



**OFFICE OF THE DEPUTY ASSISTANT SECRETARY OF DEFENSE
SYSTEMS ENGINEERING**

**System of Systems Engineering
Collaborators Information Exchange (SoSECIE)**

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**Practical Modeling Concepts for Engineering Emergence in Systems of
Systems**

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Engineering a system with the explicit goal of steering its emergent behavior is a relatively new human endeavor, and demands new ways of thinking about how we model system of systems (SoS) behavior. This paper discusses the definition of a system with an eye towards steering its emergent behaviors, frames negative emergent behaviors as those to be suppressed by engineering design, suggests that human designers are themselves an example of positive emergence, and explains five SoS modeling concepts that are foundational to engineering emergence. Examples and illustrations are provided to make the concepts tangible. The briefing concludes with a summary and future work.

Biography

Dr. Kristin Giammarco is an Associate Professor in the Department of Systems Engineering at the Naval Postgraduate School (NPS), where she teaches courses in system architecture and design, system integration, systems software engineering, and model-based systems engineering. She conducts research in the use and development of formal methods for systems architecture modeling as well as system and software behavioral modeling and architectural patterns with students and colleagues within and outside of NPS. They are working to improve techniques for teaching architecture modeling concepts in a distributed learning environment and to students at all ages and academic levels.

Before her appointment at NPS, she was Chief Engineer for the Systems Engineering division of the Space and Terrestrial Communications Directorate at U.S. Army CERDEC, and Chair of the directorate's Systems Engineering Council. Before that, she led the technical execution of systems engineering analyses as a government lead engineer in partnership with other government organizations, MITRE, industry, national labs, and academic institutions. Over these years, she developed, implemented, and refined a quick-turn model-based systems engineering methodology with her team.

Dr. Giammarco is a member of INCOSE, the Lifecycle Modeling Language Steering Committee, and the International Society for Systems Pathology. She currently serves as the Joint Executive Systems Engineering Management (SEM-PD21) Program Academic Associate. Dr. Giammarco holds a Ph.D. in Software Engineering, an M.S. in Systems Engineering Management, and a Certificate in Advanced Systems Engineering from NPS and a B.E. in Electrical Engineering from Stevens Institute of Technology.