System program were presented at the 16th I/ITSEC. The objective here is to present the results during program/contract execution; the successes, the problems, the lessons learned, and some unanswered questions. As will be seen the problems and questions represent risks.

BACKGROUND

a. Description of the Program

The AGTS program provides training systems to support individual, crew, section, and platoon gunnery training for Army personnel who operate the M1A2 Abrams tank and the M2/M3A3 Bradley vehicles. Two other variants will be delivered to Foreign Military Sales customers. The program also provides training for instructor-operator personnel, and scenario generation personnel. The vehicles addressed by the AGTS are at various levels of maturity and are funded by different Program Executive Offices, and foreign governments. Training will be required at a wide variety of sites and settings, including formal courses at institutional settings, individual battalion and squadron level units, formal and informal training centers. The training audiences are many: unit personnel and students in various enlisted and officer training courses.

b. Objectives of the Program Approach; Philosophy of the Acquisition

The various vehicle systems requirements for a gunnery training system led the procuring activity (STRICOM/NAWCTSD) to consider a number of innovations that were, in combination, in 1993 considered an untested experiment: Systems Approach to Training; Concurrent Engineering; Integrated Product Development Teams; and the sophisticated Fixed Price Incentive (Successive Targets) contract type, with flexible range priced production options. No single element of this combination was new. The innovations were the combination of these elements and the use of an Integrated Product Team approach to the entire program, embodied in a single contract. The selection of the AGTS contract type arose from a desire to synthesize the ideas above into a new way of doing business. The train of thought went something like this:

* First was the desire to use the systems approach to training as the core concept of contract performance.
* To do this successfully, Concurrent Engineering would be required to successfully implement the concept.
* For Concurrent Engineering to work, the contractor had to be pursuing his solution that he believed in. The Government had to cease dictating solutions and approaches.

* The contract had to support and satisfy multiple users with diverse needs

over a lengthy period of time. Access to technology insertions and business flexibility was needed.

All the requirements had to be achieved under competitive conditions, leading to a "program friendly" production contract that was an attractive business arrangement for industry. This need for flexibility and equity led to the combination of range pricing with the little used Fixed-Price-Incentive (Successive Targets) contract type. The use of other than Firm-Fixed-Price together with the desire that the contractor be executing his concept, led to the "best value" procurement method.

c. Innovations

i. Systems Approach to Training: For the Army, the SAT is defined primarily in TRADOC Regulation 350-7. The model presented has five interrelated, nonlinear phases: analysis, design, development, implementation, and evaluation.

The SAT links well to the Integrated Product Development for several reasons: It integrates systems engineering approaches into training system development, and provides the framework within which MIL-STD-1379D is applied. Its iterative nature provides for continuous reexamination and improvement of the training system development. Finally, the regulation itself is based on baseline processes and metrics: for each phase, key processes and minimum essential requirements (MERS) are identified.

ii. Concurrent Engineering: CE emerged as a result of efforts by industry and Government personnel to overcome two weaknesses in traditional systems engineering: the sequential, linear nature of the process; and the proliferation and isolation of specialists. Linton (1991) explains CE in the following terms: "CE involves a product development infrastructure that fosters a unified, collaborative approach that integrates inputs from business, engineering and management specialists across the traditionally segregated phases of product development (p. iv)."

iii. Integrated Product Development Team (s): Integrated Product Development is the current phase in the evolution of the engineering process. IPD focuses on customer's requirements. It commits the CE team to customer satisfaction. It also includes the customer within the team structure. By including the customer as part of the team, the customer participates on a daily basis with the trade-offs made, maximizing the potential for a happy customer when the design is complete. Product Quality is built in, not tested in.

iv. Contracting Approach: The Advanced Gunnery Training System program selected the Fixed Price Incentive (Successive Targets) contract type as a reasonable risk sharing arrangement (80% Government share). The ceiling price was 130% of cost (118.18% of price). The out year production options were priced using a range price matrix that provided the Government the ability to order deliveries other than originally planned without the necessity of repricing the contract. In effect the outyear production options were a "mix and match catalog.

d. Source Selection:

The source selection period proved to take longer than expected (from May 1993 to June 1994) : nearly 13 months. The acquisition team had to learn by doing. None of the initial proposals received were responsive. Lengthy, in depth discussions

had to be held with all offerors. The source selection authorities and the contracts "business clearance" authorities had to be persuaded that the approach was valid and that a sensible best value source selection had been made. In essence, the entire source selection apparatus was high on the learning curve: The acquisition team, the offerors' proposal teams, and the reviewing authorities.

The first lesson learned on Contracting for Integrated Product Development Teams emerged during discussions: The combination of Concurrent Engineering with Integrated Product Development Teams would require an oversight and coordination structure. There would not be one, but many Integrated Product Development Teams.

The discussion that follows will show that concept of what IPD Teams are and how they work evolves with experience. And that is the second lesson: The structure, makeup, processes and mission of the Teams must evolve with time and program needs.

LEGAL IMPLICATIONS OF INTEGRATED PRODUCT DEVELOPMENT

The literature and publications discussing the use of Integrated Product Development Teams, most notably the "Acquisition Reform Acceleration Standdown" in the Department of Defense during May 1996, have concentrated one the use of Integrated Product Development Teams with organizations, particularly with the Department of Defense. These discussions have emphasized that the authority of Programs Managers is unchanged, and that responsibility for all final decisions on requirements and allocation of resources remain unchanged from past practice. It is the delegation of authority and responsibility of functional managers that is emphasized in the extant literature. In point of fact, the Integrated Product Development Team has seen wide use under other names. An outstanding example is the "acquisition team" in use within the Naval Air Warfare Center Training Systems Division and the Army Simulation, Training and Instrumentation Command in their several incarnations over the last three decades. It has been truly written that there is nothing new under the sun. What is new is the emphasis on the use of the Integrated Product Development Team "whenever feasible" throughout the DOD.

a. Contracting and Program Authority; law of agency; delegation of authority:

Such literature as exists discusses the Government/Contractor Integrated Product Development Team in terms of an extra-contractual "partnering agreement" between the Program Manager and the Contractor's management. This approach has had some success, particularly in the context of a single phase or part of contract performance, such as the test phase. It has also encountered failures, some of which have been caused by nonacceptance of the results by the Contracting Officers responsible for contract execution. As with the authority of Program Managers, the authority and responsibility of Contracting Officers has not been changed. Indeed it arguable that it cannot be changed, as someone must have power to obligate the Government and to bind the Government at law. To give part or all of this authority to some other entity is simply to redefine who or what the Contracting Officer is. Binding agency is a key concept in the Government

in it corporate capacity placing itself in the market place. To compromise or eliminate this concept would eliminate government contracting altogether, as the basic concept of a contract is that it is a binding agreement between "equals". As long as there are contracts there will be those with authority to execute them as agents of the United States of America.

The Advanced Gunnery Training System has contracted for management of all phases of the contract to be performed by Government/Contractor Integrated Product Development Teams.

There is very little discussion of this approach in the literature. As of this writing, the only regulatory coverage is the Vision Statement in Section 1-102 of the Federal Acquisition Regulation:

FAR 1-102 Statement of guiding principals ...

> (c) The Acquisition Team consists of all participants in Governmental acquisition including not only representatives of the technical, supply, and procurement communities but also the customers they serve, and the contractors who provide the products and services.
>
> (d) The role of each member of the Acquisition Team is to exercise personal initiative and sound business judgment in providing the best value product or service to meet the customers needs. In exercising initiative, Government members of the Acquisition Team may assume that if a specific practice policy or procedure is in the best interests of the Government and is not addressed in the FAR nor prohibited by law (statute or case law), Executive order or other regulation, that the strategy, practice, policy or procedure is a permissible exercise of authority.

It has been observed that somewhere between the writers of policy in Washington and the personnel in the field who "make it happen" a miracle occurs. So it would seem here. The legal basis of contracts has not been changed. Contracting Officers remain the sole binding agency to make and change contracts on behalf of the Government. The "Changes" clause remains unchanged with its attendant court made doctrines of equitable adjustment and constructive change. There is no prescribed contractual language for Integrated Product Development Teams. Indeed, the various anti-constructive changes provisions (e.g. "Notification of Changes") militate against such arrangements. No Integrated Product Development Team effort has yet been tested under the "Disputes" procedures or in court.

The status of government employees engaged in contract surveillance has become legally ambiguous under the Government/Contractor Integrated Product Development Team concept.
The old concept was defined by the very word "surveillance" used to describe the activity of Government technical and quality people. They were inspectors. That method suffered acutely from the truth observed by Dr. Demming that one cannot inspect quality into a product. The Integrated Product Development Team concept now has the government technical personnel participating in the actual development of the product and responsibility for decisions rests with the team. Accountability for results will be

difficult to determine without sacrificing the flexibility envisioned for Integrated Product Development Teams. Arbitrarily defining responsibility for results by contract language may be unconscionable. It seems unlikely that the advantages and desirability of Integrated Product Development Teams will impress an attorney in pursuit of billable hours.

b. Implications of the "Constructive Changes" and "Constructive Knowledge" Doctrines:

In an Integrated Product Development Team contract, the Contracting Officer must empower the government team members, and accept that he has constructive knowledge of the decisions made within the Integrated Product Development Teams. There is nothing except the above quoted section of the Federal Acquisition Regulation which gives the Contracting Officer authority to enter into an Integrated Product Development Team agreement and to so empower the government team members. There is much in older regulations that would seem to limit his ability to do so. There is no incentive to the Contracting Officer to do so; indeed there is considerable risk to a Contracting Officer's reputation if the result is disputes and claims. No Contracting Officer enjoys explaining to a judge how he came to make such a mistake. There is virtually no support for the concept in the contracting community, which considers itself a "check and balance" on Program Managers and has a tradition of risk avoidance.

c. Contract language:

The Advanced Gunnery Training System program selected the Fixed Price Incentive (Successive Targets) contract type as a reasonable risk sharing arrangement (80% Government share). The ceiling price was 130% of cost (118.18% of price). This contract type provides the same cost visibility as cost reimbursement types. The interim target negotiation provides an opportunity for an early fixed price. It had the important psychological advantage that it made cost control a shared responsibility. All language defining the structure and functioning of the Integrated Product Development Teams is contained in the Contractor's proposal incorporated by reference. There exists no prescribed language in regulations or guidance.

d. Cost control; responsibility for costs:

The obverse of the government reluctance to assume risk is that Contractors' profitability is at risk. Contractors lack any financial incentive to enter into Integrated Product Development Team agreements except as a condition of doing business. Integrated Product Development Team contracts present contractors, in the absence of legal precedent, with unknowable risks to cost recovery. Like the contracts chain of command in the Government, contractor financial management is skeptical of the Integrated Process Development Team Concept. The reasons are reciprocal: financial risk of an unfamiliar concept.

The selection of contract type is not a panacea for the risks arising from the legal ambiguities of the Government/Contractor Integrated Product Development Team Concept. One of the parameters of a Government/Contractor Integrated Product Development Team is that the team can make decision that make design trade offs. In effect, a team is responsible for a budget. In the case of this program, most of Lockheed Martin's team leaders are also

cost account leaders. The blanket use of cost reimbursement contracts would tend to defeat the intent that Integrated Product Development Teams will be more efficient. The increasing emphasis on limited budgets, cost realism, and affordably (cost as an independent variable) within the Government will limit the willingness of Program Managers and Contracting Officers to undertake the risk of program failure attendant on cost overruns. Although a contractor's financial risk is sheltered by a cost reimbursable contract, a contractor's reputation and future business base are not sheltered. Risk management as opposed to risk avoidance is both new DOD policy and very necessary. To accomplish this every member of every Integrated Product Development Team, government and contractor, must be trained and sensitized to cost avoidance, cost reduction, and cost control. The Advanced Gunnery Training System program achieved only modest success at this. Direct costs under control of the Advanced Gunnery Training System program team came very close to the Government's cost realism analysis made during source selection. Factors from outside the program caused a much larger overrun. The cultural change is difficult and is perhaps the fundamental change needed to support the new way of doing business. Nearly all personnel have experience in their discipline and most are good team workers. Nonetheless, outside of Program Managers and Contracting Officers, very few have in the past regarded cost control as a fundamental part of their duties.

e. Implications of the definition of official records.

There is one more legal ambiguity that affects the use of Integrated Product Development Teams. Success with a Government/Contractor Integrated Product Development Team requires the flexibility of electronic communication and data storage. Ultimately a "paperless" environment is envisioned. But as was demonstrated when the details of the F-16 shootdown in Bosnia leaked to the public, it is not clear that an electronic computerized record is an "official record". Furthermore, not all of DOD accepts electronic media, nor is there any standardization of media.

Table 2.1.2.5-1. AGTS Team Membership

FUNCTIONAL ORGANIZATION	PMIT	SEIT	IOS PDT	Training PDT	EID PDT	CS PDT	Monitoring PDT
GOVERNMENT	S	C	C	C	C	C	C
PROG MGR	C						
DEPUTY PROG MGR							
PROJECT ENGINEER	C	C					
PROGRAM MANAGEMENT							
CONTRACTS		S					
PLANNING	C	S	S	S	S	S	S
FINANCE	C	S	S	S	S	S	S
CDM	C	S	S	S	C	S	S
SUBCONTRACTS	C	S		S	S	S	S
CITIS	C						
PROD CONTROL	C						
ENGINEERING		C (ALL LEADS)	C (PDT LEAD)	C (PDT LEAD)	C (PDT LEAD)	C (PDT LEAD)	C (PDT LEAD)
SYSTEMS		C	C	C	C	C	C
SOFTWARE		C	C	C	C	C	C
VISUAL/DB			S	S	S	C	S
ELECTRICAL			S		C	C	C
MECHANICAL			S			C	C
TRAINING			C	C	C	C	C
PRODUCIBILITY			S	S	S	C	C
SPECIALTY ENG							
EEE			S			S	S
PS&T			S			S	S
VALUE				S	S	S	S
SAFETY		S	C		S	S	S
RAM		S	C	S	S	S	S
MANPRINT		C	C	S	S	C	C
STANDARDIZATION			S			S	S
OPERATIONS							
QUALITY	C	S	S	S	S	S	S
MANUFACTURING/ PRODUCTION	C						C
TEST	C		S	S	S	S	S
ILS/CLS			C				
LOGISTICS				S		S	C
LCC				S	S	S	C
SUBCONTRACTORS		LB&M	LB&M, ECC	LB&M			ECC RAYDON

C = CORE MEMBER
S = SUPPORTING MEMBER

Table 1-1 AGTS Team Membership

ADMINISTRATIVE STRUCTURE OF THE TEAMS WITHIN THE CONTRACT

a. Integrated Product Development Teams; makeup; authority; responsibility:

Each PDT has a charter, proposed by the team and approved by the System Engineering Integration Team (SEIT) and the Program Management Team. The charter clearly establishes the makeup, authority and responsibility for each team. The overall process and charters are published in the program System Engineering Management Plan, an example of which is shown above.

"2.1.2.5 **INSTRUCTOR OPERATOR STATION (IOS) PDT**

The IOS PDT is led by Lisa Latham and Maria Casanova with membership as shown Table 2.1.2.5-1. The IOS PDT is responsible for all aspects of the design, development, test & integration, manufacturing and deployment of the instructor operator station. Lisa Latham is the CAM for the team. The instructor operator station includes the following: monitors, furniture, printers, host hardware and software, trainer software, plan view display software and hardware, and instructional subsystem software. The baseline IOS design is established for AGTS M1A2. For other systems fielded, such as LAV, the IOS is responsible for assuring maximum reuse of baseline hardware and software."

b. Concurrent Engineering oversight; makeup; authority; responsibility:

Each Team has scope, schedule and budget assigned. It is important that all three are consistent and match the effort to be performed. During the planning phase, all the skills necessary to accomplish the Team tasking are identified. Table 1-1 above shows the makeup of each of the AGTS teams. Management should expect that each team perform within the constraints established, and the teams should be free to identify the most cost effective solution within those constraints. The team must have the authority to pursue alternative approaches, not just the single one 'assumed' to be the right one based on the proposal and/or BOE. A team that is restricted to a single point solution will in all likely hood become frustrated or not provide the benefits of integrated product development process due to the frustration of the team members and their inability to contribute to a better way of solving the technical problem.

c. Program/Contract oversight; makeup; authority; responsibility:

In structure, the SEIT answered to the "Target Cost Management Board", later called the "Program Management Integration Team". This group consisted of the Contractor and Army Program Managers, the Contracting Officer and Contracts Manager, and the Program Controller. It was simply a standing forum for those who had authority to make decisions. Its purpose was that decisions be make quickly and in parallel. Initially a budget had been established with the contract to support the trade studies needed for the Systems Approach to Training. One function of this group was to approve the studies and their budgets. The other function of this group was to resolve decisions when the SEIT could not reach consensus. In the Target Cost Management Board phase the concept worked well in managing study budgets. In its later phases it came to have no other characteristics than a traditional business meeting. Its greatest benefit was to working relations and communications among those with the legal responsibility for program/contract decision making. The discussion below will emphasize consensus decision making in the Integrated Product Development Teams. This appears inconsistent with the DOD guidance but is not. Program and Contracting authority are unchanged. This oversight group has no other authority than its individual members

and final decisions are made by those designated by to make them. The requirement for consensus in the Integrated Product Development Teams insures that, when consensus fails, the proper authority makes the final decision.

COMMUNICATIONS

a. Use of electronic networking and records:

The use of common tools and shared electronic communications is one of the important facilitators for the Integrated Product Development Process. It allows for rapid and consistent communication via CCmail and for sharing of products during their production across the entire team, avoiding the after the fact review and comment process. It greatly facilitates a team approach to development.

When all information is shared electronically across the team members, it is important to differentiate between work in progress and delivered product. We made use of a CITIS system to maintain configuration management of delivered products. In addition to getting credit for products and maintaining strict CM, the CITIS system supports documentation of the Team decision making process. Meeting minutes are critical for tracking and informing the program of key decisions made.

The combination of free flowing electronic data exchange and strict configuration control of key information is one of the cornerstones of a successful IPD process.

b. Human factors; informality; respect; humor:

In the use of an Integrated Product Development Team, contact must be free, open, and frank. There should be no "channels". Informality is standard. Inevitable friction must be dealt with by good will. And humor. Formal communications should be limited to things absolutely required by law and regulation (e.g. the contract instrument; DD250s; financial reporting). Communications are structured in that individuals deal directly with their counterparts. All parties must at all times be sensitive to all others concerns and interests. At the highest level, the contractor must be sensitive to the Government's entire interest and labor to deliver the best feasible product on cost and on schedule. The Government must be sensitive to the contractor's profitability and rights. Within the team(s) all personnel must trust other professionals to do their jobs and be sensitive to their concerns and responsibilities. At no time can any member consider any part of an other’s concerns as unimportant or lacking in value added. All members must work so that their input meshes with the work of others; and accept compromise; and deal with inevitable friction. When a level of trust develops, a synergy develops that can produce results better than any reasonable expectation.

The Advanced Gunnery Training System Program found that a small percentage of personnel has to be replaced because they could not adjust to the open communication environment, or would not take decision making responsibility. Interestingly enough, the “that’s not my job” attitude was not encountered. Universally technical personnel had been frustrated with their restricted roles under past practice.

c. Decision making; decisiveness:

Decisions on "how" are made by the Teams. The Team is normally chaired by a contractor employee. There is always a

Government member on the team. All decisions are reported, both to the concurrent engineering oversight and to the other Teams. This is accomplished in AGTS by placing the minutes of Teams meeting in the CITIS. Intervention from concurrent engineering oversight, program management, or contracts levels will occur only if the decision requires more resources or conflicts with the work of another Team.

The individual Team makes decisions principally by consensus. Lack of consensus must be reported. Any decision reached by any other means (jury verdict, fiat, etc.) must be considered tentative.

The decision will be sustained or modified by program management, provided the contractors Program Manager and the Government Project Director have a consensus.

Failing the above, it becomes a negotiable issue. One of the principal functions of the Contracting Officer and Contracts Manager in an IPD environment is to intervene in all disagreements and insure there is swift and binding resolution. Disagreements in the Teams must not be allowed to fester. An arbitrary decision, when experts cannot agree, is better than none.

Decisions requiring reallocation of resources within the contract must be elevated to program management/program control/contracts. In the AGTS, this was called the “Target Cost Management Board”, later the “Program Management Integration Team”. This "Board" has no authority of its own, but rather is a group consisting of the contractor's Program Manager, Program Controller, Contracts Manager, and the Government Project Director, and the Contracting Officer exercising their authority concurrently rather than serially.

Indecisiveness is a momentum and morale killer. A Team cannot function if it must wait weeks or months for an answer to a problem.

INTEGRATED PRODUCT DEVELOPMENT TEAM TRAINING AND OPERATION

a. Formal training

Training has proven to be extremely important. Initial training in the process and team building had a major positive impact during the startup of the program. The result of the initial training was to get the team members to start talking together and begin the trust building process, and to get them to question their ‘that is the way we have always done it’ attitude. It did not result in a major shift in how things were done or in communications, but did have a large impact on attitudes and began the change process. Continuing training, through the use of experienced facilitators who worked on a daily basis with each of the teams for the first four to six months completed the initial training and team building.

Additional team training is a necessity. Our experience suggests that at least annual training is necessary. For those who have been team members, it reaffirms the group commitment to team operations. For the new team members, they go through a rite of passage as part of this ‘Qualification’ training. It also acts to cement the team identity by giving the experienced members a chance to reinforce the lessons learned by participating in the training of the new members.

Training is always necessary when the ration of trained team members drops below about 60 % of the total head count. This can occur either through growth in the total team membership or through personnel turn over. When the team drops below a certain threshold, they loose the sense of empowerment required to continue their pursuit of the group goal, and the intimate understanding of the cost, schedule and scope responsibilities of the team.

Team training needs to include all members of the team. Users, Developers, Managers, support members and core members, all should be included as all have a role to plan and a contribution to make.

b. Mentoring:

Mentoring is if anything more important in an IPD organization than in a classical program/functional matrix. In the IPD organization we are asking each individual to take responsibility for the lifecycle of their product. We are no longer handing them a plan that is clearly defined and saying, "All you have to do is follow this detailed plan and you will be a success" We are instead saying "Here is some scope, some budget, a schedule and some constraints, now you go figure out how to do this. Keep me informed." Mentoring has to provide the environment where engineers will be willing to accept the responsibility and the risks, while limiting their creative desires to meet the program goals. Mentoring has to meet lots of needs for lots of different team members. Its contribution to the overall success of the program can not be understated.

c. Organizational support:

The greater organization, both government and contractor, has to maintain its commitment and support to the teams to allow success. Enough people with the right skills need to be assigned and left on the program long enough for the program to succeed. Leaving the teams alone to do their job, not reviewing them to death is difficult for some organizations, but essential for Teams to provide full value added. Rewarding 'non classical' contributions is important. Technologists have generally all ways been rewarded, mentors have not. In an IPD organization, mentoring can be as important as technologist contributions.

As noted earlier there are key parts the organizational structure of both the Government and Industry for which the use of the Integrated Product Development Team is contrary to perceived interest. Nothing in the literature of guidance in IPTs addresses the risk to any program of those elements from destroying the effectiveness of Integrated Product Development Teams by simply exercising their oversight in an unsupportive manner. Both the Department of Defense and defense industry suffer from acute "I am in charge" syndrome. Any one of those multiple authorities can cause a collapse of trust. Simple probability tells us that any Integrated Product Development Team project is at risk.

PROBLEMS AND LESSONS LEARNED

a. Team Organization:

A common initial approach for a functional matrix organization that is not familiar with Integrated Product Development is to create teams that are functional in orientation. Their products are then defined as the

normal functional products, such as system specifications, software code, hardware, and the like. This created problems for AGTS in the early going.

Initial teams on AGTS were organized along functional lines. The teams were System Engineering PDT, the Software PDT, Crew Station/Mobility PDT , Instructional PDT and System Engineering Integration PDT. Figure 1-1 shows the initial set of Teams for AGTS.

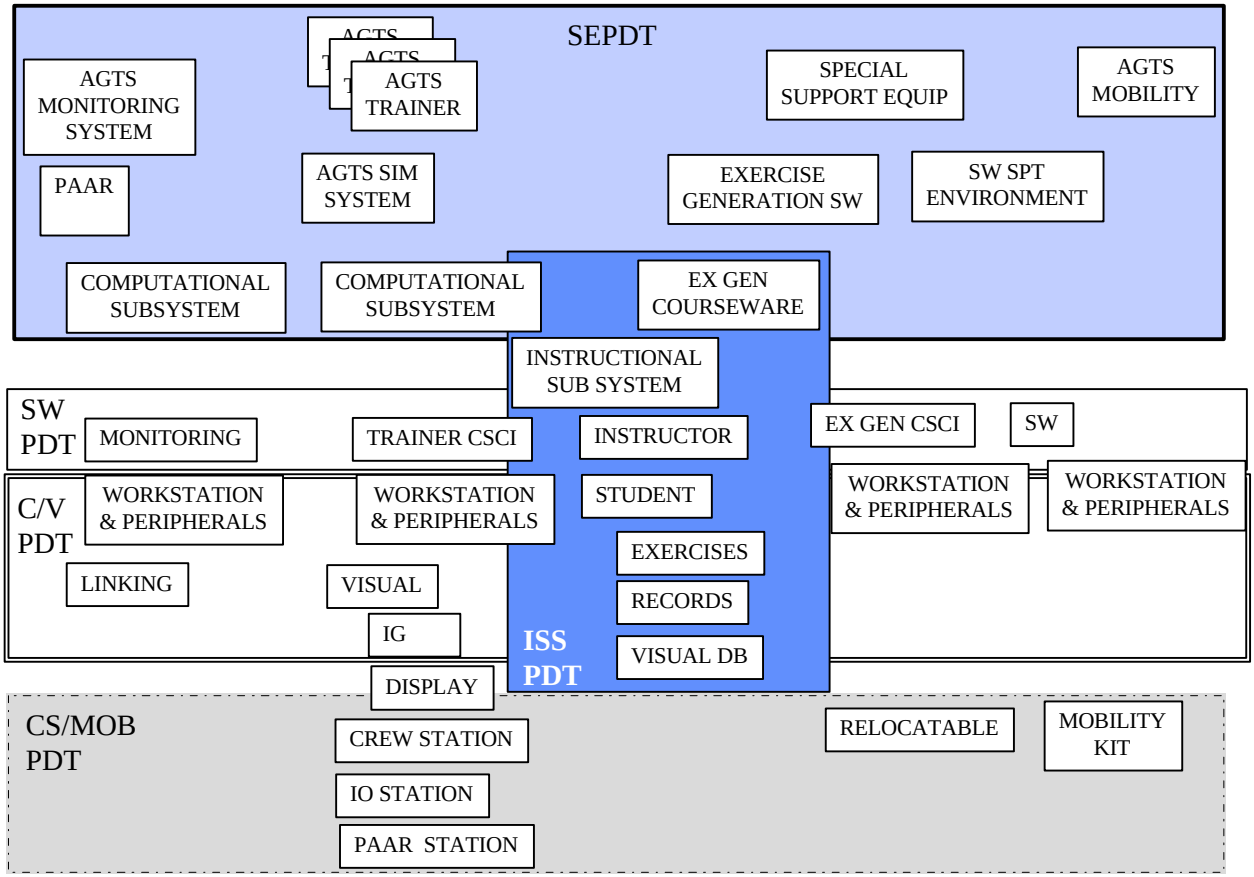


Figure 1-1, Initial AGTS Functionally Oriented Team Structure

The System Engineering PDT was responsible for requirements - the system specification(s) and interface document, generally the system engineers got together and talked about the requirements for the entire system. The Software PDT was responsible for the software development on the program. All the SW developers met frequently to talk about the software being written for the program. The Crew Station/Mobility PDT was responsible for hardware design. All the HW designers got together and compared notes on the evolving hardware design. The Instructional PDT was where all the training people got together and talked about the training needs of the program. Finally, the System Engineering Integration PDT was where all the PDT leads and engineering management got together and statused their progress.

After several months of working as functionally oriented teams, Program management gained considerable confidence in the IPD approach and recognized the need to go to a product oriented organization.

The functional teams had responsibility for their individual products, however the products did not add up to a deliverable end item. They could not make the trade offs between requirements, performance and cost that are needed to realize the benefits of IPD.

As a result the teams were reorganized with emphasis on deliverable products for each team. Figure 1-2 shows this organization. It consists of the Instructor Operator PDT, Crew Station PDT, Electronic Interface Device(s) PDT, the Training PDT, the Monitoring PDT the Mobility PDT and the SEIT.

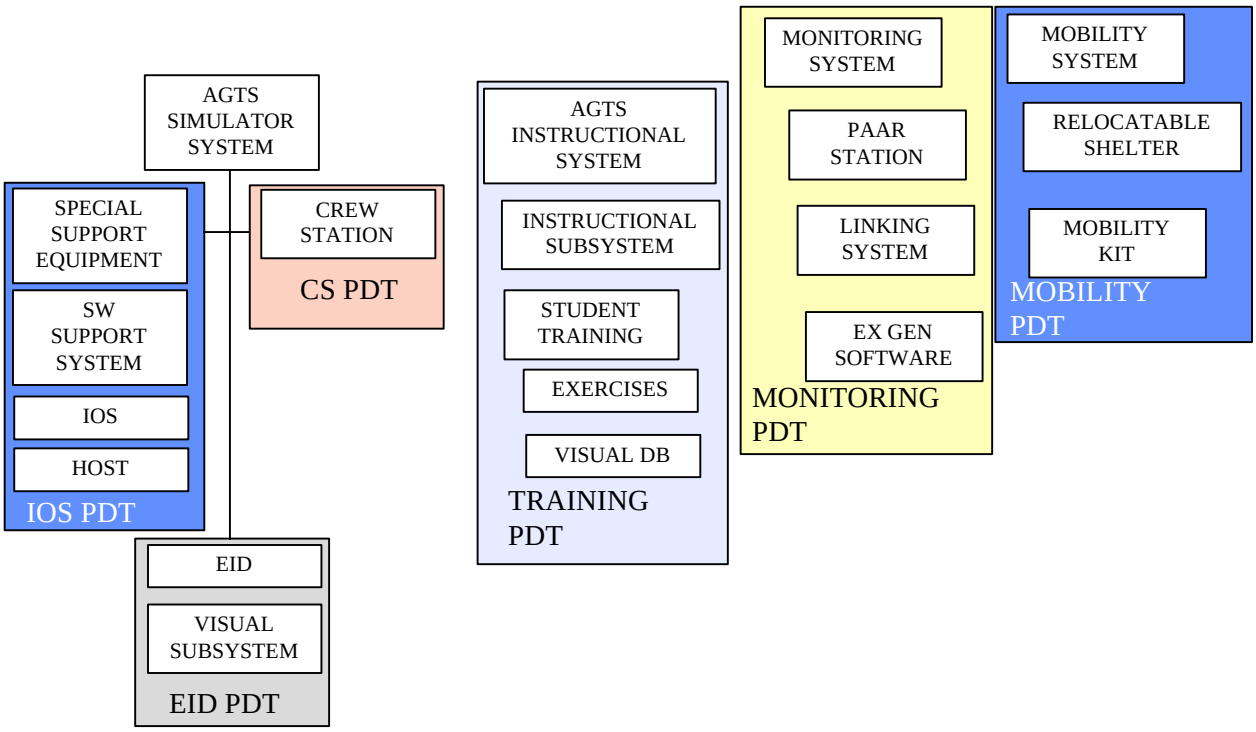


Figure 1-2 Final PDT Organization

Each of the PDTs now has a set of products for which they hold full lifecycle responsibility. Each of the PDTs was reconstituted with the full compliment of engineering and programmatic disciplines necessary to support the lifecycle of its products.

b. Personalities; trust; understanding:

Matching team leads is important. A little psychology in the team membership selection goes a long way. Do not force two individuals who will never build mutual trust to be co-chairs of a team.

Use initial training and selected tasking in the beginning to enforce the teams to build trust early. Enlightened management will create some specific situations that will help force the team members to come together and start trusting each other early.

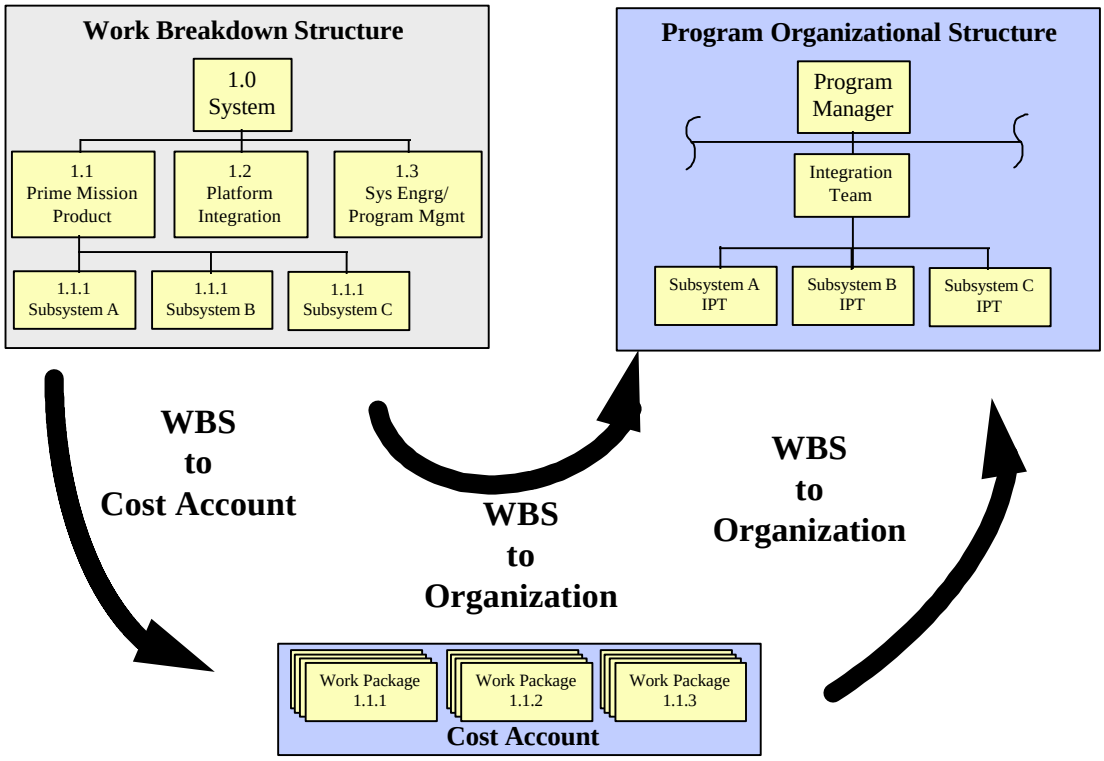
Building an understanding of the personalities and roles of the team members is very important and a major area where mentoring can help. A good mentor will become the sounding board for team members and jump-start the team building process.

Great care must be taken to not intervene in the operation or authority of a team unnecessarily. Experience on the Advanced Gunnery Training System program indicates that the teams will bring their problems to the oversight organization, if they are properly trained that one of their duties is to reach consensus decisions quickly. There was an early tendency for too much to be referred upward, until personnel gained experience with making decisions. Unsolicited intervention will destroy a teams sense of "ownership" and has proven to be unnecessary where proper training and mentoring has been done.

Building trust is an important, perhaps the most import, factor in the success of a IPD project. The most difficult area in which to develop and maintain trust is at the level of the oversight team, the programs and contracts personnel. It is here that the trained managers and negotiators and the trust building skills must be strongest. It also here that pressure from multiple government and corporate bureaucracies and oversight bear on the Government/Contractor IPD. When the pressure from any part of that oversight is hostile, it will be a rare program or contracts person who will risk his personal reputation. The key element of trust is fragile indeed.

c. Transition:

i. Necessity for reorganization as program matures: The organization should match the effort to be performed. The WBS, Cost Account Structure and Organization should all be consistent. The selection of the WBS, CA and Organization should be made as independent as possible from a specific design solution. On AGTS the initial Organization and Cost Account structure were set up to match each other. Since the initial set of PDTs were functionally oriented, this means that the Cost Accounts are functionally organized. With the reorganization of the teams from functional to product orientation, the Cost Accounts needed to be bandaided to be useable with the new organization.



ii. Personnel turnover; voluntary and involuntary: In any organization that has tasking that exceeds a few days, personnel turnover is a fact of life. With the importance of establishing and maintaining a team spirit, turnovers need to be managed carefully. The candidate team member needs to fit into the existing team personality. It is not enough to have the technical skills, they have to be able to merge into the moving team activities with a minimum of disruption. When the number and rate of turnover is low, the team may provide “on the job training” to new members. When the turnover is high, or the new members represent a significant percentage of the overall team, then special team training, including team building exercises are worth the investment.

Matching key team members is very important. The team leads must be able to work together and trust each other. At the first signs that this is not happening, management needs to take corrective action. Team efficiency is greatly enhanced by leadership who believe in the process and understand it and stable team membership.

d. Interference from outside the team; "management help":

IPD is a new approach to long standing problems. Institutional forces outside the team will from time to time feel the need to provide “help”. Some times this help is on the mark and appreciated. At other times, the need for help is coming from a different view of how things are done, frequently due to a basic lack of experience with how IPD works. The Management Team must be vigilant and handle outside influences quickly and effectively to make such experiences positive. Any outside reviewer of performance of an Integrated Product Development Team must regard himself in a mentoring role or the trust on which the team operates will be at risk. If the

reviewers comments are directed at a single individual or group of individuals, then the Team as a whole must consider the comments and deal with them from a team viewpoint.

e. Working Groups:

A successful implementation of IPD puts the full responsibility for product development into a set of vertical teams. The risk is that these will turn into stovepipes, focusing internally to the detriment of the overall program. The integration teams work against this, acting to maintain cross team integration. An approach that has worked very well on AGTS is to spawn a set of Working Groups, each chartered by the SEIT to work across all the IPTs to ensure integration. For AGTS three key working groups have been spawned. The System Integration and Test WG works across each of the product teams to assure that their integration and test plan flows smoothly into the overall program integration and test plan. They facilitate the development of individual test plans, and enforce the development of the program test plans. The Software WG works across all the development teams to assure that the SW process is consistent and meets the program needs. The Working Groups are also important points to view program metrics in key areas.

f. Team Performance Evaluation - The Government Evaluating itself:

When AGTS had completed the transition of IPD, we knew it because we had a totally badgeless society. During the development process, team members all contributed based on their abilities, unrestricted by the color or type of badge they wore. The government maintained its authority and exercised it, but as a team member, not in an adversarial or dictatorial manner. The Contractor maintained its prerogatives and exercised them, but again in the context of the teams. What we 'discovered' when we came to the second award fee evaluation period was that we were asking the government team members to evaluate their own performance. Since they were fully committed to the teams, the success of the teams was their success. This fact makes it much more challenging for the government leadership to create an unbiased evaluation of the teams performance.

g. Subject Matter Experts and Integrated Product Development:

In recognition of the importance of subject matter experts (SME), we made a concerted effort to get them involved with the Teams. We included them in all training, identified them in the team charters as core or support members and generally made sure that they knew that we were depending on them to be team members. Based on experience on other systems, we created a SME comment handling process as part of the SIT WG. This created a forum where the SMEs could come to a consensus on their comments.

CONCLUSIONS

a. Current trends in public policy:

Acquisition reform is going forward on many fronts. The one that affects the issues discussed here is the increasing emphasis on the use of non-adversarial working tools, particularly the Integrated Process Team, in its several incarnations, one of which is the Integrated Product Development Team. The recent changes to the Federal Acquisition Regulation and to DOD Directives 5000.1 and 5000.2 emphasize simplicity and delegation of authority. The Congress has

passed considerable acquisition reform legislation, and it is a reasonable expectation that it will pass more. The trends for change can be expected to continue in the executive and legislative branches. All participants in the DOD acquisition process can expect more change and should prudently prepare for it. The eventual shape of these reforms is unknown and unknowable until the judiciary has been heard from. Until the judiciary has given shape to the risks, there will remain those in Government and in Industry that will remain skeptical of the unquantifiable.

b. Necessity for commitment at all levels of both Government and Industry:

The necessity for commitment to acquisition reform in general, and the non-adversarial relationships represented by the Integrated Product Development Team, would seem to be an often repeated platitude. But, as discussed above, there are important elements of both Government and Industry management who have legitimate reasons to be skeptical. The Advanced Gunnery Training System program achieved considerable success. Above all, it solved the problem of making the Integrated Product Development Team work and work well. But transition in management in both the Government and Contractor organizations compromised management support for the program, and to a degree broke down the effectiveness of the Teams. When it is said that management support is needed, it is needed not only at all levels, but in all elements of management, both Government and Industry.

c. Matching the IPD structure the products being developed is essential:

Old organizational approaches need to be modified to make IPD work. Functional organizations will not result in the benefits of IPD being realized. Management needs to make the leap all the way, not half way to reap the benefits.

d. Cross Team working groups tie the Teams and processes together:

Working groups provide the threads across the program. A few key individuals, working in the forum provided by the working group format are insurance that all the team products will be developed consistently and will integrate effectively during the integration and test phase.

Quotations

July 1994 - “One of the main problems there has been in the past with IPD has been the Contracting Officer.” - Robert Coach, facilitating the team training for AGTS

October 1994 - “Egad! This is like jumping out of plane without a parachute!” - William Kitterman, Contracting Officer