The Department of Navy's Digital Transformation with the Digital Warfighting Platform, Strangler Patterns, Machine Learning, and Autonomous Human-Machine Teaming

M. M. Sheehan & O. A. Yakimenko, Naval Postgraduate School {*mmsheeha*; *oayakime*; @ *nps.edu*}

The Department of the Navy (DON) is rapidly adopting mature technologies, products, and methods used within the machine learning (ML) community to be applied to warfighting, readiness, and business domains in an effort to digitally transform the naval enterprise. However, stakeholders given the task to implement these solutions enterprise-wide are finding current DON instantiations to be inadequate.

In the acquisition lifecycle domain, the support systems the DON uses to procure, develop, test and deploy are built for hardware-centric products using a linear sequential "waterfall" development methodology. As the DON works to enable the warfighting Internet-of-Things through the creation of the Digital Warfighting Platform and decides which business model to deploy in uncoupling hardware from software (Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS)), security guidelines, acquisition policies, data governance strategies and contractual language will need to be developed.

In the technical domain, the DON method of "lift-and-shift" or "rip-off and deploy", while proving to be historically successful for most technologies, needs to be evolved when applied to ML pipeline development using development, security and operations (DevSecOps) methods with agile and test-driven practices. Commercial frameworks are incomplete and do not address specific DON needs, limitations, requirements, and policies. This problem becomes even more complex when using software design patterns, such as the Strangler pattern, to evolve legacy monolithic code bases within weapon systems (gradually replacing one feature at a time until decommissioning). Additionally, DON verification and validation (developmental vs. operational test and evaluation) constraints and objectives must holistically be understood to provide test data to examine and evaluate trade-offs against specification requirements, life cycle costs, and schedules.

Even for organizations considered "digitally native" or "software intensive" types with years of expertise in the above topics, successful implementation is difficult. Data collected from these industry leaders paints a troubling picture of things to come for the DON: 30% of application deployments fail (Cruz, 2018)[i], 29% of IT project implementations are unsuccessful with 20% being unrecoverable, 75% of customers rated their application deployment as failing (Hastie & Wojewoda 2015)[ii], and 87% of ML models developed never get deployed (VB, 2019)[iii]. In fact, Google's AI Chief, Andrew Moore, recently met with DON officials and stated that only 15% of ML models developed are deployed[iv]. The DON expects the transformation to autonomous human-machine systems to exacerbate these problems, as large-scale organizational change will need to take place for institutionalization to occur. Considering the DON is a distributed collection of organizations, authorities, environments, warfighting/readiness/business domain-specific requirements, mix of evolving technologies, and independent security enclaves, a holistic systems engineering enterprise architecture solution and design pattern must be sought.

In this talk, we will trace the Department of Defense and DON acquisition process shortcomings in the effort to facilitate digital transformation, introduce the DON's future vision for the Digital Warfighting Platform, explain the systems engineering design patterns to be executed in evolving legacy monolithic code bases within weapon systems, and propose a DON systems engineering solution for ML algorithm pipeline development, testing and acquisition with contractual deliverables and language.

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[i] Cruz, V. (2018, January) Why 30% of App Deployments Fail. www.wired.com/insights/2013/04/why-30-of-app-deployments-fail

[ii] Hastie, S. and Wojewoda, S. (2015, October) Standish Group 2015 Chaos Report. www.infoq.com/articles/standish-chaos-2015

[iii] VB Staff (2019, July 19th) Why do 87% of data science projects never make it into production? venturebeat.com/2019/07/19/why-do-87-of-data-science-projects-never-make-it-into-production

[iv] Google's internal peer-competitor survey.