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Learning from Experience: Acquisition Professional Education for this Century

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Abstract

We have been educating and training people in acquisition skills since the days of the Polaris missile development and the Semi-Automatic Ground Environment (SAGE). More recently, the importance of an educated acquisition workforce was front and center in the 2019 Section 809 panel's findings, which recommended a new competency model for the career development of the acquisition workforce. The findings emphasize the necessity of gaining acquisition qualifications through "a combination of education, training, and practice." This paper suggests three themes to consider as we look to improving weapons systems development. The first is the project manager (PM) and leadership team. Today, more than ever, the PM is no longer the hero; in fact, project success is a direct reflection of the project leadership team, not just the project manager. The second idea is the way we educate the acquisition workforce. Rote and classroom-based learning was acceptable when it was the only option. Today, experiential learning offers a way to ensure we are imparting not just rote learning and certifications but providing our people the knowledge, skills, and experience to effectively control the efforts we charge them to lead. The third topic is focused on the mechanics of education. Using wargaming, we can create a learning environment that provides students experience in managing acquisition without failure.

Introduction

Defense programs often fall short of achieving their planned results, whether in capabilities or meeting planned costs or schedule. Examinations of the causes of failures over the past decades show a wide variety of reasons (Pickar, 2018; Tyson et al., 1989; Van Atta et al., 2015). The reasons range from optimism in cost and schedule estimates to technological challenges, and in most cases are a combination of reasons. The reaction to these failures has been an almost continuous wave of defense acquisition reform (Bair, 1994). In fact, we have been reforming the acquisition system frequently since the 1960s (Fox, 2011). The defense acquisition reforms range from revamping the approach to product life-cycle management to the periodic changes to the names of the phases of the acquisition framework. While there have been some successes, failures persist. The question becomes not whether we need another reform of the acquisition system; instead we must ask whether we are addressing the root causes of failures in acquisition and why programs behave in ways we do not expect (Williams, 2005). This paper examines the current education and training system for defense acquisition personnel and suggests some alternatives to the current practice in education defense acquisition professionals.

We have been educating and training people in project management skills (engineering as well, but that is beyond the argument of this paper) since the days of the Polaris missile development and the Semi-Automatic Ground Environment (SAGE; Hughes, 1998). More recently, the importance of an educated acquisition workforce was front and center in the 2019 Section 809 panel's findings, which recommended a new competency model for the career

development of the acquisition workforce (Rec. 59, Section 809 panel.org). The findings emphasize the necessity of gaining acquisition qualifications through “a combination of education, training, and practice.”

The paper has four parts. First is a discussion on the state of acquisition education and training. The second section considers the idea of teams in the context of project leadership and managing projects. The third section examines the idea of experiential learning and its application in the DoD acquisition learning environment. The paper concludes with a discussion on suggested framework to develop an optimal learning environment using collaborative analysis in a simulated environment.

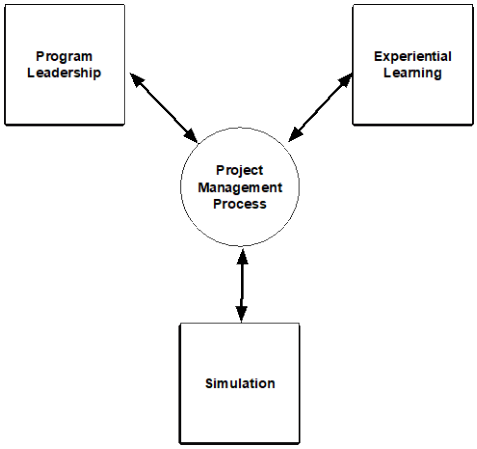

Figure 1. Acquisition Education Focus

Acquisition Project Management Education and Training

A necessary first step in any discussion on education and training is to explain the terms and how these concepts apply to the military and the acquisition worlds. At its most elemental, we train people to perform; we educate people to understand. It is possible to be highly educated and poorly trained, as well as being poorly educated and highly trained. Education is about theory, while training is about skills. In defense acquisition, we need to both educate project managers by providing the theory and the “why” we do what we do (Turner & Huemann, 2000). We also need to train to provide the hands-on skills they need to succeed. Education provides context and the tools necessary to understand a situation and identify what tools are needed to address that situation. Training provides the skills necessary to use those tools, but “mastery of theory, along with mastery of practical skills of the field, is a hallmark of professionals” (Monteiro, Santos, & Varajão, 2016).

Current education practices for the DoD acquisition workforce focus on traditional lecture and classroom exercise. Experiential learning, on the other hand, has long been recognized as the most effective means of acquiring professional education and skills (Hicks, 1996; Kayes, Kayes, & Kolb, 2016). The key difference in the suggested approach from that used by the Defense Acquisition University is an immersion process modeled on the proven Army Mission Command Training Program (MCTP). There has also been some DoD-sponsored work on experiential systems engineering education by Stevens Institute and others (Wade et al., 2013). Rote and classroom-based learning was acceptable when it was the only option. Today, the literature is rich with evidence that demonstrates the value of experiential learning (Hicks, 1996; Kayes et al., 2016).

Across the world, today's project management education is driven by what has become the de facto standard, the Project Management Institute's (PMI) Project Management Professional (PMP®) certification program. The PMP standards are based on the PMI-managed Body of Knowledge (PMBOK), a compendium of best practices. The promise of both the PMI certification and the PMBOK is that following the standards will result in project success—unfortunately, this does not seem to be the case.

The practice of project management has become synonymous with PMP certification, just as the practice of defense acquisition has become synonymous with DAU certification. That results in people mistakenly believing the answer to the question: "'Do you know project (or defense acquisition) management?' [is] really asking whether you know how to do such things as create PERT/CPM networks and S-curves" (Frame, 1999). Effective project management requires critical thinking and reflection—skills that can't be found in the PMBOK. While understanding how to build the artifacts of project management is important, it is insufficient to successfully develop weapons systems.

Experiential learning—whether an apprenticeship approach modeled on the current German educational and training approach or, as this paper will argue, a simulation-based system—offers a way to ensure we are imparting not just rote learning and certifications but providing our people the knowledge, skills, and experience to effectively control the efforts we charge them to lead. We need to focus the acquisition education effort on *learning* project management rather than *earning* project manager qualifications.

Project Leadership

In the DoD acquisition culture, indeed American management culture, the focus is on the project manager (PM)—the individual—as the primary weapons system development decision-maker. While it is true that regulations specify the PM is in charge, the reality of weapons system development is that it takes a group of individuals, a team, to gather and evaluate the necessary information and contribute to the decisions being made. The complexity of weapons system development, both technical and managerial, coupled with the limits of human capability, has forced people to specialize. The PM, while qualified in management, is at best an expert in one, maybe two disciplines. Projects depend on other experts, whether they are systems engineers, contracts specialists, or finance professionals. We need to recognize this specialization as beneficial in that we have dedicated experts in specific content areas, but that it also limits function because these specialists can only address those issues in their specific area, including that of the PM. In this case, the whole (knowledge of the experts) is really greater than the sum of the parts (individuals).

Recent academic studies of project management point to the fact that the traditional project management model (PM-centric) has been often augmented by self-managed project teams (Frame, 2002; Godé-Sanchez, 2010; Loufrani-Fedida & Missonier, 2015; Melkonian & Picq, 2010). These studies further describe the project management decision process as a team effort, collaborative and inclusive. We need to acknowledge what most practitioners already know—that it takes a team led by a PM to effectively oversee today's complex acquisitions. The PM is no longer the "hero" that makes the development successful, because project success requires a balanced team of domain experts—not just the project manager (Loufrani-Fedida & Missonier, 2015). We also need to acknowledge that, to be effective, teams require education and training not only on individual skills but collective skills as well and that collective training must be done with those members that will actually work together. Interestingly, many of these studies actually cite military operations and procedures to draw their conclusions, something the DoD can use to its benefit (Godé-Sanchez, 2010; Melkonian & Picq, 2010).

Teams

Teams consist of two or more individuals "who have specific roles, perform interdependent tasks, are adaptable, and share a common goal" (Baker, Day, & Salas, 2006). Studies of teams across many disciplines, from medicine to construction, note that key individuals invariably demonstrate high individual competence. However, notwithstanding the trend for most technical disciplines to work in teams, the teams demonstrate, at best, mediocre collective competence (Melkonian & Picq, 2010). The combined efforts of these specialists represent the data, the knowledge, and the effort necessary to make informed project management decisions in the high-stakes DoD acquisition environment.

Culturally, the military embraces teams. This has as much to do with service culture and doctrine as it does with the idea that the services fight as teams, whether infantry, ships, aircrews, or joint operations (Builder, 1989). Teams are central to the successful execution of military operations, both combat and acquisition. But teams must be trained to work together and develop the team skills necessary to accomplish their assigned tasks. Further, the ability to communicate rapidly and effectively with each other during missions is a prerequisite for effective teaming (Melkonian & Picq, 2010). The team must speak the same "language," a language that is learned from working together as a team.

Today we educate and train project managers, systems engineers, contract officers, and budget specialists separately. This approach is logical considering the basic educational principles of each of these disciplines. However, there is no educational or training environment to take these talented specialists and mold them into a functioning team. Further, this separation doesn't allow for the necessary and critical synergy developed when individual expertise combines to form something that is greater than the sum of its parts (Frame, 2002).

We need to acknowledge that it takes a team to effectively manage weapon system developments. Simply taking individuals, putting them together, and calling them a team (or making them work together on a development) is insufficient to effectively manage the complexity and the dollar value of the programs we are asking the DoD acquisition corps to manage. Certainly, no military commander would send a team to battle without first giving them the opportunity to train together. Similarly, no PM and team should be sent to manage the complex, ever-changing multimillion-dollar weapon system developments that are commonplace in DoD today.

Experiential Learning

Arguably, experiential learning—or learning from and by experiences—is a term that describes itself (Stellar, 2016). It is about learning from the results of individual and team decisions and actions—developing knowledge, skills, and expertise from doing the activities to be learned. In the medical field, experiential learning is a physician's internship and in some cases, residency. In the military, experiential learning is a type of on-the-job training—learn while and by doing. It is a way to provide experience. Neuroscientists believe the experiential learning process is the key to learning a profession and use the training of a surgeon as an example (Kolb & Kolb, 2017). The surgeon learns by doing—with the help of an experienced surgeon. The decisions the surgeon makes, the way he or she explores the body, is a function of experience gained or experiential learning. Similarly, businesses educate and train their high performers by providing them the opportunity to experience the breadth of the business and learn to manage a team. At Lockheed Martin, for instance, people identified as "high potential" employees are selected for a broad range of positions from engineering to finance to business development that provide them the experience they need to learn how to make sound business

decisions. They learn firsthand what each member of their team does so they can more effectively manage when promoted to the executive ranks.

This is how we should think about educating and training defense acquisition personnel, both individually and collectively. Experiential learning provides a perspective on the criticality of making serious managerial decisions. An experiential learning situation can provide the PM and team the ability to live the results of those decisions on the development of the weapons system without the consequences (Remington, Zolin, & Turner, 2009). The results conveyed as positive and negative, success and failure, on the three basic metrics of cost, schedule, and performance make the PM team aware of the second and third order effects of those decisions (Dörner, 1996).

The development of competence in a trade or profession requires learning a mixture of theory, skills, and behaviors to be able to deliver consistent and desirable results (Turner & Huemann, 2000). For tactical training, the military services have shifted to a mix of education and training with capstone exercises built on practical experience. The practical experience comes from mock battles—physical or virtual—in the field, at sea, or in command post exercises. This active learning is represented in the Army, for example, by tactical unit rotations at the National Training Center, and for divisions and above by the Mission Command Training Program (MCTP) expressed as the Warfighter (WFX) exercise (Chapman, 1991). A realistic environment, whether real or simulated, provides participants a stressful, true-to-life environment and true-to-life experience preparing them for the next battle. The premise is that stressful, experience-focused training prepares soldiers for the next battle, and that premise has been tested and proven repeatedly over the past 20 years.

We need to apply that same kind of thinking to the education and training in the acquisition world. While no one would directly compare fighting a ship, a brigade, or an air wing to managing a complex weapon system development program, there are some similarities—the requirements for information, the requirements for coordination, the requirements for decisions with resulting feedback, and the requirements of performing effectively as a team. Commanders, through their staffs' direct battle activities to accomplish military missions. Program managers, through their staffs' direct technology development activities to field capable weapons systems.

Collaborative Analysis, Also Known as *Wargaming*

The third leg of this new approach to acquisition education is a collaborative analysis learning technique or, more specifically, what the military calls *wargaming*. Collaborative analysis/wargaming is a broad field that ranges from engineering activities that require group approaches to strategic-level commercial and military actions that examine complex, high-level problems, like national responses to security challenges, including national approaches to pandemics. We define wargaming as a simulation of military or other activities involving at least two teams, using established rules, procedures, and human decision-making processes to produce learning in a defined environment. Figure 2 shows the range of collaborative analysis.

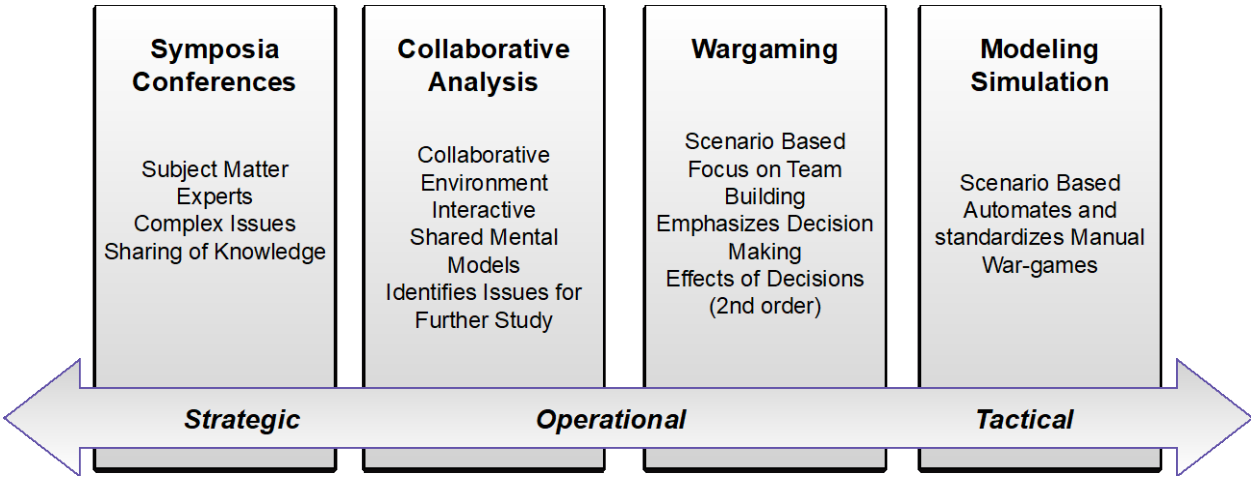

Figure 2. The Range of Collaborative Analysis

Wargaming is a tool to plan, train, and analyze. In the course of this analysis, participants work together to solve problems, which provides shared understanding. Wargames are events in which participants engage in a simulated environment using their own rules and processes to analyze, understand, and learn—resulting in a quantifiable outcome (Smith, 2010). Wargaming offers the participants the possibility of becoming totally immersed in a problem (Perla & McGrady, 2011). It enables individual and participants to learn by experiencing not only the stress of making decisions but by experiencing the results of their decisions, something actual PMs and staffs often miss because of the lag time between decisions and results (Dörner, 1996).

Like any educational activity, wargaming requires preparation, a venue, and a scenario. The preparation is both on the organization and participant side. The wargame approach applies to both acquisition organizations as well as educational institutions serving the DoD population. On the organization side, for both educational institutions and acquisition organizations, preparation means identifying the learning objectives for both individuals and the collective.

Recall the earlier discussion of the surgeon in training that emphasized the idea that in order to learn, one must be in the "operating room." Much as a surgeon can't learn to do surgery in a classroom, a PM can't learn to manage a program in the classroom either. A surgeon in the operating room, or a PM in the office, is neither the only nor the most important participant. Wargaming, in the appropriate environment, provides learning and experience. To illustrate, in a letter to the new president of the Naval War College shortly after World War II, Fleet Admiral Chester Nimitz made this observation about his wargaming experience at the Naval War College:

> *The war with Japan had been enacted in the game rooms at the War College by so many people and in so many different ways that nothing that happened during the war was a surprise—absolutely nothing except the kamikaze tactics toward the end of the war. We had not visualized these.* (as quoted in "Remarks at the Current Strategy Forum," U.S. Naval War College by Dr. D. Winter, Secretary of the Navy, June 13, 2006)

Realistic Environment

Wargaming places the student in an environment, whether the Pacific Theater in World War II, or an ACAT 1 development program office in Washington, DC. In fact, "wargaming gives them palpable and powerful insights that help them prepare better for dealing with complex and uncertain situations in the future" (Perla & McGrady, 2011, p. 2). Placing people in varying situations and then discussing their decisions, the results of those decisions, and their reactions to those effects of those decisions is central to the learning power of wargaming (Perla & McGrady, 2011). Unlike a classroom, a wargame (even though an artificial construct), can be made as realistic as possible. A central element of this realism is stress. The military provides realism by replicating the fog and friction of war using the actual command post and simulating radio communications, intelligence reports, and enemy activities. Further, the soldiers and sailors that would be in the command post are present and interacting. Using proven wargaming practices and leveraging validated experiential learning techniques, we can create an acquisition environment that will provide our key acquisition leaders valuable insight into their own strengths and weaknesses as well as the effects of their decisions without breaking cost, schedule, or performance objectives.

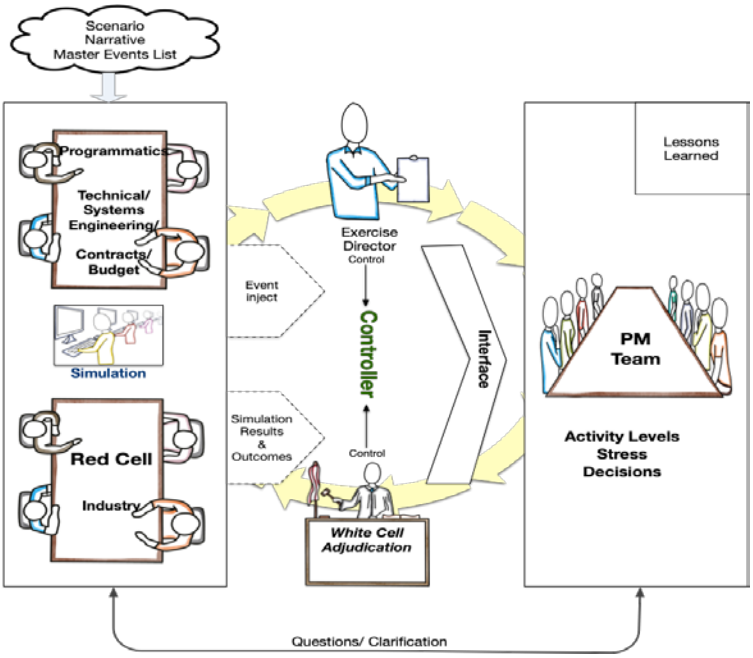

Figure 3. Notional Acquisition Wargaming Lab

At its most basic, wargaming can be done in what has been called the BOGSAT (i.e., bunch of guys/gals sitting around a table; Perla & Markowitz, 2012). In fact, some would argue that wargaming is best accomplished in this manner, although there are limits to the effectiveness of this approach (Perla & McGrady, 2011). However, given the availability of technology, including networking and visualization, dedicated collaborative analysis labs can provide a significantly better environment than the old wargaming table.

The practical requirement for the acquisition wargame is a collaborative analysis room with networked computers (Lim & Rogers, 2008). Figure 3 shows a notional laydown of a proposed wargaming laboratory. Each PM team member would have an individually addressed computer that allows communication with other team members as well as communication with

the control cell, which includes subject-matter experts as resources and adjudication of disagreements. The PM would have links to Red Cell players representing, for instance, the PEO, stakeholders, and the contractor PM. Similarly, team members would have links to their counterparts in the contractor company, as well as appropriate government contacts. The event is controlled by a senior mentor who acts as coordinator, master of ceremonies, and judge.

Wargaming Weapon System Development

The wargame, based on active-duty military training best practices, would consist of two phases (Offenhauer & Osborne, 2007). The first phase (Day 1) is a seminar concentrated on providing an environment for the PM team members to get to know their PM and each other. The primary goal of this first day is teambuilding, and it is led by a senior-level mentor, likely a retired general officer/flag officer or senior executive service. Using a prepared script, the mentor would guide the team through a series of acquisition problem-solving exercises. The team members communicate through the networked computers and by direct engagement among themselves (Lim & Rogers, 2008; Resta & Laferrière, 2007). Apart from these two forms of communication, each member has an anonymous chat capability. This allows frank discussion with no attribution and is useful when teams are new or consist of people relatively too junior to others, which might otherwise inhibit open communication. This facilitated environment provides an opportunity to understand each other's strengths and weaknesses, as well as their perspective (Resta & Laferrière, 2007). They get to know each other and how they react, an essential element of success in the complex and often ambiguous world of weapon system development.

The second phase (Day 2) is a simulation-supported exercise using a scenario developed for the PM team. The scenario is time-compressed and free-play, driven by the decisions made by the team. *Time compressed* means activities that would take months or even years to complete are compressed to minutes or hours. *Free play* means the outcomes of the exercise are determined by the decisions made by the PM and staff. For example, a decision to increase the scope of a contractual requirement is executed in a computer simulation, and the simulation will provide a response. That response could range from minor increases in cost and schedule to drastic consequences. The specifics of the simulation are not important, as it is transparent to the players. Instead, the ability for the PM and team to practice teamwork and management skills to meet the challenges of unforeseen results are tantamount.

To provide effective learning, a robust and realistic system model is critical. System dynamics as a modeling tool provides the basic structure for modeling the defense acquisition project used in the exercise. System dynamics is useful because it builds on a basic concept of flows and rework and offers the modeler the opportunity to influence the rate and diversity of the inputs to the rework process as a primary ingredient of the simulation. Figure 4 is a simplified model of the rework cycle (Cooper, 1993).

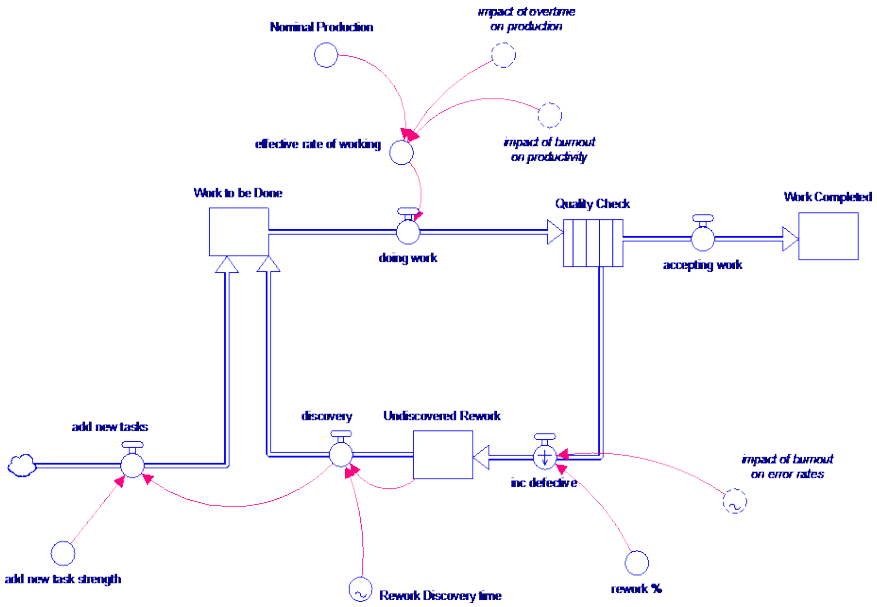

Figure 4. Simplified System Dynamics Model Including Rework

System dynamics tracks the flow of work to be done to completed work. Theoretically, the planned work to be done is executed and moves to the Work Completed box. The flow of work, however, is not that simple, and in fact, work to be done is either not completed or is not completed correctly in actual development projects. This work not done or not done correctly becomes rework—it needs to be done again (Cooper, 1994). The influences on the model will be controlled by modifying the dynamic flow. Causality associated with people and productivity are captured by causal loops, effectively changing the variables in the model. It will take time to fully develop the automated simulation, but using principles of collaborative gaming, we can quickly establish a prototype simulation that will be a mix of automation and human controllers (e.g., Red Cell, etc.). The collaborative gaming environment is built on the basic wargaming technique familiar to most, action-reaction-counteraction.

Scenarios

The acquisition wargame is based upon an actual DoD acquisition program. While the data and history of the program provide the basis to start the wargame, the free-play aspect of the wargame, along with the Red Cell, allows the PM and team to take the program in the direction they desire. The existing program provides not only a vast amount of data from which to develop the simulation environment, but also allows comparison between wargame performance and the performance and outcome of the actual program. The PM and team make decisions in response to the simulation-driven events. Using the accelerated game time, the team is forced to deal with the results of their decisions.

An essential element of the structure of the game is to adequately address not only the programmatics of the development, but the engineering, technology, contract, finance, and other activities that both lead to complexity and problems. As the wargame is refined over time, there will be separate but connected sub-models that could be also used in a stand-alone teaching environment, while maintaining connectivity to the basic flow of the overall effort. This teaching approach could be adapted for schools that teach defense acquisition, such as the Defense Acquisition University and the Naval Postgraduate School. For instance, systems engineering classes could use the stand-alone system's engineering model execute it as

training and then take part in an overall exercise. Alternatively, students in project management courses and systems engineering courses could use the stand-alone modules and then interact throughout their coursework. This approach could also be used as a capstone exercise in a formal educational setting.

Connecting the Dots

In a military wargame, the battlefield is simulated, and the decisions made by commanders and their staffs are executed in the simulation. In the proposed acquisition wargame, the development program is simulated and executes against a scenario based on a historical system development. In both cases, the simulation provides both scenario and feedback, placing participants in "real" tactical or technology "battles." The feedback allows participants to experience the results of their decisions in accelerated time. The value for the PM and team is the ability to experience the results of decisions that in life may have taken years to manifest.

Project management is a series of connected decisions that will one day become a fielded weapons system. Those decisions are not made in a vacuum, nor are those decisions exclusively driven by the project manager. In fact, PMs lean heavily on their leadership teams to assist in making those decisions. This proposed acquisition education model provides an evolutionary mechanism to build on the excellent classroom education and training available to the DoD.

No PM decides to make bad acquisition decisions; PMs and their teams make uninformed decisions. No PM decides to allow increased cost and schedule delays; the program team sometime fails to recognize the effects of their decisions. Learning through experience in a simulated exercise will help serving PMs and their leadership recognize what may become bad acquisition decisions and prevent them from occurring. An experiential learning approach to acquisition education using a simulation-based wargaming approach can help PMs and their leadership prepare for the responsibility of system development by allowing them to experience realistic programmatic events before they are exposed to the acquisition battlefield.

References

Bair, E. T. (1994). *Defense acquisition reform: Behind the rhetoric of reform.* National Defense University.

Baker, D. P., Day, R., & Salas, E. (2006). Teamwork as an essential component of high-reliability organizations. *Health Services Research, 41*(4 Pt 2), 1576–1598. Retrieved from http://doi.org/10.1111/j.1475-6773.2006.00566.x

Builder, C. H. (1989). *The masks of war.* Johns Hopkins University Press.

Chapman, A. W. (1991). *The Army's training revolution, 1973–1990: An overview.* Office of the Command Historian.

Cooper, K. G. (1993). The rework cycle: How it really works … and reworks. *PM Network,* 7(2), 25–28.

Cooper, K. G. (1994). The $2,000 hour: How managers influence project performance through the rework cycle. *Project Management Journal, 25*(1), 11–24.

Dörner, D. (1996). *The logic of failure: Why things go wrong and what we can do to make them right.* New York, NY: Metropolitan Books.

Fox, J. R. (2011). *Defense acquisition reform 1960–2009: An elusive goal.* Washington, DC: Center of Military History, U.S. Army.

Frame, J. D. (1999). *Project management competence: Building key skills for individuals, teams, and organizations.* San Francisco, CA: Jossey-Bass.

Frame, J. D. (2002). *The new project management: Tools for an age of rapid change, complexity, and other business realities* (2nd ed.). San Francisco, CA: Jossey-Bass.
Godé-Sanchez, C. (2010). Leveraging coordination in project-based activities: What can we learn from military teamwork? *Project Management Journal, 41*(3), 69–78. Retrieved from https://doi.org/10.1002/pmj.20178
Hicks, R. E. (1996). Experiential learning in a postgraduate project management programme. *Education + Training, 38*(3), 28–38. Retrieved from http://doi.org/10.1108/00400919610117399
Hughes, T. P. (1998). *Rescuing Prometheus.* New York, NY: Pantheon Books.
Kayes, A. B., Kayes, D. C., & Kolb, D. A. (2016). Experiential learning in teams. *Simulation & Gaming, 36*(3), 330–354. Retrieved from http://doi.org/10.1177/1046878105279012
Kolb, A., & Kolb, D. (2017). *The experiential educator.* Kaunakakai, HI: EBLS Press.
Lim, Y.-K., & Rogers, Y. (2008). A framework and an environment for collaborative analysis of user experience. *International Journal of Human-Computer Interaction, 24*(6), 529–555. Retrieved from http://doi.org/10.1080/10447310801971204
Loufrani-Fedida, S., & Missonier, S. (2015). The project manager cannot be a hero anymore! Understanding critical competencies in project-based organizations from a multilevel approach. *International Journal of Project Management, 33*(6), 1220–1235. Retrieved from http://doi.org/10.1016/j.ijproman.2015.02.010
Melkonian, T., & Picq, T. (2010). Opening the "black box" of collective competence in extreme projects: Lessons from the French special forces. *Project Management Journal, 41*(3), 79–90. Retrieved from http://doi.org/10.1002/pmj.20181
Monteiro, A., Santos, V., & Varajão, J. (2016). Project management office models: A review. *Procedia Computer Science, 100,* 1085–1094. Retrieved from http://doi.org/10.1016/j.procs.2016.09.254
Offenhauer, P., & Osborne, D. L. (2007). *History of the U.S. army battle command training program, 1986–2003.* Department of the Army.
Perla, P., & Markowitz, M. (2012). *Conversations with wargamers.* Retrieved from https://www.cna.org/CNA_files/PDF/D0019260.A2.pdf
Perla, P. P., & McGrady, E. D. (2011). Why wargaming works. *Naval War College Review, 64*(3), 111–130. Retrieved from http://doi.org/10.2307/26397225?refreqid=search-gateway:348790b18f4d37acc50bd9f2fb191df6
Remington, K., Zolin, R., & Turner, R. (2009). A model of project complexity: Distinguishing dimensions of complexity from severity. In *Proceedings of the Ninth International Research Network of Project Management Conference.* Retrieved from https://eprints.qut.edu.au/29011/1/c29011.pdf
Resta, P., & Laferrière, T. (2007). Technology in support of collaborative learning. *Educational Psychology Review, 19*(1), 65–83. Retrieved from http://doi.org/10.1007/s10648-007-9042-7
Smith, R. (2010). The long history of gaming in military training. *Simulation and Gaming, 41*(1), 6–19. Retrieved from http://doi.org/10.1177/1046878109334330
Stellar, J. R. (2016). *Education that works.* IdeaPress Publishing.
Turner, J., & Huemann, M. (2000). Formal education in project management: Current and future trends. *Project Management Institute.* Retrieved from https://www.pmi.org/learning/library/formal-education-project-management-trends-476
Williams, T. (2005). Assessing and moving on from the dominant project management discourse in the light of project overruns. *IEEE Transactions on Engineering Management, 52*(4), 497–508. Retrieved from http://doi.org/10.1109/TEM.2005.856572

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