Scaling Software Acquisition Pathway (SWP) to Manage a Portfolio of Systems

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ABSTRACT

The U.S. Army Project Manager Soldier Training (PM ST) is embracing the vision of the Software Acquisition Pathway (SWP) as a natural extension to its Live Training Transformation (LT2) vision. PM ST is continuously evolving its LT2 Software Factory approach for software acquisition, support, and sustainment. With this policy guidance for a SWP framework from the Under Secretary of Defense, the LT2 gains further justification in its advancement of Agile, DevSecOps and Cloud Native. SWP specifically focuses on Agile and DevSecOps as a proven approach to increasing the probability of fielding successful capabilities to warfighters at the speed of relevance. This paper addresses the use case of applying SWP for a well-established portfolio of systems that must remain fully capable and operational while addressing the emergent needs of the evolving warfighter. This paper makes specific recommendations to enhance the DevSecOps pipeline to incorporate inherent support for variation across the portfolio and connectivity to the rest of the Tech Data Package necessary for fielding and sustaining complete systems. Additionally, this paper recommends Agile extensions that better enable government integration into a portfolio governance model to handle simultaneous capability development in a government owned baseline, where changes create cascading impacts and enable added portfolio value beyond the initial development effort. These recommendations can be used to tailor the SWP framework for a portfolio use case to allow for focused development on minimum viable products, allow for extremely low risk incorporation of legacy content into minimum viable capability releases, and more quickly enable full operational capabilities. Additionally, these approaches allow a significantly reduced sustainment cost directing more funding allocation to adding incremental value in future releases. By incorporating these recommendations, organizations can better apply the SWP framework for continued successes in deploying new capacities into their portfolio of systems.

ABOUT THE AUTHORS

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LIVE TRAINING TRANSFORMATIONS (LT2)

Project Manager Soldier Training (PM ST) manages a diverse portfolio of training products using a consolidated strategy called Live Training Transformations (LT2). The live training portfolio is maintained by multiple contracts. Each contract contributes to the community by advancing common architectures and capabilities used across the LT2 portfolio. Multiple contracting strategies are employed depending on the contract's intended purpose. Primarily, an IDIQ contract vehicle allows for fast acquisition of new incremental capabilities with independent contracts aligned to the LT2 methodology when significant new development is required. This community approach contributes to reduction of effort and resources when fielding individual training products that are deployed and sustained from the shared baseline. In addition to the core mission for providing Army Live Training, the LT2 community includes the United State Marine Corps, Army Test Command and most recently, members of the virtual training community. The LT2 family of training systems grew from a recognition that although training needs differ across programs, multiple contracts were independently implementing the same core capabilities. The LT2 methodology was established to consolidate development around established core competencies, to control sustainment costs, and focus funding on incremental enhancements that advance essential training capabilities. Initially envisioned as a reuse repository for developed software, the LT2 methodology has evolved to include multiple training architectures built from a single consolidated government owned/community accessible environment using Agile development methodologies with Cloud Native services in a DevSecOps environment. **Figure *1*** below summarizes the scope of the current LT2 portfolio.

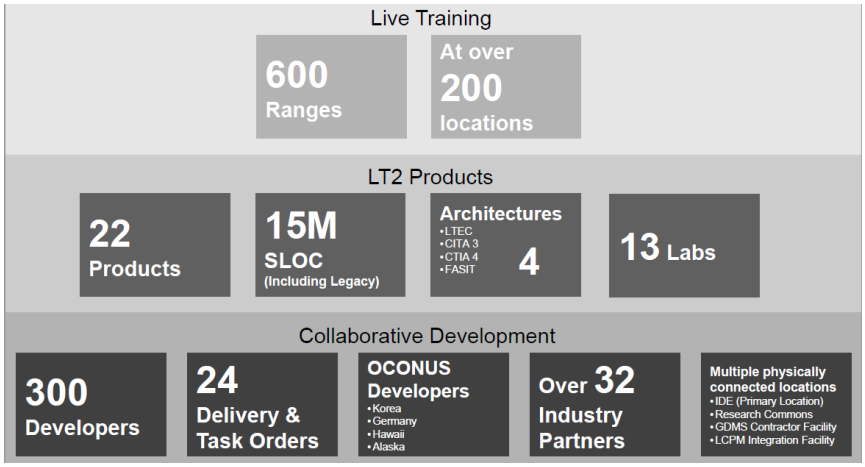

Figure 1. Scope of LT2 Training Systems

THE SOFTWARE ACQUISITION STRATEGY

In February of 2021, the DoD published the Acquisition Policy Transformation Handbook (Office of the Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)), 2021). The handbook tailors processes by providing direction of how to best procure and execute programs to more closely align with the end users core needs.

Referenced in the guidance is the Operation of the Software Acquisition Pathway DoDI 5000.87 (Office of the Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)), 2020) designed for software-intensive procurement and effective acquisition, development, integration, and iterative delivery to the end user in the operational environment. This guidance focuses on the adoption of modern software development practices to overcome many of the traditional challenges presented from a waterfall approach to deployment. **Figure *2*** is an excerpt from the guidance highlighting the significant focus areas that the guidance promotes.

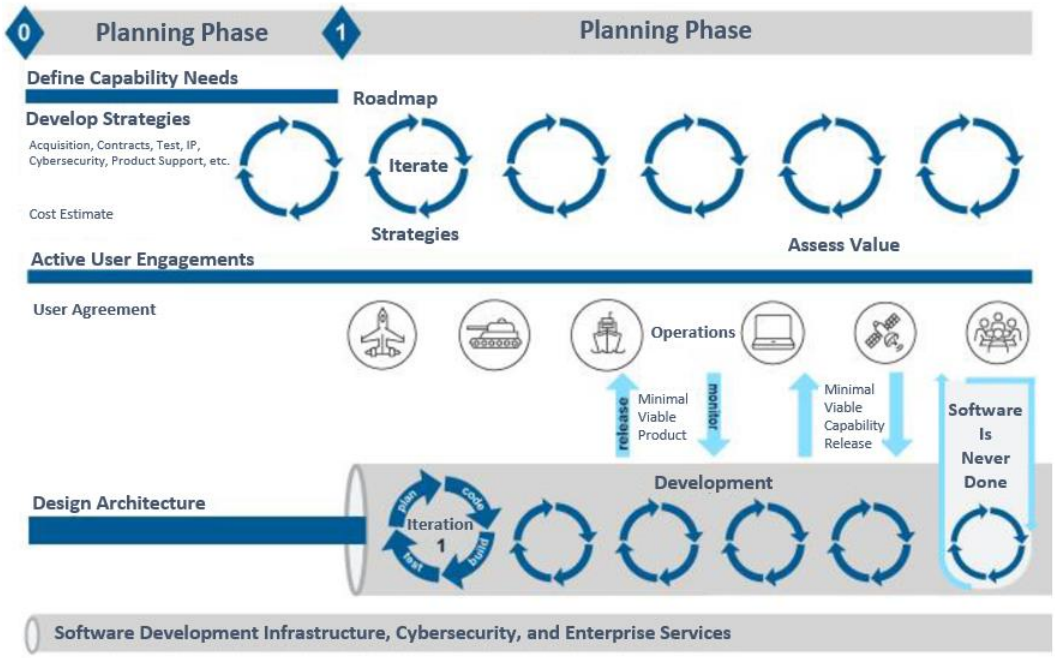

Figure 2. Operation of the Software Acquisition Pathway from DoDI 5000.87

LT2 ALIGNMENT TO SWP

PM ST continuously explores opportunities to improve the LT2 methodology and products. When the recent SWP framework was released by the Under Secretary of Defense, PM ST evaluated the guidance of the SWP framework in relation to the current scope of the LT2 approach. Although the guidance was geared towards individual systems and not a family of systems, the results were a further validation of LT2's path forward. This paper will provide context for how LT2 embodies the SWP guidance to support a diverse portfolio of training capabilities.

The Figure 3 below overlays the LT2 process tailoring over the SWP guidance. The orange overlaid symbols show how LT2 tailors the SWP guidance. It follows the intent that the SWP guidance can be applied in an environment where a family of systems require continuous development and sustainment.

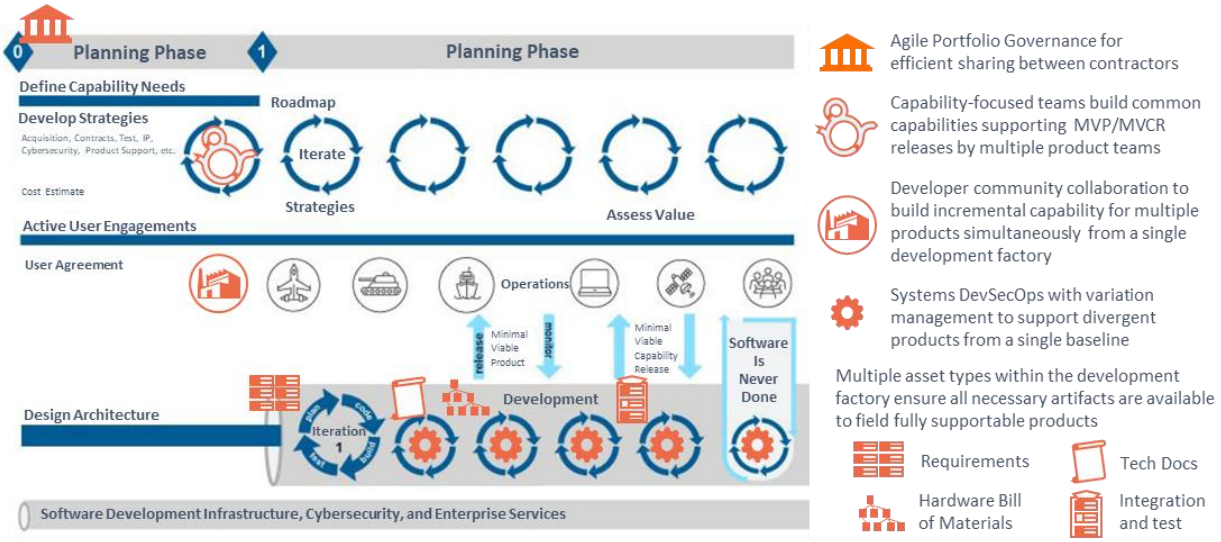

Figure 3. LT2 Tailoring to the SWP Guidance to Support the LT2 Portfolio

The LT2 family of live training systems pre-dates the SWP guidance, so existing contracts did not derive direct methodology from the guidance. However, the SWP guidance, was already strategically aligned with the ongoing contracts executing within the LT2 environment. Adoption of modern software development practices was an effort of LT2 early on and this started with the development environment. The Common Training Instrumentation Architecture (CTIA) and Live Training Engagement Composition (LTEC) architectures form the bases from which the live training products are constructed. The teams responsible for these architectures also drive enhancements to the common development approach for the work that builds upon them. Some of these recent development updates include migration to Service Oriented Architectures, Cloud Native services, and DevSecOps, as well as the decomposition of higher-level services (Lanman, Linos, Barry, & Alston, 2016). The teams continuously evaluate the technological boundaries to streamline development and decrease deployment delays, while staying compliant in a DOD environment.

The LT2 product deliveries benefit from the technological advancements because they support the development environment. Support includes implementing the methodologies for collaboration in shared repositories and the migration to Agile practices. This produces an environment for managing dependencies and a shared backlog, as well as maximizing the common development efforts performed by the diverse community of developers. Capability-focused development teams, such as the Force-on-Target (FoT) team, are developing common services for a sub-set of live training products focused on live fire training exercises. These examples of encouraged commonality provide both extremely reduced start time for fielding new Minimum Viable Capability Releases (MVCR) and enable an extremely rich suite of existing capabilities to be simultaneously fielded to new users with minimal overhead.

LT2 model is designed to extract the maximum value from the minimum viable products (MVP)/MVCR, DevSecOps and Agile approaches encouraged by the SWP, by extending them to support the portfolio of products that rely on similar capabilities to deliver training. Though these are incredibly intertwined approaches to development, this paper will separate these approaches into discrete areas to demonstrate how the LT2 methodology extends the SWP guidance to work for portfolio development.

INCREMENTAL CAPABILITY DEVELOPMENT

Incremental capability development exemplified by the SWP approach to MVP/MVCR is focused on getting necessary capabilities to the end user as fast as possible. The LT2 approach is to enable incremental improvements while simultaneously providing previously existing capabilities that fulfill the complete user needs. For new efforts, LT2 offers substantial up to date capabilities that can enable substantially more capable MVPs for initial deployment.

The MVCR updates include contributions and enhancements from the board community of developers focused on similar capability development.

The iconic example of this model in action is the development and fielding of the Integrated Live Virtual Constructive Test Environment (ILTE) system which was developed to assist the Army Operational Test Command (OTC) system. See **Figure *4*** for a contextual overview of the ILTE system. After repeated struggles to field a capable system, the team recognized that the LT2 portfolio was able to provide a substantially more capable MVP at extremely reduced risk. The ILTE system has significant required capabilities that overlap with the existing live training portfolio, including planning, setup, execution, instrumentation management, monitoring, and controlling live and synthetic interoperation in a single Common Operational Picture. As with any new product addition to an existing portfolio, the LT2 live training focus did not include all necessary capabilities to support the ILTE mission. This resulted in necessary new capability development with a small targeted team working closely with the end users to fulfill missing capabilities including test specific data analysis and assessment support. Using the LT2 shared development environment the ILTE system was fielded, complete with Hardware Baseline, in 13 months. The ILTE team estimates that the cost avoidance for their first fielding is $22M worth of high quality, previously fielded and proven capabilities. This allowed the team to focus their $10M software budget to incrementally fill the capability gaps needed to complete their mission. The result today is a fully capable system substantially more advanced than could have been achieved by a single dedicated team. Additionally, since the initial deployment, the ILTE team continues to benefit from the shared development by others sustaining common capabilities. Each incremental MVCR is substantially more capable than could be achieved from a single product focus. As is the case with many LT2 products, the development and sustainment costs to provide a complete capability would far exceed the ability of a single product, making some products economically unviable if addressed individually.

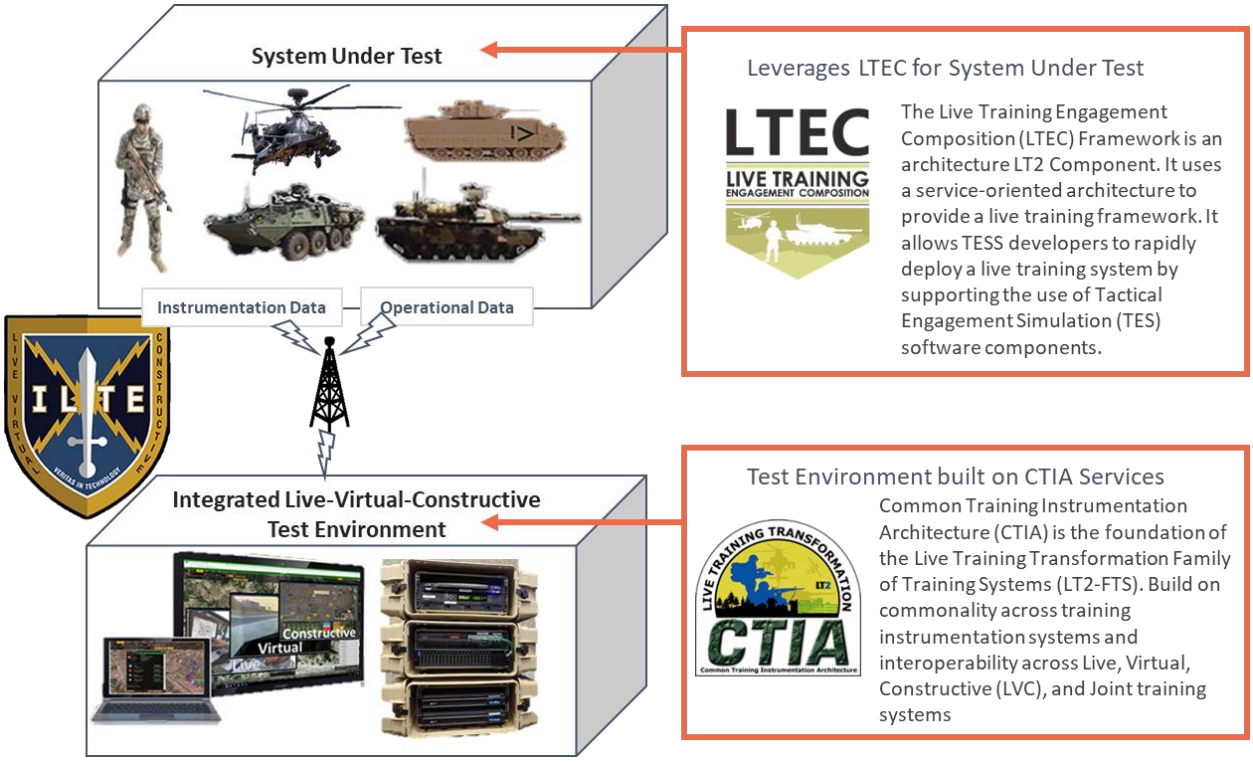

Figure 4. ILTE Deployment Using LT2 Capabilities

Since the initial fielding of ILTE, the team has added 46 significant new incremental capabilities to their baseline, including cyber security posture improvements with two factor authentication, improved testing fidelity with 3D viewing of the environment, and enhanced reporting capabilities. Most of these capabilities have since been adopted by other products in the portfolio. Teams adopting these capabilities further contribute, by continuously testing in new environments to increase the quality of the shared baseline. Additionally, the ILTE system has benefited

significantly from the ongoing DevSecOps pipeline enhancements and remains concurrent with changes to the underlying technologies in the build and evolution of the LT2 architectures. ILTE is a notable example the MVP/MVCR objectives of SWP but is by no means an outlier of the LT2 approach.

SYSTEM DEVSECOPS WITH VARIATION

Modern software development approaches are the heart of the SWP guidance for DevSecOps. Pipelines provide immediate feedback to developers and validate builds. These builds can then deploy directly to site, ideally with automated deployment to production. In LT2, the operations portion of DevSecOps does not deploy to production for live training ranges, since they are often disconnected and inaccessible. However, the teams fielding to the live training ranges still have an automated process for testing and validating the build with continuous feedback from multiple sources influencing future development. LT2 evolved substantially using this DevSecOps ethos. LT2 went from a low point of 18-hour product specific builds, to continuous incremental builds available within minutes of developer changes to the baseline.

Systems built from a shared DevSecOps environment need the flexibility to tailor based on unique needs. For LT2, those custom software and non-software aspects of system deployments are addressed using embedded variations. A variation is the expression of a difference within a shared asset introduced by feature differences in the portfolio. Variations are highly interrelated, meaning that a single feature change often requires variation across multiple asset types. For example, a variation requiring a Pan Tilt Zoom camera, instead of a fixed camera used by other systems, results in variations within software, testing, user manuals, training, Bills of Materials, and more. The final products can be built using the core baseline with the chosen feature differences (INCOSE, 2019). These variations are orchestrated by employing variation management tools alongside DevSecOps.

For DevSecOps to work in the LT2 community, the pipeline must be aware of individual product needs. Any updates to the baseline should result in updates to all applicable products simultaneously. As with the new capability development already specified, any fixes or enhancements to shared capabilities are immediately available to all products by virtue of well-established sharing rules defined for each product and agreed to prior to new development. This early identification of sharing opportunities allows teams to establish requirements based on the intended needs across the portfolio and validate implementations with automated testing. This enables teams to deploy new capabilities faster, and perhaps more importantly, drives dramatic increases in product quality with minimal investment by any individual team.

A unique aspect of the LT2 environment is the recognition that even in software centric systems, software only comprises a portion of the system necessary to support full training capabilities. The LT2 approach enables all aspects of Technical Data Package (TDP) to be included in the continuous development processes. This TDP includes the training content and technical manuals needed for a complete software deployment as well as the drawing package when needed for a technology refresh or tech insertion. These continuous development and integration efforts occur from the common LT2 baseline for the entire portfolio of products. LT2 continues to apply the Product Line Engineering approach of feature-based variation management (Dillon, Darbin, & Rivera, 2014) and has extended this to the DevSecOps pipeline. Using feature modeling to encapsulate portfolio differences, the DevSecOps approach allows continuous sharing across products from a single baseline even when emergent differences identified during incremental capability development would traditionally require divergence within the baseline. These differences are handled through feature variation that allows all baseline artifacts to be tailored to the appropriate systems, (International Organization for Standardization, 2021). An overview of the DevSecOps approach for LT2 is shown in **Figure *5***. In this depiction, the inclusion of multiple non-software assets is shown along with the variation aspects that enable the portfolio variation for LT2.

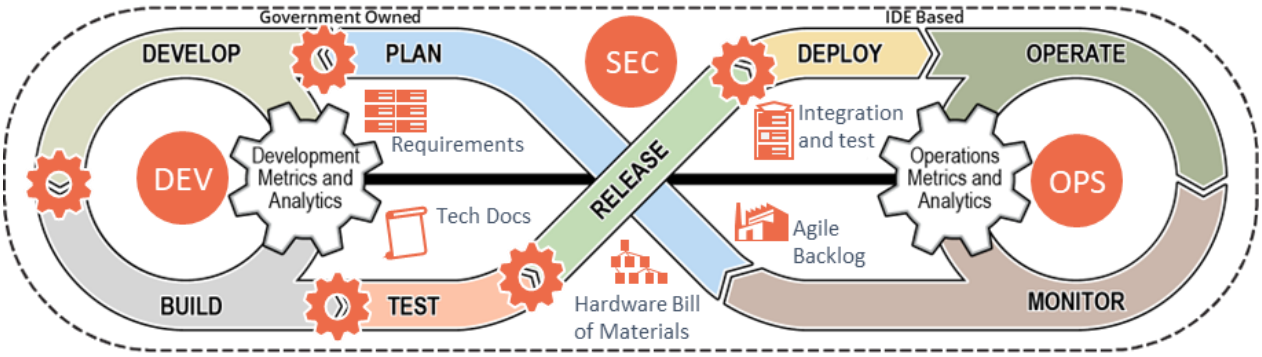

Figure 5: DevSecOps Includes Complete Systems Artifacts and Variation to Support the Differences in the Portfolio

Inclusion of feature-based variations into DevSecOps expands the SWP guidance to support a product portfolio. The expansion of the approach, beyond a myopic software focus, allows SWP intent to apply to the entire set of system artifacts necessary to field and sustain training ranges. This approach means training ranges are more capable, and immediately sustainable by on-site support teams. In addition to the direct time saving of immediate feedback for system builds, the DevSecOps approach has enabled the consolidation of build resources across the product line. This leaves more time for specialized resources to focus on product specific capability development.

AGILE ENABLED PORTFOLIO GOVERNANCE

The SWP guidance breaks the conventional waterfall approach to systems development by recommending an Agile incremental development focus enabling teams to prioritize high pay off, immediate need capabilities that meet the users' intended need. This is a trend already prevalent in industry that often finds itself in conflict with conventional procurement. The SWP guidance helps to encourage tailoring to overcome these challenges. With the LT2 approach the tailoring is enhanced by breaking down the barriers between contractors and encouraging collaborative development. This development approach encourages community driven development based on the teams' own top priority needs, while simultaneously encouraging teams to peruse solutions that can be immediately consumed by the largest number of programs. Each team adds value that benefits the largest number of products, supplanting legacy solutions and results in continuously evolving, best of breed capabilities.

LT2 incentivizes early discussion prior to implementation. It encourages teams to collect external perspectives with the potential to dramatically lower the initial investment though collaboration that would otherwise be un-obtainable within a single system focus. Collaboration across the portfolio is facilitated though a governance approach that is complete without becoming burdensome. LT2 enforces governance though a hierarchical model based on encouraged information sharing at the top level linked to lower level technical implementations that ensure baseline integrity. These governance processes are defined in the LT2 Operations Guide. Often confused by outsiders as a set of compliance rules, the LT2 Operations Guide is a set of guidelines and best practices that encourage informed discussions and enable pro-active sharing without divergence of discrete assets. This overcomes unnecessary proliferation of variation in the portfolio without demanding unwanted commonality. LT2 governance processes encourage contractors to work with an agile mind set. This enables continuous conversation and feedback though a high-level workflow with concurrence and approval by the customer at the speed determined by the team's individual execution cadence. Additionally, this open process allows broad stakeholder inputs and access to subject matter expertise, even when not on the currently executing program. The LT2 model allows developers to contribute expertise and add value concisely and constructively for the benefit of all. This aspect of the LT2 model has the added benefit of providing increased job satisfaction to those involved. **Figure *6*** shows the mapping of execution tasks to the LT2 agile execution process. The governance guides the teams and enables cross team collaboration at all levels of execution, starting from initial backlog planning through to development within the common information enterprise.

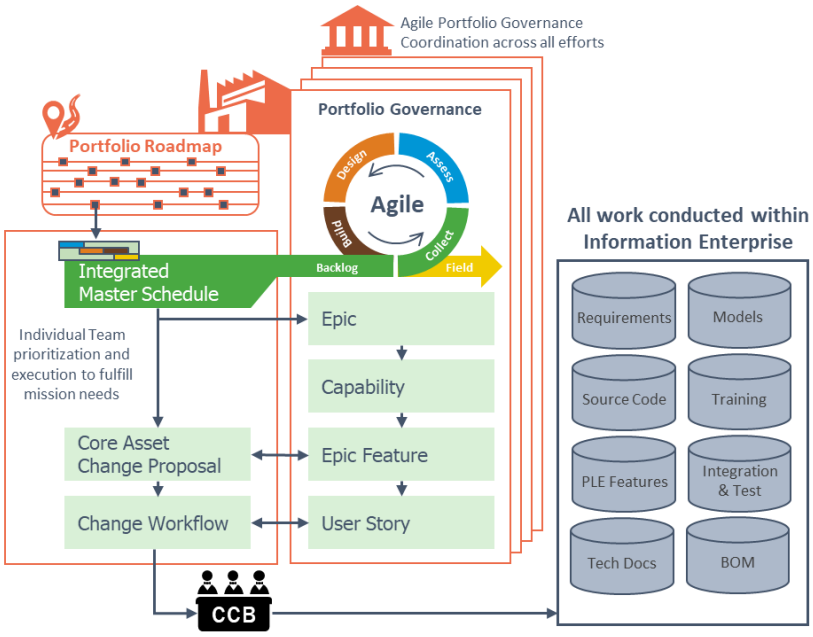

Figure 6. Agile Approach for Teams Adding Capabilities to the Common Baseline

Agile development in LT2 is further enabled through the LT2 governance and development environment by providing consolidated views of metrics spanning the entire portfolio. The LT2 approach to metrics favors immediate need and value over classical system metrics, such as Problem Tracking Report aging, and encourages teams to work on the most impactful work first and to eclipse troublesome or unused system capabilities with innovative new solutions when needed. Often time issues and enhancements are necessary and urgent for one program while valued less for others. It is not uncommon for a program to discover a defect that is resolved by another program prior to encountering the problem in the field. Resultant quality and capability improvements have enabled LT2 to evolve the architectural underpinning's of live training.

There is a slow, but continuous evolution of new technologies in the live training environment. This evolution means that as on-site infrastructure to access remote ranges matures, teams will have an automated development pipeline in place to deploy new capabilities to the end user on a regular basis using current training architecture and services. The continued focus on end user needs are enabled by the Agile methodologies recommended by SWP. Those recommendation are expanded throughout the entire portfolio of products by LT2.

SUMMARY AND TAKEAWAYS

The vision of LT2 is to enable the benefit of short cycle development without suffering the consequences of single system development. This means a continuous deployment cadence of distinct and complete systems that focus on adding the most important value for their specific end users each time. End users benefit not only from their most important needs, but the solutions developed by other community members based on their most important needs. The additional features gained from other community efforts, pay off not only in development cost savings, but also in the controlled sustainment costs of a single consolidated baseline. The SWP guidance focuses on the same types of efficiencies, such as defining capability needs, developing strategies, keeping users actively engaged, and designing the architecture. LT2 tailoring of SWP approaches elevates the benefits from a single system focus to the portfolio of similar systems sharing common capabilities.

The SWP guidance facilitates and supports the LT2 adoption of improved software development practices. PM ST and the LT2 community gain efficiencies for fielding and sustaining portfolios of systems using this guidance. The SWP guidance is reflected through development in incremental capabilities allowing for multiple products to be built simultaneously from a single factory that can scale up or down. It is employed through a DevSecOps environment with a variation management process that takes full advantage of reuse, while providing deviation capabilities to

support tailored fielding needs. And finally, it is implemented through a portfolio governance that creates an efficient environment for sharing between multiple contractors across the portfolio. The adoption of these methods mean organizations can focus on the collection of new deployment capabilities that are continuously updated in their portfolio of systems.

LT2 advancements in service-oriented architectures, Cloud Native services, and DevSecOps allow community members to focus on innovation. This innovation is cultivated with a balance of product-focused and production-focused teams. Collectively, this approach provides efficiencies in developing and fielding that outpace the same development milestones using a conventional waterfall approach. The SWP emphasis on leading industry software development practices is both incorporated and scaled to provide efficiency gains across a community of systems, versus a single product approach.

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