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Title: Functional Architecture as the Core of Model-Based Systems Engineering

Abstract Text: At the core of systems engineering as applied to any system or service definition per ISO15288 is the concept of satisfying stakeholder needs by the definition and implementation of a system solution focused on a capability to do something of value: a set of behaviors or functions. Beginning with the operational analysis (organization-based functionality), what the system does or is intended to do under nominal and anomalous conditions is the core of the development, and is the final arbiter of acceptability to the stakeholder community. Even object-oriented SE (Oliver 1994) emphasizes the definition and allocation of functions and their performance attributes to the identified objects. Integration is focused on the capability of the integrated system to perform the system functions or mission threads.

Model-based SE in an Integrated Environment (Gau Pagnanelli, et al., INCOSE 2012) based on structured analysis or SysML (Friedenthal and Kobryn, INCOSE 2004) characterizes functionality using control flows or activity diagrams, respectively. The system behavior is begun (ISO15288) during stakeholder requirements definition, continued through the requirements analysis and architecture, realized during integration, verification, and validation, and manifested for the user during operations, which is inherently “functional”. Along the way, the benefits of the functional architecture, when available, can be used to identify the verbs in the requirements statements (Piraino et al., INCOSE 2001), identify functional threads for integration and validation, and enable critical analysis of nominal and off-nominal behaviors, including hazard and functional failure analyses. In contrast with legacy hazard analysis (ARP4761) and failure analysis techniques (ARP5580), the capability to inject failure into a high-fidelity model of an operational system can help identify system architecting or requirements errors for conditions that had not been identified during the requirements definition and analysis process.

This paper describes the application and impacts of developing and analyzing the functional architecture within a model-based systems engineering environment. Examples will be provided in the areas of requirements definition, interface definition, integration, verification, and operational validation.

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