Surviving the Perfect Storm: Ensuring Readiness with Integrated Training Technologies

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ABSTRACT

In today's volatile geopolitical environment, the demands placed on military training environments are growing exponentially. Commanders are struggling with significant resource constraints and resorting to extraordinary measures to accomplish their vital training mission. In most cases, military schoolhouses are conducting training operations with insufficient staff, equipment and resources. The current pressures on military training operations may negatively affect military readiness if the situation is not addressed. Training Transformation (T2) acknowledges that we must dramatically change how we prepare our troops, going from deliberate to adaptive war planning, and the consequent need for flexibility, agility, and adaptability. T2 also has prompted a shift to the capabilities-based approach and a state of continuous transformation. Now, military commands need to evolve the way they manage, resource and conduct training operations. To quickly deploy and employ prepared forces, we must rapidly implement lessons learned, anticipate operational training needs and continuously adapt training practices and technologies. Our paper will explore some of the root causes of the perfect storm: demands for military readiness combined with constrained resources, which is creating significant barriers to the implementation of T2. The fragmentation of legacy and single-service scheduling, training and logistics processes and systems that ultimately reduce training outputs contribute to the degradation warfighter readiness. We will explore proven solutions for resource-constrained training environments, including proper application of fully integrated, next-generation technology suites that can be leveraged as force multipliers to counteract unexpected surges in demand, achieve agile training capabilities and accurate measurement of training performance. We will discuss core principles for managing demand surges in the military training pipeline and discuss the application of technology to solve the complex problem of training scheduling, administration and logistics. Finally, we will outline lessons learned and best practices for commanders to consider as they modernize their training processes.

ABOUT THE AUTHOR

Ari Vidali is CEO of Envisage Technologies Corp. In his 20 year career in high-technology, Mr. Vidali has been the lead founder and visionary for 5 high-tech enterprises. Over the last 9 years, in his capacity as CEO of Envisage Technologies Corp., he has been instrumental in assisting military and law enforcement commands with training transformation strategies. His current work involves researching next-generation learning architectures, training ecosystems, automation of high-liability training, complex logistics management and operational automation. As a nationally recognized, visionary, frequent speaker and award-winning writer on the subjects of technology as an education enabler, complex logistics, human performance improvement, data standards, cyber security and Training Transformation, he has been featured in publications such as the Wall Street Journal, Chicago Sun Times, Indianapolis Star, Journal of Asynchronous Learning Networks, Journal of Systemics, Cybernetics and Informatics and PC Week. His most recent article *"Striking the Balance: Security vs. Utility"* was published by the NATO Science for Peace and Security Programme in the volume: *Modelling Cyber Security: Approaches, Methodology, Strategies* IOS Press, 2009

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"The current demand for forces in Iraq and Afghanistan exceeds our sustainable supply of soldiers, of units and equipment, and limits our ability to provide ready forces for other contingencies….I've never seen our lack of strategic depth be where it is today."

General Richard A. Cody, Vice Chief of Staff, US Army

INTRODUCTION

During the last decade, the demands being placed on military forces around the world have grown significantly. This is due to the confluence of several factors: today's volatile geopolitical environment necessitating significant US[1], NATO[2] and non-NATO troop contributions to active operations in Iraq and Afghanistan; the ongoing "Overseas Contingency Operation[3] (OCO)"; and increasing requirements to support non-combat operations such as homeland defense and humanitarian missions.[4]

In the United States, the Department of Defense's (DOD) standard training workload, which has grown steadily since 2001, has been compounded by the need to continuously rotate combat brigades in and out of the theater of operations. This has resulted in significant increases in National Guard and Reserve pre-deployment training as well as demand surges in "Reset and Train"[5] operations for returning troops.

These trends are intensifying the competition for resources and undermining the ability of our forces to modernize training, rapidly incorporate lessons learned and prepare for the asymmetric threats of the future. The future force will necessitate a high-level of training integration in order to achieve "jointness" in operations.[6]

The United States DOD has been pursuing a training transformation (T2)[7] strategy which acknowledges that in order to achieve success on future battlefields, forces must fight as an integrated part of a joint team. In their words, "[the] focus of [DOD] Training Transformation is to better enable joint operations in the future, where "joint" has a broader context than the traditional military definition of the term. [DOD] must be able to plan, coordinate and synchronize its actions across the

[1] "Since September 11, 2001, more than 1.9 million U.S. service members have deployed to Afghanistan, Iraq, or support operations overseas -- most of them once, many twice, a few three times or more." Sydney J. Freedberg Jr. *National Journal Magazine*, September 19,2009.

[2] NATO's operational tempo is higher than ever before, with around 85,000 troops deployed in Afghanistan and 10,000 troops in the Balkans, while the Alliance supports anti-piracy operations in the Gulf of Aden, anti-terrorism missions in the Mediterranean Sea, and training and advice initiatives for Iraq and the African Union. NATO has also responded to humanitarian disasters in Haiti, Pakistan and the United States after Hurricane Katrina

[3] 'Global War On Terror' Is Given New Name, Scott Wilson and Al Kamen, *The Washington Post*, March 25, 2009; Page A04

[4] "More than 22,000 U.S. service members were in Haiti at the height of the mission. Of those, about 14,000 were in ships at sea, while 8,000 soldiers, sailors, airmen, Marines and Coast Guardsmen were on the ground at any given time during the height of operations", http://www.defense.gov/news/newsarticle.aspx?id=59159

[5] Army Force Generation (ARFORGEN) is the structured progression of increased unit readiness over time resulting in recurring periods of availability of trained, ready, and cohesive units. Army units will proceed through the Reset and Train, Ready and Available force pools to meet operational requirements with increased predictability. Units in the Reset and Train force pool redeploy from operations, receive and stabilize personnel, reset equipment, and conduct individual and collective training. Unit collective training is focused on core Mission Essential Task List (METL) tasks, such as offensive and defensive operations. The Reset and Train phase culminates in a brigade-level collective training event. Units in the Reset and Train force pool are not ready or available for major combat operations. However, they should be ready to respond to homeland defense requirements and provide defense support to civil authorities at all times.

[6] Integrated Training is training supporting integrated operations. It includes joint training and training conducted by or with partner organizations, but focuses on the processes and requirements enabling a comprehensive approach for successful joint operations in conjunction with other organizations outside the DOD. Strategic Plan for Transforming DOD Training, February 5th, 2009.

[7] T2 is part of a broader DOD Business Transformation Effort.

full spectrum of services, joint, interagency, intergovernmental and multinational operations."[8]
To accomplish these goals requires dramatic changes in how troops are prepared, an evolution from deliberate to adaptive war planning, and a profound recognition that the future threat environment requires significant flexibility, agility, and adaptability. In an effort to achieve these goals, the Department has shifted to a "capabilities based" approach and a state of continuous transformation in training (T2). While strategically sound, the implementation of T2 will require a comprehensive restructuring of existing training operations into a seamless ecosystem that anticipates operational training needs and continuously adapts training practices and technologies to quickly deploy prepared forces to meet combatant commanders' needs.

THE PERFECT STORM IS READINESS AT STAKE?

"We are currently meeting all operational Requirements with ready, mission-capable forces, but sustained combat operations and our high operational tempo are taking a toll on our warriors, equipment, and full spectrum training readiness, as well as their families."

General Robert Magnus, US Marine Corps[9]

Even as Commanders recognize that transforming training is essential to a military's ability to adapt to 21st Century threats, for many, the ability to make progress is being severely hampered by a "perfect storm" that resides at the intersection of three colliding trends: sustained increases in operational tempo,[10] severely resource constrained training environments and reduced defense budgets. Taken together, these trends are unsustainable in the long term and, if at least one of them is not reversed, may be harbingers of eroding military readiness.

There is little doubt that the current operational tempo for military forces is having a significant negative impact across all levels of training operations. These organizations are struggling under consolidation pressures[11] and increased training workloads, that are being compounded by unsustainable losses of instructional personnel and training equipment as these resources are being repurposed for combat operations. The present situation amounts to nothing less than a systemic shortage of funding, qualified instructors and equipment to fully support the rapidly expanding and evolving training mission.[12]

It has been argued that the current situation may ultimately lead to what some have termed a "hollow force," a phrase coined during the post-Vietnam era describing a military force that lacks the necessary resources required to field trained and ready forces to support ongoing operations, and to modernize.[13] Declining defense budgets are, at a minimum, forcing commands to make difficult trade-off decisions between funding new or enhanced technology capabilities, ongoing operations support, and training transformation efforts.

The Training Management Triangle

Most military schoolhouses continue to execute their training mission as they always have. As demands increase, personnel work harder and longer hours.[14] Commanders make do with dwindling training resources: fewer qualified instructors are used to teach courses, contractors are hired to fill gaps in personnel, and "non-core" training is reduced to a minimum. While these stopgap measures may allow a training command to provide combatant commanders with the allotted number of warfighters, they lead to a degradation in the quality of training and are unsustainable in the long term.

Training, like any human endeavor, is performed under a series of conditions and constraints which ultimately impact the size and quality (or readiness) of the fighting force. One way to view the problem is to adapt the well known "project management triangle" to model training environments in terms of three interlocking and competing constraints (quantity or scope, time and resources) that each have a direct impact on the quality of training (Figure 1).

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[8] Department of Defense, Strategic Plan for Transforming DOD Training (2009)

[9] Statements made at the Senate Armed Services Committee (SASC) in March 2008

[10] We might also mention the cost of "wear and tear" on materiel and troops that sustained deployments perpetuate. However, that is both evident and assumed as an inevitable consequence of "increased operational tempo."

[11] In the US the Base Realignment and Closure (BRAC) is consolidating many service schools into "Centers of Excellence"

[12] Even in the face of increased deployments, US Army, Training and Doctrine Command (TRADOC) has reduced both military and civilian staffing authorizations by a total of 11,800 and significantly increased its dependence on contractors to support steadily increasing training operations. This is resulting in the "De-Greening" of the training force and has led to a backlog of over 900 man-years of training product development.

[13] Avoiding the Hollow Force: Maintaining a Trained and Ready Military, The Heritage foundation, April 18, 2006, James Carafano, Ph.D., Alane Kochems and David Gentilli.

[14] During periods of surge demand, it is not uncommon for military schools to implement a 6-day work week with up to three 8-hour shifts to accommodate the additional training work load.

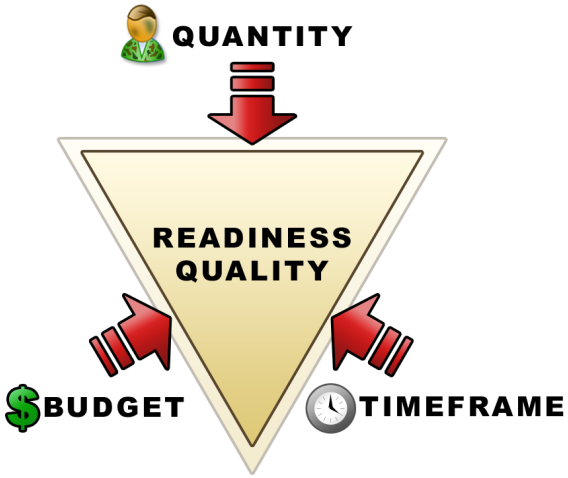

Figure 1. Training Management Triangle

Here each side of the triangle represents a constraint and no individual side can be changed without directly impacting the others. At most, two of the constraints can be "fixed" at any given time. For example, we can train more soldiers more quickly by increasing our budget, or we can reduce costs and time by training fewer soldiers. If all three constraints are impacted the result is a significant lowering of our training standards and a concomitant impact on force readiness.

Because the quality of training is an essential component of military readiness, few leaders would be willing explicitly to sacrifice quality for the sake of budget, quantity or timeline constraints. However, it is logical to conclude that given the current environment, this is precisely what is occurring because schools are being required to train more soldiers (quantity), more quickly (time), and with fewer resources (budget).
T2 envisions the future of military training as "enterprise-centric, open and collaborative, adaptive and incentive-based."[15] Yet today, most military schools lack the necessary resources or manpower to transform existing curricula, incorporate new doctrine and methodologies or implement the major policy and operational changes required by T2 without severely impacting their core training mission.

Given the confluence of complex demands, can military training organizations weather the perfect storm? Are there solutions and best practices that schools can adopt that will limit (or reverse) the negative impact of these constraints on existing training operations?

[15] Strategic Plan for Transforming DOD Training, February 5th, 2009 p.6

Weathering the Storm - The Efficiency Variable

Under tightening constraints, training organizations will need to seek operational efficiencies to maintain training quality standards. Many private sector industries have demonstrated that improvements in efficiency lead directly to increased throughput, lower unit costs and faster production without sacrificing quality. Are the lessons learned in the private sector such as "lean manufacturing, lean six sigma or lean dynamics"[16] directly applicable to increasing the efficiency and lowering the cost of military training?

To put this hypothesis to the test, we conducted interviews of training staff at all levels within 14 military training organizations. Our analysis was focused on documenting training information flows and quantitative cost modeling. We wanted to hear from those actually conducting or supporting training as well as from commanders to better understand their perceived state of training operations, uncover commonalities, and discover operational bottlenecks. Information and process flows were modeled in Microsoft Visio to allow visualization of "choke points' within the training pipeline. In addition, we developed a cost model to see if a direct correlation between operational inefficiency and per-unit (warfighter) training cost could be discovered. Our findings revealed that all of the organizations we reviewed shared a common set of challenges and traits spanning the entire training lifecycle, from registration to graduation. It was noted during our analysis that military training environments did not exhibit the same economies of scale found in most manufacturing settings, in which the per-unit cost decreases as production output rises. In fact, the very opposite was true. As surge demands rise, the "unit cost" per trained warfigther tends to increase disproportionately to the additional units trained. While this is partially due to a complex set of interrelated factors,[17] we found that a fundamental

[16] Use of the term "lean," actually refers to a production system introduced by Toyota Motor Corp. back in the 1930s. Lean manufacturing's approach to realizing efficiencies results in an environment where there is no waste and value is added during every process and activity. Lean dynamics takes a different approach. Introduced by the book, "Going Lean" Ruffa, Stephen A. (2008), does not directly target the desired outcome of waste elimination; instead, it focuses on identifying and addressing sources of "lag", or imbedded disconnects in flowing value through operations, decision-making, information, and innovation that lead to workarounds and amplify disruption when business conditions change. It promotes a different way of structuring the business that creates an inherent "dynamic stability" or greater responsiveness for accommodating shifting business conditions.
http://en.wikipedia.org/wiki/Lean_Dynamics

[17] Including inefficient "pipelining" i.e. the optimization of warfighter flows from recruiting through basic training and into their advanced individual training (AIT) which is largely a result of the inability to model capacities in real time and the "disconnected"

problem is the lack of accurate training capacity metrics available to inform the Structure and Manning Decision Review (SMDR)[18] process. The lack of objective training capacity information is a function of non-standardized scheduling processes embedded within the schools which cannot support the quantitative or qualitative measurement of training throughput.

intensive because required elements of planning; scheduling, resourcing and student tracking information are either non-digital (paper copy) or fragmented across numerous individual data files and legacy systems. This fragmentation causes significant administrative "friction" as information is not easily shared across process boundaries and requires significant messaging overhead as shown in Figure 2 below.

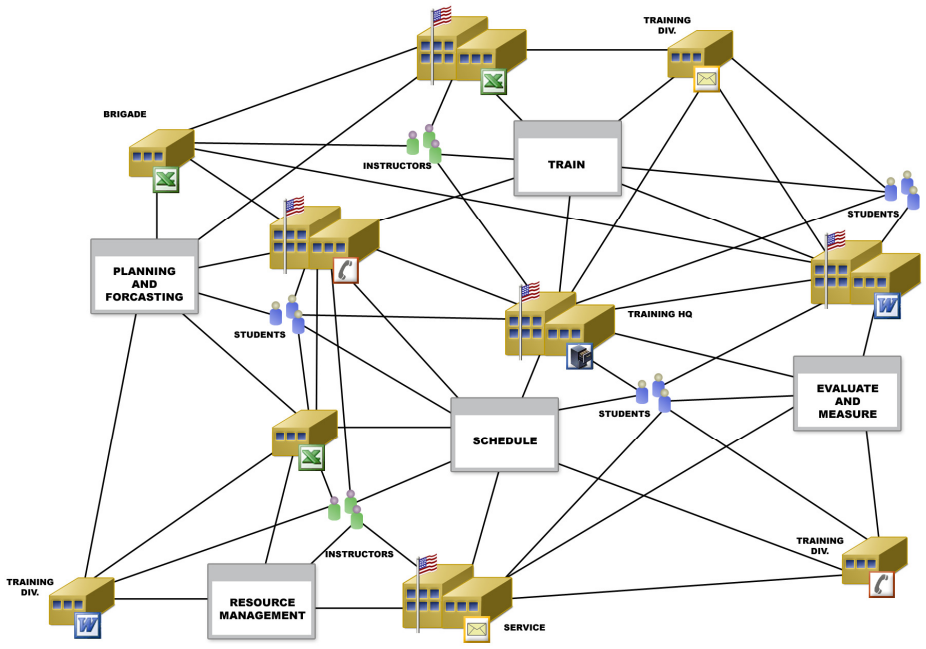

Figure 2 – Labor Intensive Messaging Overhead

Like any large scale endeavor, military training involves numerous, highly complex and interrelated business functions that must constantly be synchronized to support the effective planning, scheduling and execution of training. Many of the underlying macro and micro-processes we reviewed that directly enable the delivery, support and oversight of training were found to be highly inefficient, duplicative and uncoordinated. For most schools, the challenge of a high operational tempo is compounded by administrative processes that are unnecessarily labor-

This state of affairs is the very antithesis of "lean" manufacturing which aspires to minimal waste and promotes workflows that are designed to add value during every process and activity.

Most of the schools we interviewed lacked even rudimentary processes or tools for the tracking of resource allocations and utilization. High turnover rates for commanders, instructors and support staff are a further impediment to any training transformation effort.

Key findings:

1. Inability to measure resource utilization (how many hours per day a category of resource is used)
2. Inability to measure personnel utilization by task (how many hours instructors or support staff spend teaching, setting up classrooms, designing curriculum etc.)

nature of the current training establishments. An additional critical factor is the cost of soldiers in a hold-under status which a leading cause of increased per unit costs.

[18] Most military establishments have a similar process whereby manpower allocations are calculated based on the future force requirements and mission composition. We have found nearly identical processes within the Navy and the UK Ministry of Defense (MOD). For the US Army, the SMDR ". . . compares the total Army training requirements, on a by-course basis, for a given fiscal year, against the training capability of the concerned Training and Doctrine Command (TRADOC) school or training center. The SMDR also identifies constrained training programs."
http://www.tradoc.army.mil/dcsrm/mfad/smdr.htm

3. Inability to accurately measure capacity (the number of students that can be trained by program and timeframe). Capacity Planning is primarily based on the last year's schedule.
4. Scheduling is conducted manually, and is not adaptive to changes in other training workflows
5. Many resources (facilities, equipment etc.) that schools believed were constrained are actually not fully utilized
6. Perceived resource constraints are causing schools to deviate from the approved Program of Instruction (POI)
7. Process standardization is not institutionalized, processes are constantly "reinvented" when there is staff turnover
8. Scheduling granularity was based either on weekly or daily resource allocations, artificially inflating resource "needs" and causing significant resource and scheduling conflicts
9. There exists no culture of sharing between co-located schools
10. Outdated budgeting practices do not incentivize transparency and cost savings
11. Hold over/under expenses are significant yet have low visibility

Based on an analysis of the flow of information, we identified several areas where training commands could mitigate existing constraints by improving management practices and leveraging automation as a force multiplier to improve operational efficiency, reduce the average cost per trainee, increase student throughput and measure capacity. We demonstrated that these improvements can be achieved through a combination of policy, process, people and technology focused on optimizing and integrating the planning (scheduling and logistics) functions with standardized training workflows and recordation.[19]

In this paper, we focus on the two key areas which have the highest Return on Effort (ROE) and are essential for the implementation of T2: Automated Scheduling and Unified Training Operations.

Beyond Whiteboards - Complex Scheduling

One area in which military training can operate more efficiently and which has the potential of generating significant operational cost savings is automated scheduling. Scheduling is an essential function of any training environment. It impacts and informs every aspect of operations from capacity planning and budgeting to daily execution of training.

Most training commands still schedule the "old fashioned" way using paper, whiteboards and excel spreadsheets to determine the availability of resources.. Yet human scheduling "systems" are incapable of efficiently managing the sheer volume of information required to evaluate trade-off decisions when assigning available resources. In most cases resource availabilities are unknown during the planning phase , obliging schedulers to constantly adjust resource assignments "on the fly" if they are to resolve schedule conflicts. Within most schools, scheduling is a highly collaborative yet dispersed process in which no single entity possesses complete and authoritative information. Changes are communicated verbally or via email to affected parties, creating significant "lag" in operations. Our detailed analysis of the enterprise scheduling process across military training environments revealed five distinct scheduling activities or phases, which are depicted (Figure 3) below.

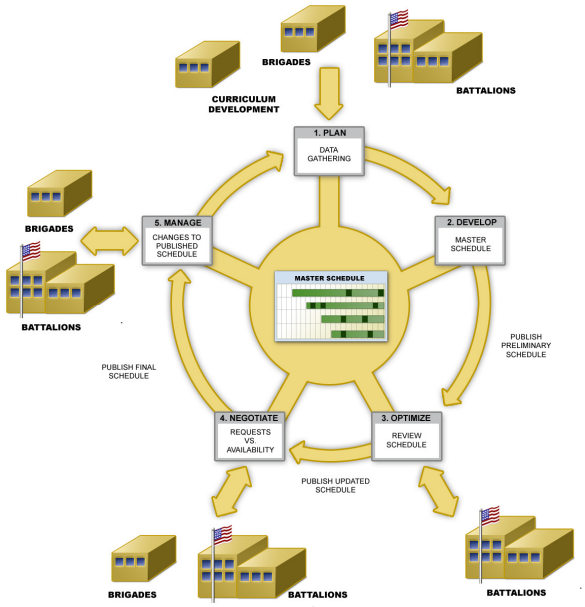

Figure 3. Enterprise scheduling process

To put the scale of the problem in context, an average size military school will conduct hundreds of training classes per year ranging in length from a single day to several months long. Each individual block[20] of training within a program of instruction (POI) requires

[19] Ari Vidali, *Best Practices for Enterprise Scheduling*, January 4th, 2008

[20] A "block" of training is a discrete training event (1 hour-1 day long) where a specific topic will be taught and which requires the assignment of instructional and/or other resources. Programs of Instruction or Courses are made up of many discrete "blocks" of instruction.

the assignment of an average of 6 resources[21] per block of instruction. Thus, the number of individual resource assignments, availability profiles and calendars that schools typically need to manage can easily exceed 1.5 million per year.

Table 1. Typical Volumes (Large School)

Event Resource Pairings *Typical Large School ~20-24k trained/ year*	
Programs	400-600
Class Iterations	800-1000
Students per Class	24-48
Avg. Length	8-12 weeks
Avg. Number of blocks/ POI	250-400 blocks
Resources Assigned (per block)	4-6
Annual Event/Resource Pairings	1.2 – 2.4 million
Avg % of Students Awaiting Training	2-3%

The calculation required to estimate the number of annual event to resource pairings is simple and can give training organizations a quick benchmark of scheduling scope (1).

$$\mathbf{c} \times (\mathbf{b} \times \mathbf{r}) = \mathbf{TRP} \quad (1)$$

Where:

c = Class Iterations
b = Average Number of Blocks per Program
r = Average number of resource pairings per block
TRP = Total Resource Pairings

Total TRP matters because any change to the execution schedule immediately causes significant ripple effects throughout the organization. For example, a classroom requiring maintenance impacts dozens of individual (instructor, student, resource and facility) calendars. These impacts need to be quickly resolved and efficiently communicated to all affected stakeholders including students, instructional staff and resource managers. As numerous impacts to the schedule occur daily, the communication problem rapidly compounds.

Given the sheer volume of information inherent in the scheduling function, it is easy to see why current manual scheduling processes will not effectively or economically scale to support military training and how this, in turn, can result in sub-optimal classroom and resource utilization, frustrating double-bookings, and students being maintained in a costly hold-over/under status. Likewise, there exists no efficient means of sharing constantly changing training and resource availability information across training divisions when it is maintained on whiteboards and spreadsheets. Nor is it possible under these circumstances to compile accurate utilization metrics to support optimal resource load leveling during the planning and budgeting process. Even more concerning is the cost of these inefficiencies.

The cost of inefficiency -- The average daily cost for a warfighter in non-combat status (including pay, benefits, meals & lodging) is roughly $250/day. Students being held in a "hold-under" status are essentially non-productive for our armed forces. They are not performing their primary duties and are not acquiring new skills. To better understand the impact these students have on the military budget, we modeled the hold under costs generated by an average large school and found that annual costs can easily exceed $30 Million/year. The total non-productive headcount for a Service can exceed a full Brigade and cost taxpayers *hundreds of millions of dollars* in fixed and variable expenses per year. However, because these hold-under costs are spread across numerous budget line items, no single entity has oversight or is incentivized to reduce them.

If military training were a commercial enterprise, this set of circumstances would inevitably lead to catastrophic business failure.

Scheduling Technology – The State of the Art

Technology exists today that can help automate many labor intensive scheduling processes. These state-of-the-art-systems support accurate measurement of training throughput, facilitate capacity planning, automate conflict resolution and provide visibility into resource calendars. In addition, these technologies can facilitate long range planning and the rapid creation of multi-day schedules by using pre-configured schedule templates. If utilized in conjunction with a scheduling-specific business rules engine (BRE), scheduling algorithms can intelligently assign and "optimize"[22]

[21] Training resources in this context can include instructional personnel, facilities such as a classroom, various training ranges or computer labs, equipment and consumables.

[22] "Optimal" is a somewhat fluid concept given that it requires specific context. For example circumstances may dictate that an "optimal" schedule is one that produces trained warfighers at the "lowest cost" as opposed to one that optimizes for maximum training throughput. As we have seen with the Training Management Triangle, only two constraints can be "fixed" at any given time. In this context, optimization should be focused on resource utilization and conflict avoidance which in effect amounts to increased throughput and lower costs per unit trained.

resource allocations while enforcing POI specific sequencing and dependency rules.[23]

If properly implemented, automated scheduling has the potential to radically improve training operations by providing a real-time "common operating picture" for all stakeholders, thus simplifying resource allocation decisions and eliminating conflicts. Access to accurate and timely scheduling information for everyone in the training "value chain" from student to resource manager will also improve a school's ability to rapidly scale operations during periods of surge demand and adjust resource allocations "on the fly" to meet evolving needs. T2 requires precisely such significant improvements in organizational agility, collaboration, and efficiency.

There are two primary architectures for enterprise scheduling solutions; *Stand-Alone Aggregators* and *Modular Software Suites*. The distinction between the two is significant as we outline below.

Stand Alone Aggregators – Systems that fall into this category attempt to "integrate" data from existing training databases into a "common" decision support environment. Data from these legacy "feeder systems" - which can include curriculum design, registration, resource management, personnel systems and others - is aggregated. This aggregate dataset is overlaid with dashboard and visualization tools in order to create a uniform interface which augments the information pulled from the existing systems. This approach purports to reduce the cost of implementing enterprise scheduling by "re-using" an organization's existing legacy data. In this way training organizations can continue to utilize their existing administrative processes with minimal retraining or business process reengineering required. Stand-Alone Aggregators can conceivably be implemented by IT staff alone, which, during times of high operational tempo, makes the approach theoretically desirable.

At first glance, the "convenience" of such a solution might seem compelling. While potentially useful for creating a rudimentary "common operating picture" or decision support system, extra care must be taken to ensure the validity of the underlying data as it remains highly volatile. Stand-Alone Aggregators do not achieve improvements in operating efficiency within the training pipeline nor are they a means to modernization because they inherently perpetuate the poor data management practices embedded in the legacy training process.[24] Additional drawbacks to this approach include:

1. Overly complex technology infrastructure
2. System integrations are costly to build and maintain.
3. Legacy systems data is not "clean" and often lacks the required attributes for scheduling[25]
4. Significant gaps in execution scheduling data due to paper processing and stand alone files
5. High potential for costly errors in both planning and execution scheduling.
6. Does not address the critical problem of process fragmentation within the schoolhouses

In short, the most significant barrier to establishing seamless planning and scheduling across the enterprise is often an inability to effectively interface the various stand-alone systems that were created to address individual needs or only a limited subset of the training lifecycle requirements. Stand-alone aggregations are at best a "stop-gap" measure, at worst, they actually create significant barriers to modernization because they fail to address the fundamental transformation requirements of T2.

Modular Software Suites – In contrast to Stand-Alone Aggregators, implementation of modular software suites require training commands to standardize, justify and where appropriate redefine training workflows and data management practices. Processes where value is not being added during discrete activities are eliminated. Modular Suites are designed to incorporate and enforce data management best practices and ensure that each individual training process is adding value to the training enterprise. For example, student tracking processes are tightly coupled to scheduling ensuring that if a student departs due to injury or illness, the

[23] It is important to note here the there is a substantive distinction between enterprise training scheduling solutions (those that are architected to manage and link vast quantities of temporal and curriculum data) and geospatial visualization tools that are focused primarily on facility capacity planning such roadway optimization, traffic flow modeling, facility and range upgrades or construction, and other aspects of facility management.

[24] It might be argued that the stand alone aggregation can be developed utilizing a Service Oriented Architecture (SOA) and thus would not create fundamental impediment to modernization. This is only partially true as many of the legacy systems are not capable of participation in an SOA and would require significant retooling at a high cost to effectively interface. Also, this approach still fails to improve inefficient training processes as it perpetuates current behaviors.

[25] We reviewed numerous official Programs of Instruction (POIs) that are published by TRADOC and compared the same with data present in their legacy Army Systems Approach to Training (ASAT) system and individual school's Commandant Approved Schedules. The results were revealing in that most of the POIs manifested significant material errors in both content and block lengths that would have caused an automated scheduling process to improperly calculate required resource and instructor assignments.

scheduling process is natively "aware" of that event and can immediately adjust required training resource allocations for that class. Similarly, a facility requiring maintenance informs personnel of a scheduling conflict in real time. This fully-integrated approach creates tremendous efficiencies within a training organization as communication "friction" is reduced to an absolute minimum.

It is important to stress that complex scheduling environments are highly collaborative and that an efficient scheduling process requires clear communication between parties (Schedulers, Registrars, Curriculum Designers, Instructors, Students, Resource & Facility managers, Garrison operations, Housing & Maintenance managers, and others) during schedule change negotiations. It is when communications break down that training commands experience a rapid escalation of schedule conflicts, inadequate event resourcing and high hold-under rates.

Modular software suites are designed to be inherently collaborative. They achieve a high-level of efficiency by fully integrating all of the critical *processes* that impact the training schedule. Training stakeholders contribute data and update the status of the schedule automatically, simply by processing their daily tasks. This information in turn can prove invaluable during capacity planning, when costly trade-off decisions must be made.

For scheduling and capacity planning to provide meaningful information, the underlying data must reflect the actual disposition, availability and quantities of the individual people, resources, housing, and facilities that need to be scheduled. These data must be standardized, fresh and validated before capacity planning can be effective, as they represent the baseline (current state) of an organization's current capacity. Long-range planning needs to take into account this current state as a benchmark from which it can assess both shortfalls and excess capacities. Imagine an airline trying to determine its resource requirements for next year's schedule. Based on market demand, management has decided that some routes will need to be added, and others removed. Without knowing how many working planes, pilots, crews, fuel, parts, etc., are available, there would be no way of determining whether a shortfall existed and, if so, how severe. Nor could the airline determine the optimal time for its new flights by scheduling them during periods of excess capacity.

Long-range scheduling and capacity planning should use accurate "current state" data as the starting point for the "What if?" analysis which allows a command to model various resource and schedule scenarios and provides support for the frequent trade-off decisions that commanders need to make between strategic priorities, budgets and operational necessities. Long-range planning is especially useful when a Command needs to manage anticipated surge demands, perform budget modeling and make policy decisions. Because modular software suites enforce data management best practices and are designed to institutionalize a consistent, standardized process across the enterprise, they are ideally suited to support high-level decision making with accurate information.

Failures and Successes

Beyond a few forward-leaning schools and small-scale pilot tests, most military training organizations have yet to successfully adopt enterprise scheduling technology.[26] We found that this was due to five contributing factors:

1. **Scheduling is complex.** A high-level of cross-domain expertise is required to lead an enterprise-class scheduling effort. Pilot projects failed because oversimplification often led to unrealistic expectations.
2. **Sharing is not institutionalized**. Many schools have little incentive to share resources (inter or intra school) or promote transparency in operations. There is a fear that "Jobs will be automated away" and that less money will be allocated if resource utilizations are perceived to be low by the chain of command.
3. **Fragmented training systems**. Scheduling requires harmonized curricula, people and resources data to make allocation decisions. Required scheduling data is either non-existent or fragmented across duplicative and non-standard training systems.[27]
4. **Lack of strong program managers.** Most scheduling pilot projects failed due to lack of strong program managers, frequent project manager turnover, and insufficient long-term leadership support.
5. **Training Workflows not standardized**. Each of the 14 schools we reviewed had entirely different

[26] In this regard the UK Ministry of Defense is somewhat ahead of their US counterparts as they developed a modular software suite (TAFMIS) in the 90s for the British Army to automate training and scheduling functions which, while outdated, is well entrenched and has standardized their training workflow.

[27] The US Army alone has dozens of "single purpose" training systems which store curricula (POI), people, resources and facility data. However none of these were architected with enterprise scheduling in mind and most lack the requisite scheduling attributes.

processes for managing everything from student transcripts and instructor certifications to resource requests and scheduling.

These early failures coupled with the significant impediments to the adoption of enterprise scheduling might seem discouraging to some. However there are also some notable exceptions. For example, the US Navy reported significant successes with automated scheduling in 2001. Originally developed under the Small Business Innovative Research (SBIR) program in 1999, the Navy's TOURS decision support software was deployed across 11 Navy and Marine Corps schools to automate over 600 courses. The TOURS project resulted in savings of over $50 million/year, an impressive 450% increase in student throughput, and a savings of 119,518 training and 1,354 instructor man-days per year.[28] Notwithstanding these impressive statistics, TOURS was eventually abandoned. Like many promising technologies, it lacked the requisite funding and high-level support required to be fully institutionalized across the Navy enterprise.

The US Army Ordnance Mechanical Maintenance School (OMMS) located on the Aberdeen Proving Grounds in Maryland, successfully implemented automated scheduling in 2004. Based on an internal study conducted in 2005 it was confirmed that the scheduling technology (Acadis OnSchedule) saved the OMMS over 23,960 labor hours/year, lowered scheduling related costs by 62%, increased schedule efficiency by 74%, significantly increased schedule accuracy across the school and reduced costly "hold-unders." OMMS abandoned their successful scheduling project when the school was consolidated into the Combined Arms Support Command (CASCOM) as part of the Base Realignment and Closure (BRAC) process.

Both these examples prove that automated scheduling is not only possible but also, that it can provide the necessary efficiency improvements for training commands to adapt to resource constrained environments. However, they are also a sobering reminder that technology and process innovation cannot fully take hold without determined leadership. In recent years, there have been several attempts[29] in the United States to develop a "top down" *centralized, "multi-echelon"* scheduling capability. These are signs that the underlying constraints on the military training pipeline are pressuring some Services to reevaluate scheduling automation as a means to model capacity and increase training throughput. It is interesting to note that in most of these cases, the functional requirements point to a strong desire for a technological "quick fix" based on the stand-alone aggregation model and a false assumption that "*optimization*" of the training pipeline is possible without process standardization.

There are three reasons why this "top-down" model is unlikely to provide the anticipated return on investment:

1. **It does not solve the underlying problem.** Inefficiency inherent in the legacy training processes is simply incorporated into the new system. Nor does it reduce the messaging "friction" that is a significant contributor to existing capacity constraints.
2. **Accuracy of the data is questionable**. If the data from the "feeder systems" is inaccurate, automation will simply compound the capacity problem.
3. **Creates strong barriers to innovation**. Further entrenches legacy systems and processes as the aggregation relies on these for information.

Given the complex nature of the domain and the urgent need to improve data management practices in preparation for T2, training commands may need to take bolder steps towards unifying and harmonizing training operations.

Training Ecosystems: Unified Training Operations

T2 envisions an unprecedented level of process and data integration. Accomplishing this will necessitate a rapid evolution which will eventually lead to the extinction of many legacy systems and stand-alone processes. These "endangered species" may tenaciously cling to life but will ultimately be forced to give way to new, highly evolved operational models such as Training Ecosystems. Like its namesake, a training ecosystem is a highly symbiotic community of inter-dependant processes whose scope encompasses the entire "hire through retire" lifecycle. This collectivity is more than the sum of its parts because it

[28] http://www.navysbir.com/docs/1999Navy_Success3.pdf (page 22)

[29] For example, the US Army has issued multiple Requests for Information (RFI) over the years for centralized scheduling. Recent examples include the ASSET (Army School Scheduling/Resourcing Enterprise Tool) in 2007 and the Army Enterprise Scheduling System (ESS) in 2010 both of which are based upon stand alone aggregations. In contrast, the UK Ministry of Defence (MOD) is pursuing a Defence and Individual Training Management (DITM) which is **modular suite** described as"*an information system enabled change programme aimed at harmonising and managing the existing tri-service Regular and Reserve individual training business processes.*" http://www.mod.uk/DefenceInternet/MicroSite/DES/OurTeams/InformationSystemsandServicesTeams/ApplicationServicesTeamast.htm

focuses individual behavior towards a common set of goals, and promotes a highly transparent, enterprise-view of training outcomes.

Training ecosystems will enable new levels of collaboration, data sharing and alignment between traditionally disjointed human resources functions, such as recruiting management and training operations, because the individual processes across the entire training pipeline will be fully integrated and measurable. (Figure 4)

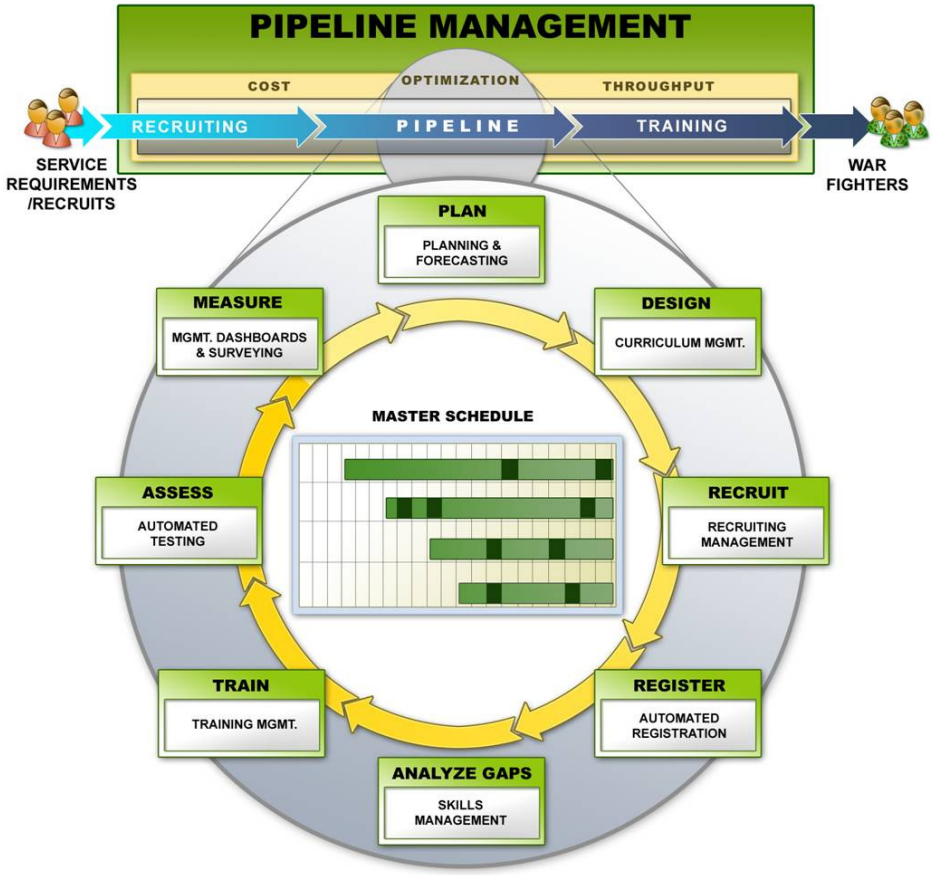

Figure 4 – Training Ecosystem, Unified Operations

Information (not data) is the vital nutrient that feeds a training ecosystem. The system will thrive to the extent that each training process evolves to become "natively aware" of environmental[30] changes once messaging friction between discrete processes is eliminated. As the ecosystem matures, its value improves exponentially with each legacy process that it absorbs. This is because the information these workflows produce are no longer inaccessible and can now be seamlessly shared across the enterprise. For example, recruiting commands will be able to easily crosslink information regarding the origin of highly successful students, enabling pinpoint accuracy when determining the productivity of recruiting pools for specific occupational specialties. Such pinpoint accuracy allows for a highly-focused, less costly marketing approach. Likewise, critical manning decisions can be informed by real-time recruiting and training pipeline *"confidence indicators,"* which will take the guesswork out of forecasting based on trade, the number of deployable warfighters who will be graduating from the training pipeline during any given period. These same data, when viewed historically, can feed precise recruiting quota calculations that account for historical attrition averages. Training ecosystems will spawn an entirely new breed of "services" for students, instructors, course designers, administrators and commanders: services that were inconceivable within a fragmented systems landscape. Perhaps most important will be the ability to continuously assess training performance by tracking metrics for almost any process within the ecosystem. One such key indicator, for

[30] Such as student counts, housing inventory levels, asset disposition, class cancellations, availabilities of personnel and other factors that materially impact events within the pipeline.

example, is "cost per trained warfighter."[31] While the optimum value varies widely by occupational specialty, it nevertheless is a key indicator of training efficiency.

The highly desired ability to optimize the "hire to retire" pipeline has largely eluded most militaries around the world. The complex series of dynamic constraints within the pipeline itself can only be resolved once the underlying operational processes across recruiting and training continuum act in unison. Like our central nervous system, these underlying processes provide the necessary signals that allow commanders to make agile and informed trade-off decisions when planning their manpower needs.

The Human Factor

To achieve the intensity of process and data integration, training ecosystems require a holistic approach which a technology solution alone cannot provide. There are many issues military commands will need to address as they transform training operations, not the least of which is the significant change management effort. Overcoming the "human factor" will require a well-articulated vision and a highly methodical approach to implementation. As with any significant organizational change, success requires sustained and dedicated leadership across all levels of the training organization in order break down the longstanding barriers that prevent collaboration and innovation. As one Army Colonel observed, "*there are lot's of turf battles . . .even though we are on the same team, there are many folks who won't share their resources or consider changing the way they do things*."

A frequent yet critical mistake during "transformational" projects is the tendency to implement an enterprise-wide technology-only solution before the underlying process itself has been perfected. This creates significant disruption in operations and further compounds the problem of data fragmentation. In most cases, these projects either fail outright, or require significantly longer to take root because stakeholders have no motivation to adopt them and find work-arounds instead.[32]

A command wishing to implement a training ecosystem should consider the lessons learned from earlier successes and failures, and implement a methodical multi-phase approach:

1. **Start small**. Implement a Training ecoystem within a *single* representative schoolhouse. Until the standard process is proven within a single school, enterprise roll-out is premature.
2. **Perfect the process**. Do not broaden the scope until the "first adopter" school is complete. Be persistent and use an *iterative* approach to perfect the process until it is fully implemented.
3. **Perform a lessons-learned analysis**. Incorporate what was learned to accelerate implementation at the next school.
4. **Methodical roll-out.** Execute a rational roll-out strategy across the training enterprise, taking into account high-value targets and current operational tempo.
5. **Standardize before Optimization.** It is impossible to optimize capacity before standardization is complete. Decision support will be the last component to be added to the ecosystem.

CONCLUSION

T2 presents an unprecedented opportunity to redefine military training operations. The agility, adaptability and "jointness" required by future forces will necessitate unified approaches to scheduling, coordinating, and delivering world class training that leverages technology as a force multiplier. To avoid a fundamental erosion in military readiness, our armed forces should strongly consider a training ecosystem strategy if they are to replace the fragmented landscape of single-purpose systems and inefficient processes, which are standing squarely in the way of Training Transformation. The inherent symbiosis which is the foundation of a training ecosystem will accelerate process and technology innovations that have been largely stymied by the status quo.

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[31] We acknowledge that **quality** is the primary indicator of readiness. This too can be tracked in an ecosystem by rolling up objective grade/score data into a numeric indicator of quality. Without an ecosystem approach, this is not even remotely possible.

[32] We uncovered numerous examples of costly enterprise systems that were being minimally utilized because they did not add value and created unnecessary duplication of effort within a functional domain.