SECOND-GENERATION PARADIGM

By staying ahead of product growth, PEO STRI improves efficiencies

by Brian E. Kemper and Dr. Jeremy T. Lanman

BETTER INFORMATION, BETTER TRAINING
Soldiers perform live-fire qualification on a Digital Range Training System Instrumented Range. Live Training Transformation (LT2) products allow for improved training data collection and after-action review capabilities in heavy tactical vehicle training, live-fire gunnery training and qualification, and combined live-fire exercises. (U.S Army photos.)

BRINGING TRAINING ALIVE

Soldiers undergo a simulated improvised explosive device attack at Camp Blanding, FL. LT2 products enhance the training experience by providing battlefield tracking, control of effects, and after-action review.

With success comes growth that often introduces new challenges. The key is to address these challenges early and to proactively develop next-generation solutions. For Project Manager Training Devices (PM TRADE), this involves streamlining the software product line to support the efficient production of systems by reducing the complexity of development, deployment, and sustainment.

As noted in the article "Integration Imperative: Transforming live training through common standards" (*Army AL&T* Magazine, October-December 2011; **http://asc.army.mil/docs/pubs/ alt/archives/2011/Oct-Dec_2011.pdf**), PM TRADE has taken the lead within Program Executive Office Simulation,

Training, and Instrumentation (PEO STRI) in evolving core asset-based product lines through the introduction and development of the Live Training Transformation (LT2) strategy.

The LT2 Family of Training Systems is based on the Common Training Instrumentation Architecture (CTIA), common components, and other LT2 core assets. The CTIA is the technical framework that provides commonality across training instrumentation systems and is the live training instrumentation interface to the Live, Virtual, Constructive Integrated Training Environment. It consists of standards and protocols to be used by system developers and is the core software infrastructure of training instrumentation systems.

Reusable LT2 core assets consist of the open architectures, common software components, standards, processes, policies, governance, documentation, and other assets. Together these make up the common approach and frameworks for developing live training systems in support of home station, deployments, Military Operations on Urban Terrain, the Maneuver Combat Training Center, instrumented live-fire range training, and Joint training domains.

Maximizing component reuse reduces fielding time and minimizes programmatic costs, while enhancing training benefits. "This live training transformation has generated a considerable return on investment within PM TRADE's live training portfolio and realized significant cost avoidance for the Army

Product Line Management

Figure 1
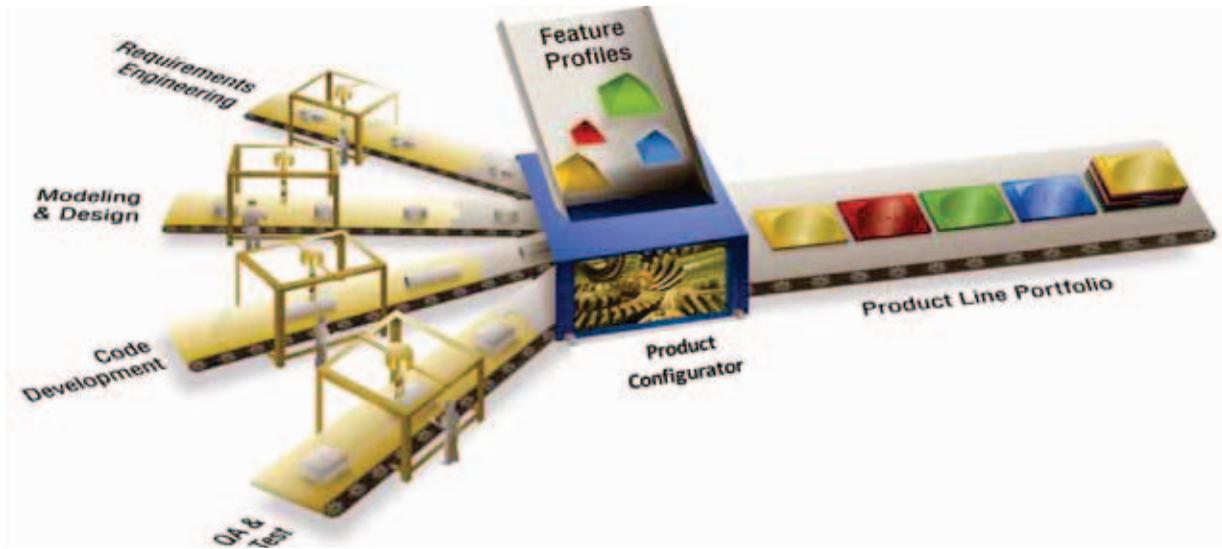
Second-generation product line management (2G PLM) introduces a new factory model, whereby products are created from feature profiles and an automated product line factory, generating all variants of products and programs from a consolidated set of core assets. (SOURCE: Program Executive Office Simulation, Training, and Instrumentation.)

across development and sustainment," said COL Mike Flanagan, PM TRADE.

The LT2 product line architecture, standards, assets, and environment have been used by more than 16 major Army and DoD live training programs, with more than 130 systems fielded. (See "Supporting the Warfighter.")

Second Generation Product Line Engineering (2G PLE) techniques will ensure that the PM TRADE software product line strategy maintains the combat edge and builds resilience in our forces by providing state-of-the-art training systems using a Consolidated Product Line Management (CPM) paradigm. This enables an automated production line process that optimizes productivity and cost, eliminates duplication and divergence, and provides scalable and efficient means of production. With CPM/2G PLE, the

Army live training domain has made an investment in an advanced product line systems engineering capability and is reaping substantial benefit.

SUCCESS BRINGS CHALLENGES
This widespread usage of LT2 products presented challenging repercussions. The first-generation software product line reduced stovepipe development and the initial cost of developing new products in the LT2 family. However, with this product-centric perspective and increasing demand, managing the multiple customer variations could have become an issue as the portfolio continued to evolve. Product teams could pull individual components and add features unique to their individual solutions.

With each new baseline created, the cost and effort would begin to grow

exponentially for merging software features and patches from the products back into the core assets and then out to other members of the product line.

"We recognized early on that as the number of successful deployments in the LT2 product line grew, the associated exponential growth in cost and complexity for maintaining the integrity of the product line would become difficult to manage," said Mike Dillon, CTIA Project Director. "To optimize productivity and cost, we needed to eliminate duplication, divergence, and the resulting merging. Our most effective way ahead would be to implement a product line approach that provides scalable and efficient means of production."

With these challenges identified, PM TRADE is implementing Second Generation Software Product Line Management

(2G PLM) to consolidate the LT2 product baselines using variation management and an integrated, feature-driven, product-line factory approach to software (see Figure 1). This incremental approach incorporates state-of-the-art automated software tools and processes, management dashboards, and software product line technology, all while protecting the investment in the existing LT2 core assets.

"The main shift in 2G PLM is realizing it is much more effective to view systems and software product line engineering as creating a means of production—a single system capable of automatically producing all of the products in a product line—rather than viewing it as the creation of numerous interrelated products," said Dr. Charles Krueger, Chief Executive Officer and Founder of the consulting firm BigLever Software Inc., and an internationally known software product line expert.

FEATURE-DRIVEN PERSPECTIVE

2G PLM allows for an automated process of generating all variants of products from a consolidated set of core assets. This means of production is simpler, more agile, more scalable, and more cost-effective. Shifting from a product-centric to a feature-driven perspective supports core assets based on the needs of the entire product line, resulting in high levels of reuse, deep asset expertise, and optimal quality. This eliminates uncontrolled growth in complexity management and allows us to move beyond trying to keep up with all the current product issues and instead to focus on the evolution of the LT2 product line.

Supporting the Army vision to evolve live training solutions and to improve cost efficiencies in a resource-limited

SUPPORTING THE WARFIGHTER

LT2 software assets have been used not only by the Army, but also by the Marine Corps and Air Force to meet their requirements ahead of schedule and for significant cost savings.

The Marine Corps Instrumented Training System was developed reusing 87 percent existing LT2 software and was completed in two years, saving $11 million and seven years in schedule.

The U.S. Air Force Counter Improvised Explosive Device (IED) After-Action Review System leveraged LT2 assets and fielded seven training systems to meet the Air Force IED training needs at four bases, with very little developmental investment.

LT2 Exercise Control, a composable set of capabilities, has been systematically leveraged for 13 different products fielded around the globe, delivering more than $94.2 million in cost avoidance for new product development, as well as significant cost avoidance for new equipment training, sustainment, and procurement.

environment, the 2G PLM approach provides the means to:

- Protect the significant live training investment.
- Provide for the continued development, production, and sustainment of LT2 products and ease the insertion of new technology.
- Realize objectives for return on investment and sustainment cost avoidance.
- Enable managers to maintain visibility and provide enhanced configuration

control of their systems, to avoid duplicating efforts.

CONCLUSION

"Managing the LT2 product line based on features rather than products will result in optimized scalability and improved time-to-field, ensuring our Soldiers are prepared for the challenges they face on the modern battlefield," said Flanagan.

PM TRADE is focused on systemic reuse to eliminate redundancy, increase cost avoidance, and improve production efficiencies. The 2G PLM approach demonstrates PM TRADE's dedication to remain at the forefront of finding efficiencies, providing Soldiers with the realistic training solutions necessary to ensure that they are the best-trained force in the world.

For more information, visit the Live Training Community portal at **www.lt2portal.org**.

BRIAN E. KEMPER is the Live Training Transformation (LT2) Chief Engineer for Program Executive Office Simulation, Training, and Instrumentation (PEO STRI) in the office of Project Manager Training Devices. Kemper holds a B.S. in electrical engineering from the University of Central Florida.

DR. JEREMY T. LANMAN is the Lead Systems Architect for PEO STRI's Common Training Instrumentation Architecture and Consolidated Product-Line Management construct, supporting the LT2 Family of Training Systems. Lanman holds a B.S. in computer science from Butler University, an M.S. in software engineering from Embry-Riddle Aeronautical University, and a Ph.D. in modeling and simulation from the University of Central Florida.