WORKING SMARTER: TRAINING AND SIMULATION DEVELOPED THROUGH COLLABORATION

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Military operations have entered a new era of uncertainty, requiring agility, rapid response, and innovative teamwork. In turn, training systems play an increasingly larger role in achieving the goal of military readiness. Just as the complexion of military operations has changed, so has the strategy of developing the training systems to support military readiness. Traditional procurement, with its associated long product development cycles and high cost, is impractical in today's environment. It virtually guarantees a training system will be both technically out of date and not as effective in meeting current needs by the time it is delivered. This paper presents a successful approach for the procurement and development of training systems, one that responds to varied and changing needs in a timely and cost effective manner.

BACKGROUND

Rising costs, reduced budgets, and changes in the role of military operations worldwide are reasons to consider changes in the way in which we procure training systems. In the four decades between 1950 and 1989, the U.S. military participated in ten (10) deployments, of which four (4) were combat missions and six (6) were peacetime operations. From 1990 to 1996, the U. S. military engaged in twenty-five (25) deployments, of which twenty-three (23) were peacetime operations covering a wide range of locations and missions. Training and simulation developed through collaboration or teamwork is a concept that has been tested and proven to pay large benefits to the military by providing training devices quicker, cheaper, with more application to actual training requirements and the training environment. Teamwork applied to training system development requires a more flexible, dynamic environment for both the Government and contractor to work in, while cost and schedules are both constantly monitored and controlled. When this concept is used properly it can result in reduced costs, expedited delivery and a product that exceeds even the user's expectations. Because of reduced budgets the Military readiness is becoming more dependent on training systems, however, these training systems need to demonstrate training effectiveness, affordable fielding and maintenance costs, and be deployable to where the training is needed. This is why teams of users, developers, engineers, and manufacturers work together in an environment that provides the freedom to ex-change ideas and information of people working to achieve common goals.

In the past, procurement cycles were lengthy, with years passing between the identification of a need and the final delivery of a product. Often, the end user's only contribution was at the very beginning of the cycle, when the initial requirements were being specified, or at the very end, when the system was being tested for acceptance. This practice resulted in systems not meeting needs, and costing more as a result of rework.

NEED

As training requirements have entered a new era, development of training systems subsequently requires a new approach. We no longer can afford the luxury of a long and complex process of selecting a supplier, followed by original and lengthy product development, and, delivery, years later, of a product to a user who had little voice in the entire process. We can no longer afford the adversarial relationship between Government and Contractor. Rapidly changing needs, as well as rapidly changing technology, demand a process that provides a rapid solution to training needs, and includes the very best technical solution that is useful to the customer, while falling within schedule and cost constraints.

OBJECTIVE

To identify and respond quickly in fulfilling military training requirements requires an intelligent and collaborative effort among contractors, procurement agencies, and the customer. The collaborative process consists of individuals and teams with specific roles, resulting in a team of teams who collaborate to effectively distribute information of relevant knowledge, expertise, and share common views of goals. As team members share their mental models and test them in the environment, they collectively devise better ones. The better the shared understanding, the stronger the model. The process aims to achieve integration of users, manufacturers, engineers, and maintainers throughout the manufacture, documentation, test, acceptance, and support process. The goals of the process are to produce the most cost-effective training device, in the shortest period of time, while meeting real, rather than perceived, training needs. Essential to this process is the effectiveness of the training device. The users become the designers of the training methodology and human interfaces. The manufacturer evaluates the producibility, and the engineers evaluate the concept of the design for manufacture and maintainability.

THE PROCESS STRATEGY

The "Collaborative" process is one that has been developed in a common sense, "Demming-esque" manner. The first question asked is, "What is the system for developing and acquiring training systems?" with the all-important second question: “Why?” To understand this innovative process, a background on the older system and its failings is important.

The Old Process

The old process of procuring training devices is a model that has been established for acquisition of weapons systems. Figure 1 describes the 15 steps of a traditional trainer acquisition.

This process assumes a zero defect imperative. Additionally, the process assumes schedule is no object, funding is bottomless, and the user is incapable of communicating the requirement directly to the provider. The process also tends to demand a completely new development rather than using existing Government-owned intellectual properties, because a new specification is de-veloped for each new requirement. Weaknesses are evident in the source selection, user par-ticipation, and testing, resulting in undesired con-sequences. Additionally, this process tends to "pigeon-hole" participants into certain roles that are contrary to the team-first attitude necessary to deliver complex systems quickly and affordably.

Source Selection The primary weakness in the source selection area is that the Government's selection is based primarily on the responsible bidder that submits the best proposal. Although the "buzz" in the industry is best value, more often than not, best value equates to technically acceptable, low cost. A competitive buy tends to create a feeding frenzy amongst contractors where industry schemes how to deliver the lowest price and still satisfy the letter of the specification. Contractors also tend to team more for shared marketing resources than real technical need. The result: upon contract award, an adversarial relationship is established between the buyer and seller. The seller wanting to grow the program to recover dollars eliminated from bids during competition, the buyer wanting delivery of what was promised. The resulting compromise: cost growth with the promise of enhanced

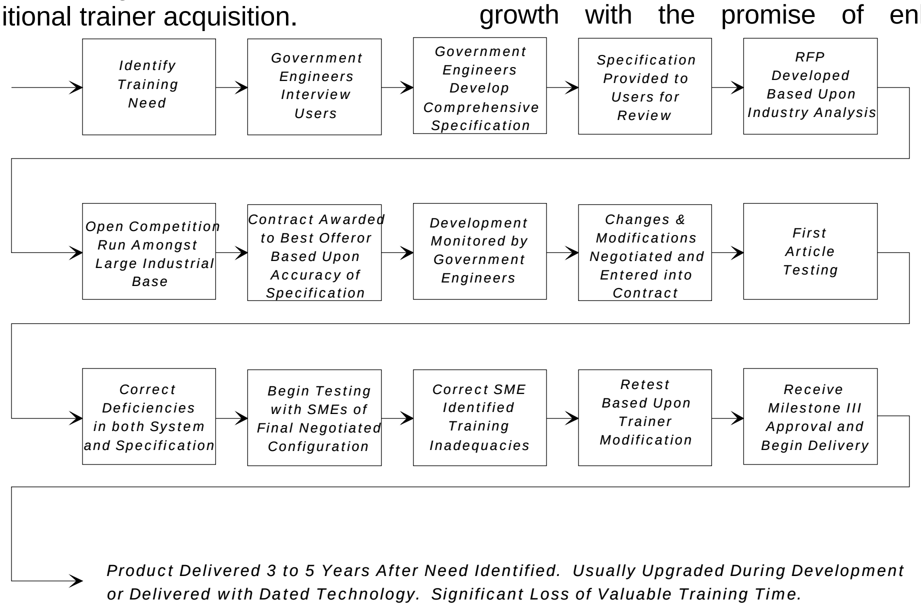

Figure 1. Conventional Trainer Acquisition Process

performance, however, these performance enhancements are not necessarily required by the user.

Essentially, this process does not even afford the Government the luxury of selecting the source; the process does that for them. If an analogy was drawn to purchase an automobile, you would write a specification for a car and, without seeing the car (it is not yet designed), you select a supplier based upon a written proposal. This is not how the average responsible American buys durable goods. The fact is the specification for training systems that is included in the RFP is never the final specification. Change is not only necessary, but often desirable. Yet, this acquisition process is most beneficial when the specification is anticipated to remain static.

Little analysis, by the technical team, is placed upon the most important aspect of source selection: the motivation of the supplier. Often small suppliers are eliminated from consideration because they are perceived to have too high of a risk. Large firms are selected where the "deep pockets" of the supplier provide a sense of comfort to the Government. The Government rarely bene-fits from these "deep pockets" and instead, ends up feeding a large appetite. Also, large or publicly held firms are graded on revenue growth and earnings. Stretching the schedule and cost growth are desirable program characteristics to large firms. Responsible small firms grade themselves on customer satisfaction.

The key in source selection is the Government is not looking for "lowest risk, lowest price" but acceptable risk with a fair price.

User Participation The old process also clearly involves the user at two key segments: the development of the requirement and the user testing phase. The immediate glaring weakness is the first stage: requirement development. The user often has a sense as to what he needs but rarely can visualize what he wants. A Government engineer documenting what he believes the user wants and returning the specification to him assumes a user is capable of understanding the systemic impact of a great deal of technical jargon to his trainer. The subject matter expert (SME) understands training and what it takes to achieve readiness, not specific details of implementation, such as Johnson's criteria or sub-pixel anti-aliasing.

This element of the process introduces another undesirable factor: accumulated error. We all remember when we were children and a message was passed through whispers, that the final message rarely even resembled the original. Effective communication requires the person with the need to communicate directly with the person satisfying the need.

Eliminating the SME from the process until testing ensures that whatever arrives at test will not be what the user wants. No matter how astute the Government engineers are, they will never possess the innate knowledge of training possessed by the SME. The only way an SME can affect the development is to participate throughout.

Testing The classical process of testing assumes the original specification was 100% correct. If you have a program where the supplier is satisfying the letter of the specification and the SME participate in a limited fashion, all the test does is prove the process a failure. Training effectiveness, which is actually the most critical feature of the trainer, is rarely tested. Testing which requires a completely finished trainer generally means the schedule cannot be shortened in any fashion.

Roles This process also tends to drive the participants into adversarial roles. (Figure 2)

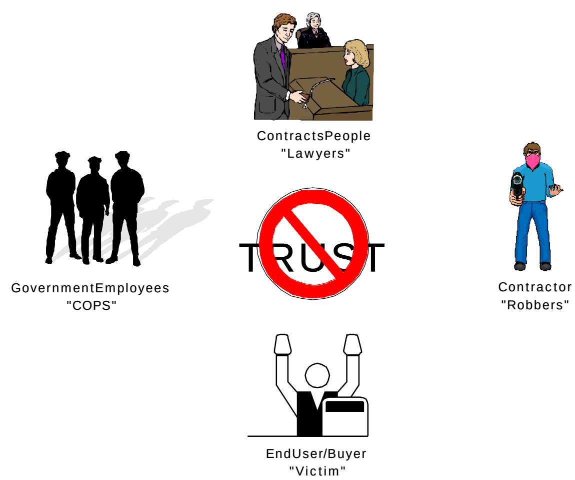

Figure 2. Roles

As described in the source selection section, there is a complete lack of trust on the part of the individual players. This is not a beneficial means of achieving program success. On past programs, the Government employees see their role as defending the position of the user. The supplier is treated as a criminal and consequently behaves as such, demanding compensation for every change whether there is a real cost impact or not. The user is held hostage by this process and Government and supplier contracts people haggle incessantly. It is not difficult to see the emphasis moves from working to create a successful system to fighting over money.

Even successful programs that have employed this process are often held captive by one of the organizations and the team has to live with it because this is the way the Government does things.

The New Process

The new process (Figure 3) makes some assumptions, that on the surface may seem to be great leaps of faith, but in point of fact are merely common sense. The first one is that a supplier can be found whose primary focus is in customer satisfaction and product development. Secondly that there are two hard "truths"...schedule & cost. In conceiving this new system, we first examine the desired roles of the participants.

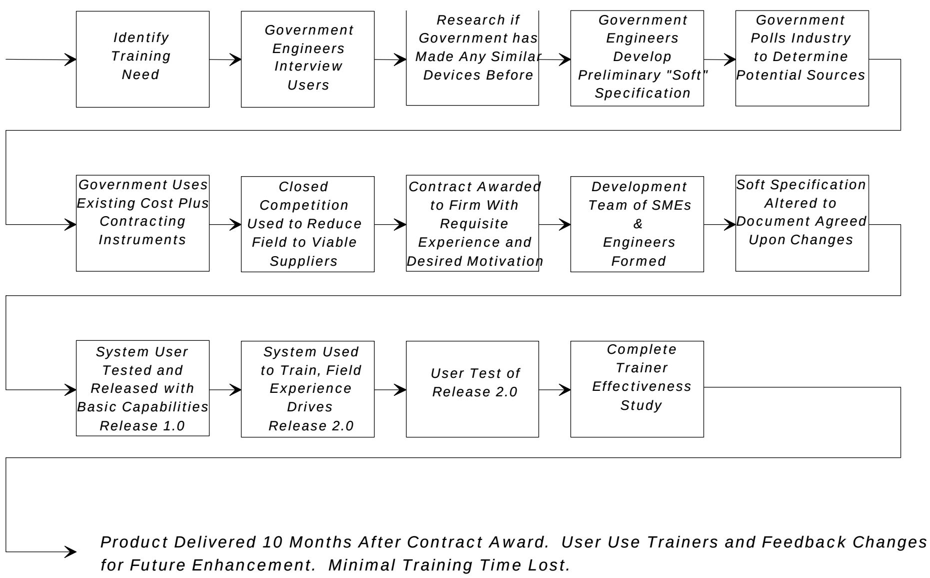

Figure 3. Collaborative Trainer Acquisition Process

An analysis of roles, just as in professional athletics, emphasis should be placed on the most important players. By definition, the most important players are the "doers". The "doers" in a trainer acquisition program are the SME's and the suppliers. All other players, Government and contractor management, Government engineers, logisticians become facilitators, not the COPs as in the older process model.

This places great emphasis on source selection. The source selection strategy used on the example LAV-FIST program was to use an existing cost plus contract that was in place with a responsible firm to reach the suppliers and manage the effort. This firm, along with Government representatives polled only valid potential sources and made a selection based on capability and motivation. The existing contracted firm was able to place a subcontract with the chosen suppliers in less than a week.

The collaborative process begins with a coopera-tive community, exchanging and testing ideas. The user community is brought to the table early, dur-ing product definition, and remains, through design and development, through delivery and operation.

Intelligent collaborative processes leverage rele-vant knowledge, expertise, and perspectives of the training requirements to develop reliable and innovative training solutions. Ideas are shared freely and creatively, to encourage the develop-ment of mental models and validate these in real-time testing in the manufacturing environment. Pro-active players allow rapid progress through problem areas. The application of new technology is tested by rapid prototyping. By designing a flexible and modular product, advances in technology are more easily accommodated. To keep cost down and shorten schedule, existing technologies are used whenever possible, including non-development items (NDI), COTS products, and re-used software. The Government has the role of facilitators, controlling tradeoffs in a flexible environment that includes user needs and cost and schedule limitations.

Fielding the system in a phased methodology results in the rapid delivery of usable systems. Phased delivery, in turn, results in the ability to allow feedback to effect improvements in the design of future releases.

PROCESS APPLICATION EXAMPLE

The U.S. Marine Corps (USMC) had an immediate requirement for training the full crew of the 25 MM Light Armored Vehicle (LAV). Training requirements include basic, advanced, and sustainment training in all gunnery skills to the vehicle commander, the driver, and the gunner. Additional training requirements include stand-alone training for each of these positions. The USMC preferred a training solution that provides interactive simulation in real-time with simulation equipment appended to, or attached to the actual LAV. This permits tactically oriented training exercises or scenarios to be run while the LAV sits motionless, even indoors. This concept allows the USMC to utilize the actual weapon system in the training environment, and they can remove the simulator, to deploy the LAV as required. Most importantly, the USMC needed these simulators at each reserve-training site by March 1997 to meet readiness requirements.

The fact is the program was not funded until March 1997. To meet the challenges and to expedite delivery, an existing cost plus contract was utilized to place the order. This order was in place 1 April 1997. The prime contractor assisted the Government in the evaluation of existing capabilities and systems (NDI) by suppliers of appended training devices. The prime contractor and Government decided to subcontract to a vendor that had just completed a Bradley-Full-crew Interactive Simulation Trainer (B-FIST) with similar weapon systems. Six other suppliers were evaluated on system availability, producibility, schedule risk, cost risk, and technical performance.

Program managers, engineers, logisticians and SMEs (instructors and operators from the USMC reserves and active duty) were teamed together with the prime and subcontractors from the very start of the program. Spokespersons were chosen for each team of teams to take lead on collectively expressing the views and input from their particular team. The stage was set for the collaborative processes to begin. What followed exceeded our expectation of cooperation and collaboration. The results were that an initial system was delivered in less than 10 months, with completion and fielding of final release tested and installed in all six systems in 15 months from date of contract award.

The Light Armored Vehicle Full-crew Interactive Simulation Trainer (LAV-FIST) clearly shows how cooperative collaboration provides a product that exceeds the customers' expectations, while keeping within cost and schedule.

The LAV-FIST is a fully-functional system offering precision gunnery training to the commander and gunner as well as driving and "swimming" practice for the driver of the vehicle. The project had a short delivery cycle and a number of technical challenges. The major challenges included implementation of the Helmet Mounted Display, stimulation of the thermal sight, repackaging the image generator and design of the instructional sub-system.

One of the unique features of this contract was the early involvement of SMEs. They were brought on-board at the very beginning of the program to verify and identify training requirements and provide constructive criticism of our design. This allowed the supplier of the system to concentrate resources on issues that contributed to the usability/improvement of the product and, as a result, the supplier was able to design and manufacture the first trainer in less than 10 months.

The LAV-FIST, a FIST-B variant, has LAV unique functions such as swimming, a helmet mounted display, and the ability to operate on-board ship. LAV-FIST benefits from using the well known user interface, that provides over 400 exercises designed to improve crew coordination and precision gunnery skills, and detailed student records. It provides training in seven different visibility conditions, desert and European terrain, and in both stationary and moving own vehicle scenarios. It also incorporates a SME/supplier designed Graphical User Interface (GUI) display, which streamlines the Instructor/Operator functions. All of the appended items can be installed with the vehicles' on-board tools. For the displays, the supplier concept of "Drop-in-Place Display Alignment Fixtures" requires no special tooling or alignment equipment. With this equipment familiar to the user, it allows the supplier to respond faster and deliver new customer requirements well ahead of schedule.

Additional functionality was designed into the LAV- FIST to allow the crew members to train using manual controls. Innovative techniques were required to mechanically interface our sensors with tactical multi-rotational controls of the vehicle. The LAV FIST simulated both the Commander's and Gunner's primary day sight, as well as, the Commander's and Gunner's Unity View Window. This was especially challenging since each day sight and unity window share the same optical path but have far different fields of view. Additionally, the LAV-FIST design provides the driver with three vision blocks to give the driver improved orientation over the single vision block simulated by the FIST-B.

The supplier also repackaged the image generator that is a COTS item. In its commercial cabinet the image generator would not go through the hatches of a ship and weighed over 350 pounds. They were able to reduce the weight by 40%, the size by 50% and the heat generated from the system by 30%. The supplier engineers were able to reduce the weight of the image generation (IG) system to 196 pounds and package it in a standard COTS shock isolated enclosure that meets the Marine Corps requirements.

KEY BENEFITS

The process of collaboration fulfills complex training requirements and produces the most cost-effective training device in a significantly reduced period of time. By including the SME "in the loop", rework is minimized, and a complicated set of requirements is distilled into a compact set of features, producing an accurate and usable training device, designed by the user. Cooperative relationships among team members allow the rapid evaluation of technical options and a speedy selection of a final choice. Tradeoffs allow the maximization of training needs without adversely affecting cost or schedule. The use of NDI, software re-use, and COTS products shorten the design cycle. Modular design accommodates advances in technology. Because documentation is provided only on the "as-built" system, costs are reduced and accuracy and completeness are assured. Customer satisfaction becomes the primary goal of the supplier.

CONCLUSION

This innovative process defines efficient development of effective "next generation" military training systems designed by the users to meet their needs in a collaborative environment. This pro-cess results in a very satisfied customer, and a product that exceeds expectations. It is a process that has the potential to meet the challenges of the evolving world of training systems.

ACKNOWLEDGEMENT

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