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Critical Integration Links Identification for System of Systems

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Abstract
In recent years, with the budgetary constraints and ever changing mission requirements, the Department of Defense (DoD) has shifted its focus towards component-based system development. The development of systems with commercial off-the-shelf (COTS) components expedites the development process, and improves interoperability and reusability benefits, resulting in significant cost savings. However, integrating the COTS products, testing of the integrated system, correctly identifying dependencies between components, and identifying which dependencies to test pose challenges to large system development. Testing every dependency is cost and time prohibitive, and budget limitations often times lead to insufficient resource allocation for testing, particularly for integration testing. The key to cost-effective integration testing is identifying the type and significance of component dependencies. We propose the use of multi-dimensional dependency (MDD) analysis, which addresses the gaps in existent dependency analysis of system's components, for the identification of critical integration points in large systems. The proposed approach relies on design structure matrix (DSM), the existent dependency analysis method, to identify the dependencies among system components. These dependencies are further analyzed for their interrelationships to identify precise integration points among system components. The identification of critical system components dependencies and their inter-dependencies using the MDD analysis contributes towards seamless integration and interoperability of large-scale defense systems. As part of the research, enterprise architecture information from the Joint Planning and Development Office (JPDO)'s Joint Planning Environment (JPE) is used to analyze the integration of DoD into the Next Generation Air Transportation System (NextGen) using MDD. The preliminary results indicate that MDD is able to efficiently and effectively identify key integration points in large systems.

Biographies
Subash Kafle is a Ph.D. candidate in the Department of Engineering Management and Systems Engineering (EMSE) at The George Washington University (GWU), Washington, DC. He holds Master of Science (M.S.) and Bachelor of Science (B.S.) degrees from Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA. He is supporting federally funded research and development centers (FFRDCs) as a Senior Systems Engineer at MITRE Corporation.

Dr. Jason McZara is Lead Systems Engineer at the MITRE Corporation working mainly on systems engineering of large-scale IT systems. His research interests include system integration, system interoperability and interdependency, and disaster recovery. Within the DoD, he has supported the DoD Chief Information Officer (CIO), U.S. Air Force, Missile Defense Agency (MDA), U.S. Strategic Command, and the U.S. Marine Corps (USMC). He received his PhD in Systems Engineering from GWU and his Engineering M.S. and B.S. degrees from Virginia Tech.