Emerging Research

From SEBoK
Emerging Research

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Doctoral level systems engineering research has taken root over the last two decades. Many programs that have either an Industrial Engineering and/or Systems Engineering Master's program also have a doctoral program. This has enabled new and interesting research to be conducted. The problem arises, however, of finding this research. Some of this research is found in national or international repositories that can be searched. Some is resident in university libraries. Some can be found on the researcher's webpage. And sadly, some does not see the light of day once it is successfully defended. The SEBoK Board of Governors has approved the creation of a new section where this research may be found. The first article in the SEBoK states "The purpose of the Guide to the Systems Engineering Body of Knowledge (SEBoK) is to provide a widely accepted, community-based, and regularly updated baseline of systems engineering (SE) knowledge." The Emerging Research topic under the SEBoK Emerging Topics will be a place to showcase some of the systems engineering research published in the past 3-5 years. Here you will find bibliographic citations and summaries for recently defended research. Bibliographic information will contain the **Author** of the research, the **Title** of the research, the **Institution** in which the research was performed, the **Year** the research was defended, and either a **Link** to the repository where the dissertation can be located (preferred) or an email link to the researcher.

To be considered for inclusion in the SEBoK, the dissertation must contribute to the field of systems engineering. It may focus on systems engineering principles, processes, methodologies, etc. Submitted dissertations must have been published within the last 3-5 years unless a compelling reason is presented. If the SEBoK already has an established Part, Knowledge Area, or article addressing the content of a dissertation, it will not be accepted into the Emerging Research portion of the SEBoK.

Submissions must contain the name of the author, the title of the dissertation, the date of publication, the university at which the work was completed, and a direct link to the dissertation itself. If you are comfortable summarizing the dissertation in one paragraph, that would be appreciated. If not, the SEBoK team will do so if the abstract is provided to them. If there are published conference papers, journal papers, books, or book chapters based on the dissertation, we welcome full citation information for them as well. Dissertation submissions can be directed to mhaas5@masonlive.gmu.edu.

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Dissertations

Towards Early Lifecycle Prediction of System Reliability

Salter, C. “Towards early lifecycle prediction of system reliability,” Ph.D. dissertation University of South Alabama, Mobile, Alabama, July 2018. Available: ProQuest Store

Reliability is traditionally defined as “the probability that an item will perform a required function without failure under stated conditions for a stated period of time” (O'Connor, 2012). This definition is applicable to all levels of a system, from the smallest part to the system as a whole. Predicting reliability requires extensive knowledge of the system of interest, thus making prediction difficult and complex. This problem is further complicated by the desire to predict system reliability early in the acquisition lifecycle. This work set out to develop a model for the prediction of system reliability early in the system lifecycle. The model utilizes eight factors: number of system requirements, number of major interfaces, number of operational environments, requirements understanding, technology maturity, manufacturability, company experience, and performance convergence. These factors come together to form a model much like the software engineering and systems engineering models COCOMO and COSYSMO. This work provides the United States Department of Defense a capability that previously did not exist: the estimation of system reliability early in the system lifecycle. The research demonstrates that information available during early system development may be used to predict system reliability. Through testing, the author found that a model of this type could provide reliability predictions for military ground vehicles within 25% of their actual recorded reliability values.

Toward the Evolution of Information Digital Ecosystems

Lippert, K. “Toward the evolution of information digital ecosystems,” Ph.D dissertation, University of South Alabama, Mobile, Alabama, May 2018. Available: ProQuest Store.

Digital ecosystems are the next generation of Internet and network applications, promising a whole new world of distributed and open systems that can interact, self-organize, evolve, and adapt. These ecosystems transcend traditional collaborative environments, such as client-server, peer-to-peer, or hybrid models (e.g., web services) to become a self-organized, interactive environment. The complexity of these digital ecosystems will encourage evolution through adaptive processes and selective pressures of one member on another to satisfy interaction, adaptive organization, and, incidentally, human curiosity. This work addresses one of the essential parts of the digital ecosystem – the information architecture. The research, inspired by systems thinking influenced by both biological models and science fiction, applies the TRIZ method to the contradictions raised by evolving data. This inspired the application of patterns and metaphor as a means for coping with the evolution of the ecosystem. The metaphor is explored as a model of representation of rapidly changing information through a demonstration of an adaptive digital ecosystem. The combination of this type of data representation with dynamic programming and adaptive interfaces will enable the development of the various components required by a true digital ecosystem.

Cybersecurity Decision Patterns as Adaptive Knowledge Encoding in Cybersecurity Operations

Willett, K. “Cybersecurity decision patterns as adaptive knowledge encoding in cybersecurity operations”, Ph.D. dissertation, Stevens Institute of Technology, Hoboken, NJ, July 2016. Available: https://pqdtopen.proquest.com/doc/1875237837.html?FMT=ABS.

Cyberspace adversaries perform successful exploits using automated adaptable tools. Cyberspace defense is too slow because existing response solutions require humans in-the-loop across sensing,

sense-making, decision-making, acting, command, and control of security operations (Dōne et al. 2016). Security automation is necessary to provide for cyber defense dynamic adaptability in response to an agile adversary with intelligence and intent who adapts quickly to exploit new vulnerabilities and new safeguards. The rules for machine-encoding security automation must come from people; from their knowledge validated through their real-world experience. Cybersecurity Decision Patterns as Adaptive Knowledge Encoding in Cybersecurity Operations introduces cybersecurity decision patterns (CDPs) as formal knowledge representation to capture, codify, and share knowledge to introduce and enhance security automation with the intent to improve cybersecurity operations efficiency for processing anomalies.

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