United States Army
Live Training Transformation (LT2)
Product Line

SPLC 2013 Hall of Fame Nomination

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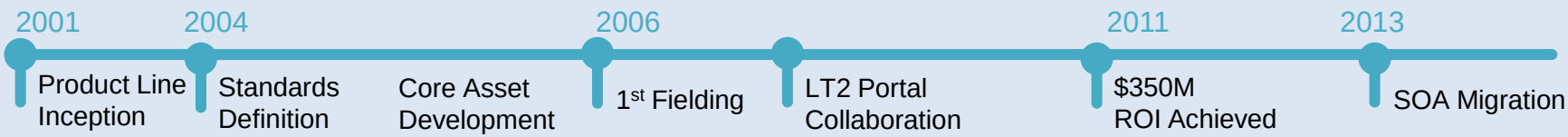
Introduction to Live Training Transformation (LT2)

- Live Training Transformation (LT2) is the product line strategy of United States Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI).
- Prior to the LT2 product line, live training systems were developed separately by a variety of different manufacturers.
- LT2 uses a common architecture with common data, standards, processes, and components.
- LT2 is a proven and mature product line



Hall of Fame Criteria (http://splc.net/fame.html)

1. The family that constitutes the product line is clearly identified.
2. The family is explicitly defined and designed as a product line.
3. The product line has had a strong influence on others who desire to build and evolve product lines, and has gained recognition as a model.
4. The product line is commercially successful.
5. There is sufficient documentation about the product line that one can understand it without resorting to hearsay.

Is the Family Clearly Identified?

- Yes: There are currently 13 systems funded, deployed, and managed as members of the LT2 product line
  - Military Operations on Urban Terrain systems
  - Maneuver Combat Training Center systems
  - Instrumented live-fire range training systems
  - Homestation live training systems
  - Various Joint (that is, inter-Service) training systems
- These systems are deployed and operational on over 200 sites.

Is the Family Clearly Identified? (cont'd.)

- Other parts of Army and DoD have commissioned additional members of the LT2 product line*:
  - CIEDAS – Counter IED (Improvised Explosive Devise) After Action Review System (USAF)
  - SMS – Soldier Monitoring System (Army – SOCOM)
  - I-TESS II – Instrumented - Tactical Engagement Simulation System II (USMC)
  - MC-ITS – Marine Corps Instrumentation Training System (USMC)
  - RISCon – Range Instrumentation System Control (USMC)

* These systems are described in "Second Generation Product Line Engineering Takes Hold in the DoD," *Crosstalk: The Journal of Defense Software Engineering,* 2013 (accepted for publication)

Is LT2 Explicitly Defined/Designed as a Product Line?

- Yes: It could not be otherwise!
  - The requirement for LT2 issued by the U.S. Army *explicitly* called for a software product line solution.
    - It was the first requirement in the U.S. Army to do so, and perhaps the first in the entire U.S. Department of Defense.
  - For over 10 years: Industry, Academia and Government teamed up to provide an explicit product line solution for the U.S. Army's Live Training Transformation programs.

Is LT2 Explicitly Defined/Designed as a Product Line?

ASSISTANT PROJECT MANAGER TRAINING DEVICES - APM TRADE

Live Training Transformation (LT2) Product Line

Project Office: APM Training Devices (APM TRADE)

LT2 Portal

MISSION:

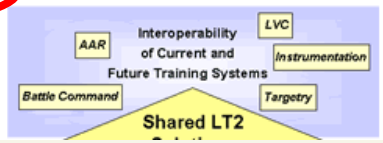
To provide the **Project Manager for Training Devices (PM TRADE)** a product-line strategy to efficiently and effectively address future live collective training systems acquisitions by focusing on the shared requirements of all live domain training systems with the strategic objectives to maximize commonality and systematic component reuse and to ensure interoperability across the live, virtual and constructive domains. The LT2 product line reduces fielding time, minimizes acquisition costs, enables total ownership cost reductions across the live training domain, the Live, Virtual, Constructive-Integrated Training Environment (LVC-ITE), the live domain and enhances training benefits afforded to the Soldier through software and component reuse.

DESCRIPTION:

The **LT2 Product Line** focuses on live-training domain requirements, LVC and joint interoperability to maximize component reuse, reduce fielding time, minimize programmatic costs and enhance training benefits afforded to the Soldier. The LT2 product line includes live training systems in support of homestation training, deployed training, Military Operations on Urban Terrain (MOUT) training, Maneuver Combat Training Center (MCTC) training and instrumented live-fire range training. The LT2 product line is comprised of programs that use the Common Training Instrumentation Architecture (CTIA), the Future Army System of Integrated Targets (FASIT) architecture and the LT2-CTIA components to implement the various product instantiations, such as the Objective Instrumentation Systems (OISs) for the MCTCs,Homestation Instrumented Training System (HITS), Army live-fire Digital Range Training Systems (DRTS), Integrated-Military Operations on Urban Terrain Training System (I-MTS), Exportable Training Capability-Instrumentation System (ETC-IS), One Tactical Engagement Simulation System (OneTESS), the Targetry Range Automated Control and Recording (TRACR) program and the New Generation Army Target Systems (NGATS) ground target programs.

PRODUCT LINE STRATEGY:

Through successful execution of the product line strategy, LT2 will deliver a set of assets that provide integrated and interoperable training solutions for live collective training across the homestation, MCTC and deployed and joint training domains. The LT2 product line vision is captured in the figure at the right and in the following program objectives:



live instrumentation, Tactical

ecific services and associated equipment

www.peostri.army.mil/PM-TRADE/lt2_productline.jsp

Is LT2 Explicitly Defined/Designed as a Product Line? (cont'd.)

- The LT2 family of training systems is explicitly based on the Army's Common Training Instrumentation Architecture (CTIA).
  - Technical framework that provides commonality across training instrumentation systems
  - Provides interface to the Live-Virtual-Constructive Integrated Training Environment (LVC-ITE), a common instrumentation platform for training systems.
  - Consists of standards, protocols, infrastructure services, and common software components to be used by system developers
- LT2 core assets include open architectures, common software components, standards, processes, policies, governance, documentation, and more

Is LT2 Explicitly Defined/Designed as a Product Line? (cont'd.)

- LT2 vision: Create a family of live training systems using a common architecture with common data, standards, processes, and components.
  - Facilitates the rapid development of new products
  - Ensures that products across the LT2 product line can communicate and interoperate with each other.
  - Permits changes, upgrades, and fixes developed for one product to be applied to others
- Product Line is expanding to include a larger segment of the live training domain
  - Military target systems extending FASIT standard
  - Tactical Engagement Simulation Systems
  - Physical transmitters and receivers

Does LT2 Have Strong Influence as a Model?

- Yes: LT2's influence as a model comes from
  - Being well known in the U.S. Army and beyond
  - Its strong programmatic and economic success
  - Its strong publication history (25+ journal papers, articles, and conference proceedings)
  - Cited by the Software Engineering Institute (SEI) at Carnegie Mellon University as the product line model for the DoD.

- Select Recognition
  - U.S. Army Acquisition Excellence Award for Information Enabled Army from the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT))
  - Excellence in Enterprise Information Award from the Association for Enterprise Information (AFEI)
  - U.S. Army Modeling and Simulation Office (AMSO) award for Cross-Cutting category in applying LT2 product line to embedded training and development of common test and training solutions.
  - U.S. DoD Defense Standardization Program Outstanding Performance Award in recognition of distinctive contributions promoting standardization within the Department of Defense.

Does LT2 Have Strong Influence as a Model? (cont'd.)

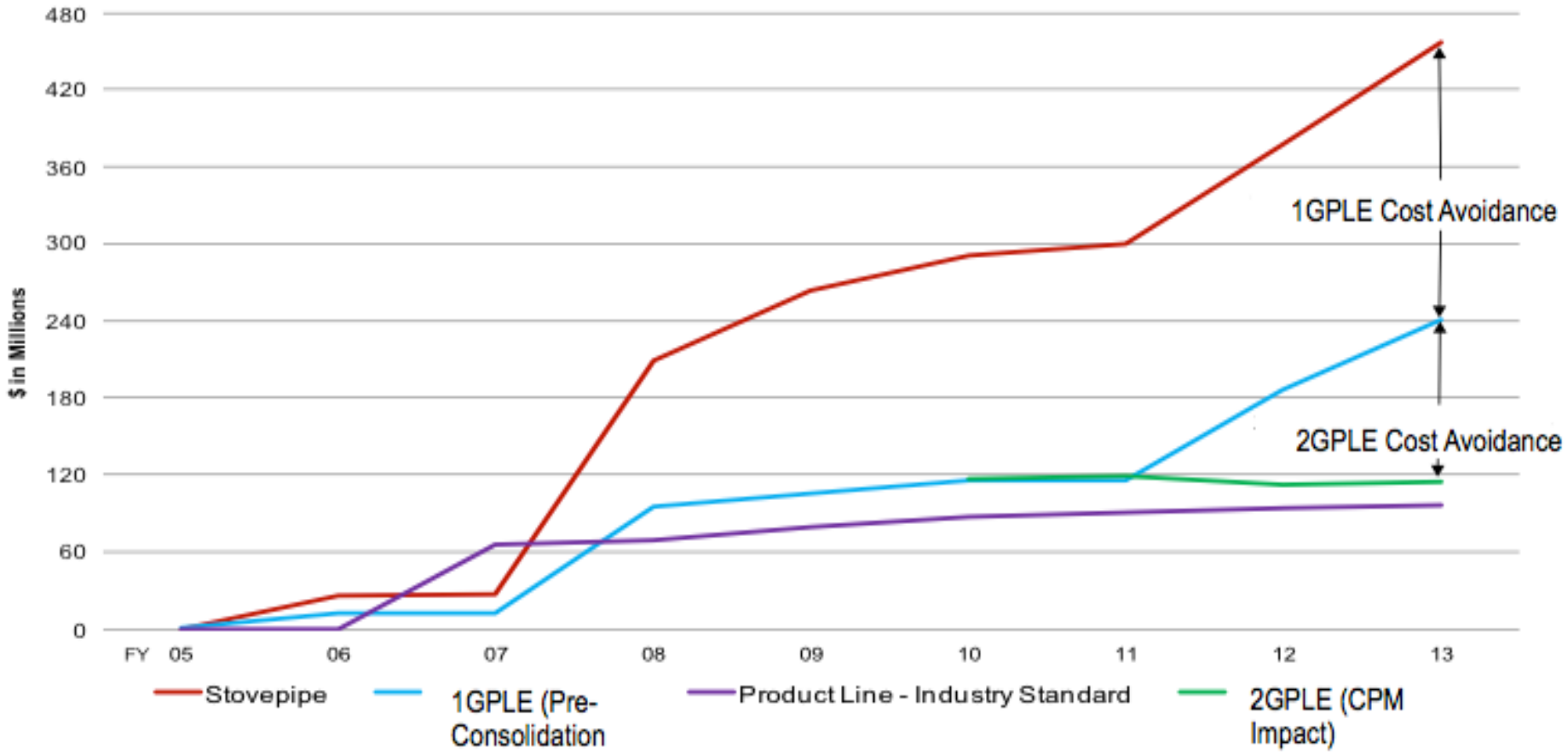
- Yes: LT2's influence as a model comes from
  - Its sponsors introducing and teaching it explicitly as a product line, and capturing/sharing product line lessons learned

Is LT2 Commercially Successful?

- Yes: The U.S. Army has fielded 13 members of the product line, deployed on over 200 separate sites.
- *Programmatically* successful for the Army
  - Beyond the U.S. Army, LT2 now includes the United States Marine Corps and Air Force systems as well in its family.
- *Economically* successful for the customers*
  - Over $350M in cost savings to-date
  - Projected to save another $200M in savings over the next 2-5 years

* Figures based on industry standard estimates of code cost, assuming post-deployment software support constitutes 70% of development cost and a life expectancy of 10 years.

Is LT2 Commercially Successful? (cont'd.)



Figures based on industry standard estimates of code cost, assuming post-deployment software support constitutes 70% of development cost and a life expectancy of 10 years.

Is Sufficient Documentation Available for Understanding?

Yes: LT2 *as a product line* has been featured in these sources:

- SPLC
  - 2013: “The Challenges of Applying Service Orientation to the U.S. Army's Live Training Software Product Line”
- *Crosstalk: The Journal of Defense Software Engineering*
  - 2013: “Second Generation Product Line Engineering Takes Hold in the DoD” (accepted for publication)
  - 2013: “Software Product Line Engineering of Army Live Training Systems”
- Army Acquisition, Logistics, and Technology (AL&T) Magazine
  - 2013: “Live Training Goes Mobile - Mobile Product Line Architecture Framework (MPLAF)”
  - 2012: “Second-Generation Paradigm: By staying ahead of product growth, PEO STRI improves efficiencies,”
  - 2011: “Integration Imperative: Transforming live training through common standards,”
- Simulation Interoperability Standards Organization (SISO)
  - 2009: “Evolving Standards in US Army Live Simulations. 2009 Simulation Interoperability Workshop (SIW)”
  - 2006: “Component-Based Software Reuse Strategy for Army Live Training Ranges. 2006 Simulation Interoperability Workshop (SIW)”

Is Sufficient Documentation Available for Understanding? (cont'd.)

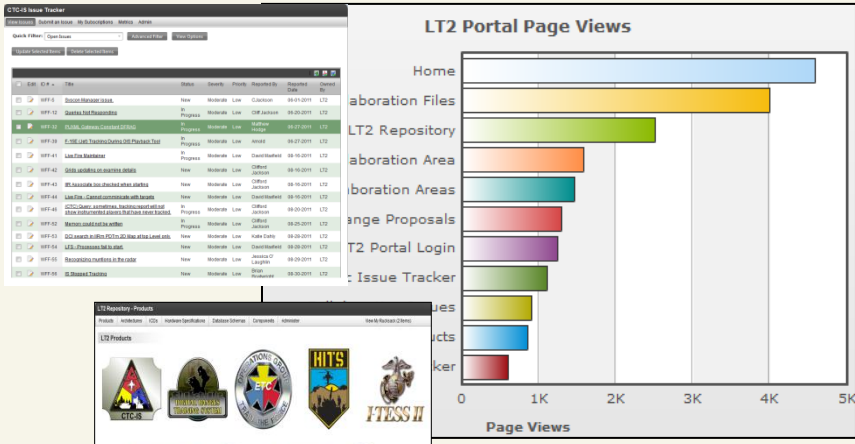
LT2 as a product line has been featured in these sources (continued):

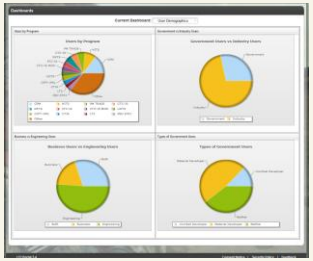
- Interservice/Industry Training, Simulation, and Education Conference
  - 2012: "Maximizing U.S. Army Return on Investment Utilizing Software Product-Line Approach"
  - 2011 "Next Generation of Distributed Training utilizing SOA, Cloud Computing, and Virtualization"
  - 2011: "Employing the Second Generation Software Product-line for Live Training Transformation"
  - 2009: "Joint Service Partnership: Extending the Live Training Transformation Product Line"
  - 2009: "Training Range Modernization: New Technology on Old Infrastructure"
  - 2007: "Applying the LT2 Software Reuse Strategy to the Homestation Instrumentation Training System"
  - 2005: "Live Training Transformation (LT2)-A Strategy for Future Army and Joint Live Training"
- Software Engineering Institute, Carnegie Mellon University
  - 2011: "Exploring Acquisition Strategies for Adopting a Software Product Line."
  - 2010: "U.S. Army Software Product Line Workshop" (CMU/SEC-2010-TR-014).
  - 2009: "Software Product Lines: Report of the 2009 U.S. Army Software Product Line Workshop" (CMU/SEI-2009-TR-012)
- MILCOM Military Communications Conference
  - 2008: "Live Training Transformation Product Line Applied Standards For Reusable Integrated And Interoperable Solutions." Paper No. 483; MILCOM 2008.

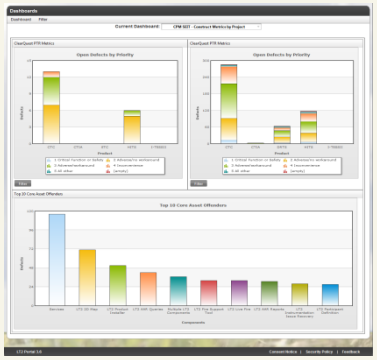
Is Sufficient Documentation Available for Understanding? (cont'd.)

Portal: www.lt2portal.org

- Shared knowledge repository
- Wiki / Forums
- Helpdesks
- Metrics
- CM Operational procedures guide
- Training Material
- Standards & ICDs
- 1600+ Users







Is Sufficient Documentation Available for Understanding? (cont'd.)

Documentation of the methodology underlying the LT2 product line (selected set):

- Encyclopedia of Software Engineering
  - "Systems and Software Product Line Engineering," P. LaPlante, ed., 2013, Taylor and Francis, in publication
- SPLC papers:
  - 2013: "A PLE-Based Auditing Method for Protecting Restricted Content in Derived Products"
  - 2012: "Mega-scale product line engineering at General Motors"
  - 2008: "HomeAway's Transition to Software Product Line Practice: Engineering and Business Results in 60 Days"
  - 2007: "The 3-Tiered Methodology: Pragmatic Insights from New Generation Software Product Lines"
- Other:
  - The Systems and Software Product Line Lifecycle Framework. BigLever Software Technical Report #200805071r3. 2010. http://www.biglever.com/extras/Spl-LifecycleFramework.pdf
  - Industry Validation of Feature Oriented Software Development (FOSD) via Software Product Lines, Feature-Oriented Software Development Seminar 11021, Schloss Dagstuhl - Leibniz Center for Informatics, Wadern, Saarland, Germany. January 2011.
  - "Second Generation Product Line Engineering: A Case Study at General Motors," in *Systems and Software Variability Management: Concepts, Tools, and Experiences,* Capilla, Bosch, and Kang, eds., Springer, 2013.
- Portal: www.biglever.com

Conclusion

- LT2 is one of the most successful systems and software product lines in the U.S. Department of Defense.
- It has spawned 13 family members distributed at over 200 sites globally
- It has saved the DoD about half a *Billion* dollars in development cost
- It uses a well-defined, well-documented, state-of-the-art methodology that is well documented in literature