

IMPLEMENTING INTEGRATED PRODUCT DEVELOPMENT: A PROJECT MANAGER'S PERSPECTIVE

Richard W. Bregard and Taylor Chasteen

This is a first-hand account of an actual Integrated Product Team implementation experience from the project manager's perspective. Using the vision articulated by senior leaders in the Department of Defense and the Army, the manager tailored a practical approach to fit the development effort. Implementing an integrated product development (IPD) approach that can return significant benefits is a formidable task, over and above the serious technical and programmatic challenges facing the team. The authors discuss the historical and cultural reasons for the resistance to IPD they experienced. They explore the types of teams and implementation steps in terms of their value added to the end product. Finally, the authors express some concerns about the future of IPD and its role in changing the established organizational culture.

Officially chartered in 1979, the mission of the Office of the Project Manager for Tank Main Armament Systems is to manage the development of Abrams Tank lethality systems, including armaments and ammunitions systems. Over the past 17 years, the Project Office has been extremely successful at this mission. One current ammunitions program is the M829E3, 120mm Kinetic Energy Cartridge. The goal is to develop and produce the most lethal and accurate kinetic energy round the world has ever seen. This

is proving to be the most technically challenging project this office has ever attempted. Moreover, the project must operate in an environment of shorter development cycles and very limited funding. To increase the chance for program success, the office determined initially that it must fundamentally change the way it manages development. While the more traditional management styles have been successful, they now appear too costly and time consuming to survive in the new era of military and product modernization.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 1996		2. REPORT TYPE		3. DATES COVERED 00-00-1996 to 00-00-1996	
4. TITLE AND SUBTITLE Implementing Integrated Product Development: A Project Manager's Perspective				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Army Materiel Command, 9301 Chapek Rd, Fort Belvoir, VA, 22060-5527				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Acquisition Review Quarterly, Fall 1996					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 12	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

A relatively new management model, Integrated Product Development (IPD), offers substantial benefits that would help overcome these challenges. Flatter organizations and more teaming are central tenets of the IPD philosophy. The Department of Defense (DoD) has tailored the IPD philosophy by instituting the Overarching Integrated Product Team (OIPT) to help solve problems and expedite the decision process at a higher level of defense acquisition management. Meanwhile, senior DoD and Army leadership charges the project manager (PM) with responsibility to foster the Integrated Product Team (IPT) at the working level.

IPD integrates all relevant skill sets early in a product's life cycle and pushes critical decision making authority down to the lowest possible level. Early integration of skill sets increases the probability that issues are raised and solved early in the life cycle. Streamlined decision making decreases development time, reduces personnel costs, and improves integration of the total product. However, correctly implementing the IPD philosophy can be difficult. In this case, it required a fundamental cultural change throughout government and private contractor organizations that had successfully managed 120mm tank cartridge development for decades. This paper describes our recent IPD implementation experience in the Office of the

Project Manager, Tank Main Armament Systems.

CONTEXT

Project management in today's Army requires the PM to solicit and employ expertise from various government organizations and contractors. During the previous era of ammunition development, developmental government organizations became characterized as too hierarchical, with engineers and scientists working at the lower levels, engineering management above them, and business management on top. Generous project money helped support this management structure. Past funding levels also supported independent, and sometimes simultaneous, development programs having several contractors whose hierarchical management structures reflected those in the government organizations they were supporting.

Though top heavy and sometimes ponderous, 120mm tank munitions development was very successful. Problems were solved by focusing on the product and schedule at the expense of cost. Cost was not an independent variable. Successful programs and a tradition of adequate funding created a natural bureaucratic inertia in the organizations that develop tank munitions. When these efforts began, gov-

COL Bregard was the Project Manager, TMAS. He holds a B.S. degree in business from Alabama A&M University and an M.S. in logistics from the Florida Institute of Technology. He is currently assigned to Headquarters, Army Materiel Command.

MAJ Chasteen was the Assistant Project Manager, TMAS. He holds a B.A. degree in political science from Western Kentucky University and an M.B.A. degree from Babson College. He is currently assigned to the Software Development Center - Washington, D.C.

ernment and contracting organizations were resisting significant process changes despite the funding pressures experienced over the last few years. Recently, changes in organizational thinking have taken place.

CONTRASTING IPD WITH TRADITION

In the generic and more traditional project management model, the project office manages funding, development, product integration, transition from R&D to production, and fielding. However, due to limited staff, independent technical organizations such as design engineering, testing, and procurement often provide matrix support to the PM. Unfortunately, along with the technical expertise comes layered functional management. Decision making is slowed by time-consuming meetings, briefings, and staffing requirements.

Complicating matters further, each functional organization, working on its piece part, vies for resources provided by the project office. The competition is good, but at a micro level, the result is often over- and under-funding of the differing technical areas. Under-funded areas naturally cause project delay. Redesign, which is costly and generally reserved to solve integration problems, increases program time and money requirements. Thus, the decision making process is further aggravated by management “stovepipes” and inefficient communication.

On the private contractor side, businesses tend to closely mirror the organizational structure and culture of their counterpart government customers. Again,

generous project money supported this approach. Many of the same problems associated with powerful functional organizations and layered management also exist with the contractors. Some private companies have embraced acquisition streamlining and IPD on their own. Others resist change and are waiting for their government customers to take the lead. Clearly, there are significant efficiencies yet to be realized from both the government and contractors.

In contrast to the more traditional approach, IPD is the integration of all needed skills (program management, technical development, producibility, etc.) early in the product’s life cycle. In the language of IPD, the team, the (IPT) implements the IPD philosophy. The core IPT has overall responsibility for managing both the programmatic and technical decisions and looks for means to integrate the product (i.e., tries to understand the mutual impacts of the product’s various piece parts) early in the life cycle. The team leader and members are empowered by their respective organizations. Indeed, most decisions can be made within the context of the team. Consequently, many of the briefings, meetings, and staffing requirements are reduced if not eliminated.

Moreover, with the team making resource allocation decisions in one “stovepipe,” thereby subordinating functional interests to the goals of the team, program management is optimized to avoid schedule and overall product performance impacts. Equally important is the fact that more informed decisions can be made on the most important cost drivers early, when most of the program cost is determined. Agreed-upon team goals and metrics create pressure to manage within

budget and schedule. Ultimately, rapid communication, team empowerment, integration of all relevant skill sets, and team synergy result in a shorter decision cycle and lower development costs.

IPD IMPLEMENTATION

Transition to IPD is made possible by a commitment to acquisition reform by senior leadership in DoD, DA, PEO, Armored Systems Modernization and the Army Materiel Command. Senior management support is critical to IPD due to organizational inertia and general resistance to change. Similarly, IPD is critical to acquisition reform in the sense that it allows us to do more with less, brings the acquisition community (public and private) closer together, both horizontally and vertically, and facilitates better, faster, more effective communications. Clearly the timing is right to shift to this new development philosophy.

Ideally, integrated product development teams form before development projects are transitioned to a project office. In actuality, this is rarely the case. When it was decided to manage the M829E3 program using the IPD approach, advanced development work had been ongoing for a couple of years. Fortunately, the office maintains a relatively seamless relationship with the organizations that provide most technical expertise, the Army Research Laboratories and the U.S. Army Armaments Research, Development and Engineering Center. This close working relationship mitigated the reality that the formal team structure was not in place as early as desired. Also, since the program is in the early technology demonstration

phase, using an IPD approach will still have a significant beneficial impact.

WHAT TYPE OF TEAM SHOULD BE USED?

There are many types of teams including integrated product development teams, concurrent engineering teams, integrated concept teams, and process action teams that may be chartered to deliver products, concepts, or processes. Teams are chartered for various lengths of time, perhaps to encompass an entire product life cycle or to address a specific process or task, and then disbanded. It is very important to understand how to differentiate types of teams, because of a tendency to paste the IPD label on “business as usual,” and the concern that the wrong type of team would be established for the M829E3 development.

To address this organizational need for a better understanding of teams, this office conducted a serious review of the range of optional team structures and implementation strategies. Specifically studied were lessons learned and guides from the private sector, Department of Defense, Army Materiel Command, and the U.S. Air Force. Particularly interesting is the work of Steven Wheelwright and Kim Clark. In their book *Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality*, they define a spectrum of teams classified as lightweight, heavyweight, and autonomous. The spectrum is largely differentiated by the strength of the team leader and the amount of empowerment the team is given, starting from the least empowered lightweight to the most empowered autonomous team.

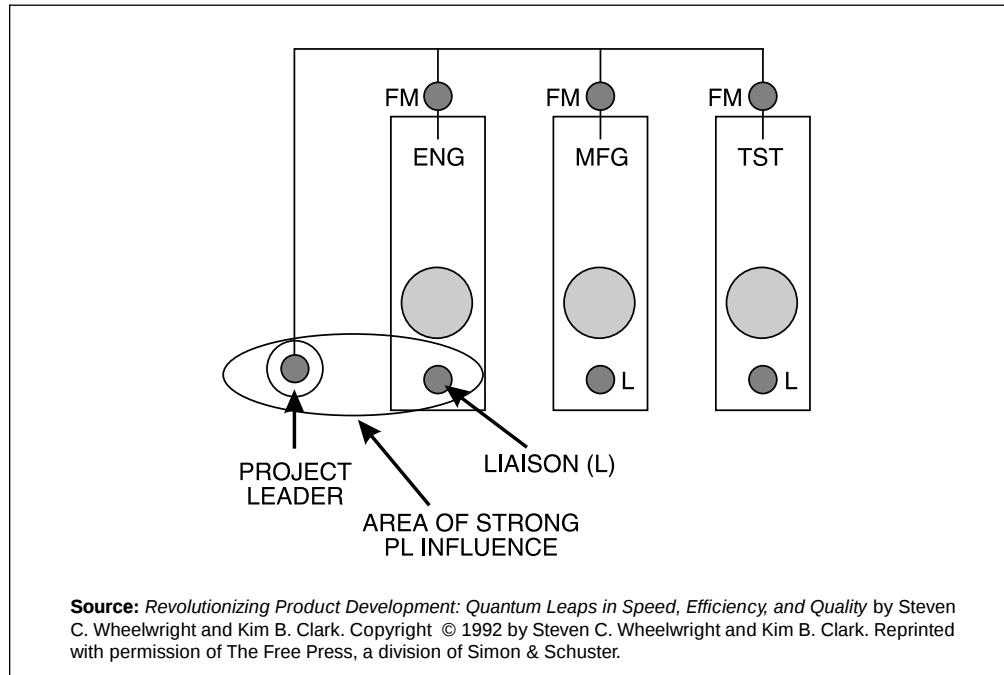


Figure 1. Lightweight Team Structure

The lightweight team structure, depicted in Figure 1, is distinguished by a team leader who is usually a middle or junior person in the parent organization. He is more of a coordinator than a leader. Additionally, the lightweight team leader does not control critical resources. Team members remain physically located with their functional organizations. Rather than focusing primarily on the work of the team, team members look to their functional organizations for daily support, guidance, and priorities. Responsibility for team member's evaluations, training, and support resides solely with the functional organization. The lightweight team is, in effect, a reflection of the way our products have traditionally been managed.

The heavyweight team structure, shown in Figure 2, has a *strong* team leader with collocated core team members. The leader

is directly responsible to senior management for all the work done by the team. Core team members are collocated with the team leader. The team leader has a direct influence on the performance appraisals of team members and indirectly influences extended team members through his influence over the core team. The team is empowered to make decisions in a streamlined environment, eliminating the need to get functional management approval. The team has control over key resources, and the team leader has influence across organizations. While it is a significant departure from the traditional development model described earlier, the heavyweight structure occupies the middle part of the team spectrum.

Finally, the autonomous team structure, depicted in Figure 3, is distinguished by a strong team leader, little communication

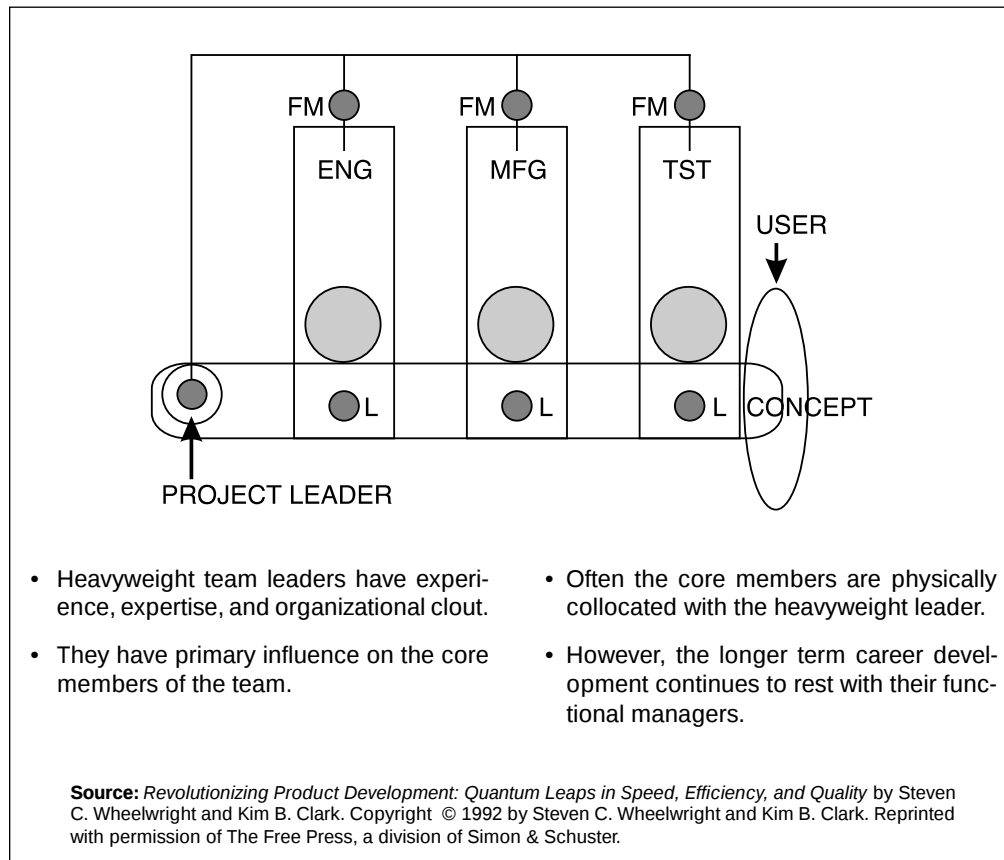


Figure 2. Heavyweight Team Structure

with upper management, and a great deal of empowerment. Sometimes referred to as a “tiger team,” the autonomous team members are full time, dedicated, and collocated with the team leader. They have full control over resources, practices, and procedures. Likewise the team has full responsibility for success or failure of the project. This type of team is most appropriate for a new product development requiring an unusually rapid development cycle. Of course, with so much delegation of power, this type of team often makes senior management nervous.

In his book *Managing in a Time of*

Great Change, Peter F. Drucker also discusses three types of teams. Drucker approaches the team issue from both a structural and humanistic perspective. He uses the analogy of a baseball team, a football team, and a tennis doubles team. In Drucker’s view, baseball is much like an assembly line. The process is stable. Everyone has a job and if you mess up, usually there is no one who can help. Although aficionados may disagree, Drucker says, “[B]aseball players play on a team; they do not play as a team.” In contrast, football is more flexible and fluid. There are usually opportunities to do more than

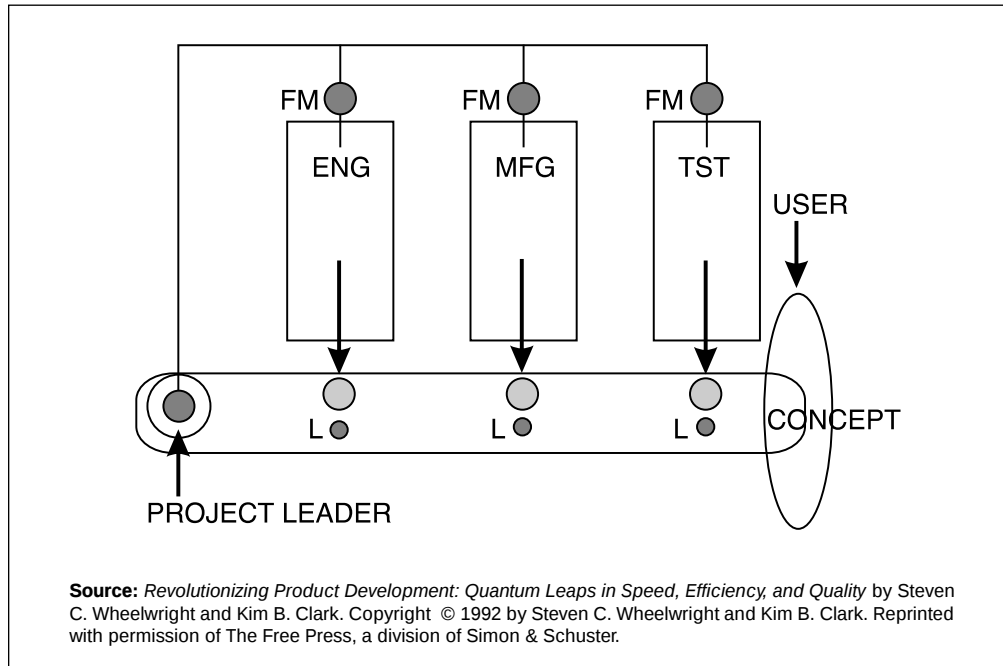


Figure 3. Autonomous Team Structure

your specific assignment on a given play. Therefore, football players must play *as a team* to be successful. Finally, the tennis doubles team requires still more synergism than the previous two examples. Both players must be in total sync to win. In Drucker's example, the Japanese create this kind of synchronization by using design teams that incorporate the various relevant disciplines working in parallel. As in football and tennis doubles, each member must subordinate themselves to the team to be successful.

The lightweight team, with a weak team leader having little influence over team members and few incentives to create team synergy, did not seem to offer a credible chance to provide the real benefits this office wanted to achieve. Likewise, the autonomous team, with its considerable empowerment and associated high risk, was

not appropriate for the M829E3 development. In extreme cases, such as war or serious immediate threat to our national security, the autonomous team may indeed be preferable. Instead, a composite of the heavyweight or football type team was chosen because it represented the greatest possibility for efficiency and synergism, given a long-term developmental program in its early stages.

Specifically, a robust heavyweight team could be tailored by incorporating all relevant disciplines for tank ammunition development and capable of managing the entire life cycle. Core team members could be collocated to the maximum extent, the team could be empowered to make decisions in a streamlined environment. Yet, the team's freedom would be bounded by the legitimate authority reserved by the project manager and codified in the team's

documentation. The heavyweight team would be able to “push the envelope” in terms of faster communication and decisions, without going to extremes in terms of empowerment and associated risk. This type of team seemed to be a proper balance of risk and reward for a full-scale development program.

IMPLEMENTATION—EX POST FACTO

After the team was chosen, an implementation strategy was designed that offered the best chance for success. It was a very methodical approach consisting of four discrete steps in hopes it would help avoid major problems. In order, the implementation steps were readiness assessment, senior management training, facilitator training, and team launch.

The process of putting the team in place would take five months (six, counting the government furlough of November 1995). That seemed reasonable, since successfully negotiating the hurdles of change requires a great deal of brainstorming and thought. Namely, for the first time since the office’s charter was enacted, it was empowering a heavyweight integrated development team to manage a program. This was in fact significantly changing the organizational culture of the tank ammunition business. Meanwhile, the office was managing a technically challenging effort, which was moving at a rapid pace, and was underfunded. The challenge was huge—so were the rewards.

READINESS ASSESSMENT

A readiness assessment was critical to IPD implementation. Its purpose was to

assess the potential organizational and cultural barriers to the successful IPD effort. From top to bottom and across the organizations providing human resources to the team, relevant persons were asked to fill out a questionnaire concerning how ready the organization(s) were to accommodate IPD. The questionnaire addressed ten areas, including customer focus, senior management support, agility, etc. Respondents were asked if they thought team members understood customer requirements, whether there was sufficient senior management support, and if team members were committed to IPD. The responses to the questionnaires were used in follow-up interviews to amplify the responses. The data was compiled, organized, and quantified.

The value of the assessment was threefold. First, the large body of responses identified the problem areas more reliably. Second, anecdotal information was turned into quantifiable assessments that could readily be used to identify organizational barriers to IPD. Third, the assessment process was viewed as objective information gathering. This tended to take parochial politics out of the process to a great extent and provided a more solid foundation for the steps that followed.

To address the potential barriers identified in the readiness assessment, the office needed a vehicle in which to codify an organizational framework across several organizations. (These organizations included the Office of the Project Manager for Tank Main Armament Systems, Abrams Project Office, Army Research Laboratories and the U.S. Army Research Development and Engineering Center. The Ordnance Support Contractors, OLIN Corp and Alliant Techsystems were also

involved on an *ad hoc* basis.) Hence, a Memorandum of Agreement (MOA) was drafted around the heavyweight team structure, incorporating solutions to the concerns identified by the readiness assessment. Importantly, the MOA included the extent and limitations of authority provided to the IPT. There were also specific mandates to the IPT, such as a requirement to develop process plans like communication, decision making, and administration. Finally, the MOA included clauses that would foster team development, addressing issues like collocation, performance appraisals, and team awards.

SENIOR LEADER TRAINING

Senior leadership training came next. Many IPT implementation plans eliminate this step. Typically, new worthy concepts gain favor and people assume that senior management has a thorough understanding of the concept and associated issues. That is a false assumption. Also, leadership must sometimes un-learn false notions derived from incomplete knowledge and years of managing the old way. Many times the results of not training senior management are lack of support, misapplication of concepts and failed efforts. This office set out to avoid this trap.

IPD senior management training was combined with a full discussion of the MOA in a two-day meeting. Dr. Jack Byrd of the Center for Entrepreneurial Studies and Development, Inc. (CESD, Inc.), a leader in the field of IPD, facilitated the meeting. Attendees included senior executives and upper management from the four major governmental organizations providing human resources to the M829E3 ef-

fort. Senior managers from the potential systems contractors were also included in the two-day meeting as ad hoc members and potential signatories to the MOA.

Senior leader training was very successful. Discussions of the M829E3 program and IPD philosophy led to a specific agreement to embrace IPD. Armed with a laptop computer, the meeting recorder made real-time changes to the MOA as discussions progressed. By the end of the second day, the leaders of the four major organizations signed the MOA. This event marked the end of the first phase of implementation and was a major step in generating cultural change. The significance of a signed MOA demonstrated the highest level of commitment of the organizations involved. Moreover, these leaders gave the IPT the freedom of action it would need to return real benefits.

FACILITATOR TRAINING

The facilitator of the senior management training is essential to achieving the stated goals for the meeting. Good facilitators plan a meeting. In conjunction with the team leader and subject matter experts, the facilitator lays out the agenda, goals, time limits, and ground rules ahead of the meeting. The facilitator then manages the dialogue using various facilitation techniques and focusing the group on the goals of the meeting. The facilitator gets everyone involved and promotes meeting ownership. Trained facilitators are key to maximizing the time spent in meetings.

Candidates for facilitator training were chosen for their personality, expertise, and mental agility. In addition to training members of the team, the office also

trained facilitators who were not part of the team and who could be used as independent resources. Facilitator training was timed to coincide with team launch, thus allowing the trained facilitators to apply their newly acquired skills. This training approach incorporated current product and process issues facing the IPT. Hence, trainees accomplished real work instead of exercising with case studies and hypothetical examples. This approach was a constant theme throughout implementation.

TEAM LAUNCH

The final phase of implementation was team launch. The purpose of this phase was to carry out the mandates embedded in the MOA. The launch was the most difficult, and some said the most critical, stage of IPD implementation. It is during the launch process that the reality of cultural change becomes apparent. As specifics are discussed and decisions made, the extent to which old lines of authority are being severed and new ways of operating put into place becomes clear. The increased responsibility is felt by team members and the old hierarchical system reacts nervously.

To implement the launch, team members focused on process issues. Members developed team norms and decision making plans, along with a host of other process plans. Since this was a labor-intensive effort that required time and depth of consideration, the launch activities were split into two parts. First, a two-day session attended by the core team (about eight persons) was held to develop “strawman” plans. An interim period of three weeks passed to allow for discussion and thought

before the ‘strawmen’ were presented to the whole team. Changes were made to the strawmen and the plans were placed into a team contract book. The contract book is a collection of governing documents for the team, such as the team leader’s charter, MOA, and all the process plans developed through the launch process. The plans are considered draft; the team can always change them. On the last day of team launch, the team leader was presented with a written charter that delineated his responsibilities as the leader of the IPT. This event signified the end of the implementation process.

The implementation plan required a great deal of hard work that was accomplished without halting the technically challenging program. Big challenges lie ahead. The team is expected to return immediate benefit. For example, the Quality Functional Deployment (QFD) model with a common dictionary ensures that user requirements and trade off decisions are understood. The uncertainty risk reduction tool provides a formal process to manage risk over the life of the development. The decision making process complements the empowerment given to the team in the MOA. As the team matures and goes through team development phases over time, it will develop confidence and operate more efficiently as team members and functional managers become comfortable within this new organizational framework. In due time, the team owes management an objective evaluation of its effectiveness. Team metrics and goals, developed during the launch process, will be evaluated and the real successes and disappointments weighed.

ISSUES AND CONCLUSION

There are still many issues to be addressed with regard to Integrated Product Development. After years of creating large and powerful functional organizations, we must clarify the role of the functional organization and indeed the respective management structure. We have created career tracks for employees that use the hierarchical functional organization as the centerpiece of career aspirations. What is the logical career track for IPT members? How do we accommodate team members who have been collocated with a team for three years and return to their functional organization? These issues transcend any one organization. They go to the heart of the way we manage civilian personnel in the government and the future of IPD in this business.

IPD is still viewed as a serious threat by some in the public and private sectors. Failure to deal adequately with these issues could easily lead to pasting IPD labels on programs without making real changes in the way they are managed. The workforce is watching how team members are treated. We must address their needs and their career aspirations. Failure to do so will deliver a hard blow to IPD. Successfully addressing issues such as these

will be the final blow to an outdated and costly way of doing business.

Cultural change takes years to accomplish. The momentum for IPD is strong now, but we must be vigilant to make it last. The automotive industry, for example, was traditionally very bureaucratic and slow to market—that is, until foreign competition brought incredible pressure on the players to make real changes to their organizational culture. Yet, some would argue that the automotive industry is still going through cultural change after 15+ years. We are not so different. Therefore, we must be prepared to accept the risks and continually push for this new management paradigm.

The real proof of IPD lies in the product we deliver to the soldiers. If IPD does not provide them with the best equipment available, in a timely and cost-effective manner, then we have not implemented it correctly. IPD is clearly the wave of the future in the private sector. There is a large body of evidence that supports this statement. Saturn develops new cars in 18 months. From first concept to flying production models, Boeing develops airliners in less than six years. We should be able to match this kind of performance in the defense acquisition system. IPD is our best opportunity to achieve this goal.

REFERENCE

- Wheelwright, S. C. and Clark, K. B. (1992). *Revolutionizing product development*. New York: Free Press, 1992.
- Drucker, P. (1995). *Managing in a time of great change*. Truman Talley/Dutton.

SELECTED BIBLIOGRAPHY

- Perry, W. (May 1995). *Use of integrated product and process development and integrated product teams in DoD acquisition*. Memorandum to Department Secretaries.
- U.S. Army Materiel Command. (1995). *Research, development, and acquisition integrated product and process management: Vols. I, II, III*.
- Department of Defense. (1994). *Report of the process action team on military specifications and standards: "Blueprint for change."*
- Production Base Modernization Activity. (1994). *The material developer's guide to life cycle readiness*.
- Under Secretary of Defense for Acquisition and Technology. (1995). *Rules of the road, a guide for leading successful integrated product teams*.
- Byrd, Wood, and Farquer. (1992). *Overcoming Resistance to IPD/CE*. The Center for Entrepreneurial Studies and Development, Inc., and the Concurrent Engineering Research Center.