Advanced Technologies to Enable Simulation of Life-Cycle Sustainment of Weapon Systems

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Abstract: *The authors have witnessed and been part of the development of the burgeoning complexities of weapons systems. They have focused some of their research on the need to analyze the life-cycle sustainment of these systems. This sustainment analysis has similarly grown in complexity and sophistication. To be optimally useful, the results and insights from these analyses need to be accessible long before the systems are fielded and before sustainment parameters can be established and sustainment data collected from live implementations. This strongly supports the need to employ both constructive and virtual simulations to provide pre-deployment "experience" with systems. These simulations must be programmed to include the various input and output parameters of the system-engineered sustainment model. The size of modern weapons systems and the wide geographical dispersion of such systems calls for significant computational capabilities; this need is exacerbated by the current focus on simulating operations in large urban areas, fully populated by red, blue and civilian populations, all suitably programmed to act in a demographically appropriate way. Because a major factor of sustainment is maintenance and that maintenance is dramatically impacted by environmental factors, the modeling of these factors, along with verifiable functions representing their impact on hardware and personnel, must be implemented as well. There is a long history of using high performance computing to enable and enhance large-scale simulations and some of the authors have been part of that development process since 1995. Further, new advances in computing now offer to create a new computational paradigm for high performance computing, e.g. the innovations at the University of Southern California, Quantum Computing Center. As Systems Engineering has co-evolved with these computational advances, it has made good use of Markov and Martingdale Analyses, and one of the authors is currently developing a model that relies on this sub-discipline of analysis to better characterize the sustainment of weapons systems. Serendipitously, this line of inquiry is well situated to make excellent use of the quantum annealer at USC, as Markov processes are the foundation of the annealer's operations, This paper will briefly describe the need for and the current state of the art of sustainment analyses, lay out the need for improved and expanded simulation techniques, and discuss the path to facilitating the implementation these across the entire spectrum of the simulation community. Alternative approaches, interoperability challenges, and future developments will be suggested, outlined and documented.*

Authors' Biographies

Daniel P. Burns is a life-long Systems Engineer first with the Active Duty Navy, then with a Fortune 250 Company and small business as well as in Academia**.** He formerly served as the Naval Chair and a Professor of Practice in the Department of Systems Engineering at the Naval Postgraduate School (NPS) in Monterey California. He is a Captain in the United States Navy and has served as the as the Military Associate Dean and as acting Dean of the Graduate School of Engineering and Applied Sciences at NPS. For eight years he directed research as a senior executive at SAIC. His research interests center on analyses of both human and resource utilization in defense efforts. Captain Burns received a BS degree from the U.S. Naval Academy and an MS from the Naval Postgraduate School. He is currently finishing his dissertation for a PhD in Systems Engineering from Southern Methodist University.

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Dan M. Davis is a consultant for the Information Sciences Institute and the Institute for Creative Technologies, University of Southern California, focusing on large-scale distributed DoD simulations. His pre-retirement service there was capped by his being the Director of the JESPP project for a decade. Earlier, as Assistant Director of the Center for Advanced Computing Research at Caltech, he managed Synthetic Forces Express, bringing HPC to DoD simulations. Prior experience includes serving as a Director at the Maui High Performance Computing Center and as a Software Engineer at the Jet Propulsion Laboratory and Martin Marietta. He has served as the Chairman of the Coalition of Academic Supercomputing Centers and has taught at the undergraduate and graduate levels. As early as 1971, Dan was writing programs in FORTRAN on one of Seymour Cray's CDC 6500's. He saw duty in Vietnam as a USMC Cryptologist and retired as a Commander, USNR. He received B.A. and J.D. degrees from the University of Colorado in Boulder.