System-Level Activities and Value at the CALCE Center

CALCE has a distinguished history in the development and application of models, analysis approaches and testing methodologies for reliability assessment of electronic components and systems. The technology developed by CALCE is recognized as being directly applicable to organizations that design and manufacture electronics. Recently, however, several organizations have posed the question: “Why would a systems integrator be interested in joining an organization like CALCE, since they are not directly involved in the design or fabrication of electronics?”

The CALCE Center provides significant value to the system integrator in the form of:

**Being a smart customer** – Even if an organization is not directly involved in electronics design and fabrication, they still must be “smart customers” in dealing with their subcontractors who design and fabricate electronics for their systems. Failure to be aware of important aspects of the design and manufacture of systems can result in serious consequences to the performance and affordability of the system.

**Awareness of technology trends** - System integrators are faced with a responsibility to make sure that subcontractors are aware and are dealing with developing trends in the electronics industry (e.g., part/technology obsolescence, atmospheric radiation, time-dependent dielectric breakdown of gate oxides, reliability problems associated with new technologies and materials, impact of environment regulations on electronics, etc.).

**Driving guidelines and standards** – Guidelines and standards for design, manufacturing, and qualification of systems historically flow down from the system integrator to the designers and manufacturers. It is through organizations like CALCE that appropriate and useful guidelines and standards become developed and accepted.

**Distillation of knowledge** - Organizations like CALCE help to distill knowledge related to many aspects of electronics producibility, reliability, affordability, etc. CALCE also provides a forum for experts in both the electronics designer/fabricator and system integrator domains to discuss important issues impacting their communities.

*Figure 1 – CALCE system sustainment strategy.*

CALCE has developed a system sustainment roadmap that is directly applicable to the system integrators, Figure 1. The roadmap is designed specifically to build upon CALCE’s core reliability and testing competencies to apply modeling and design methodologies at a systems integration level and to address issues associated with the creation and management of sustainable systems. The objective of the CALCE Center’s system sustainment strategy is to identify and develop risk assessment methods and risk-informed guidelines for the insertion of electronics technologies into products and systems in support of sustainable systems through:

*Figure 1 – CALCE system sustainment strategy.*
• Technology/parts selection and management
• Supply-chain creation and management
• Life cycle optimization
Value is delivered in the form of product-performance based metrics, implementation methodologies, software tools, guidelines and standards.

Specific efforts in CALCE that contribute to the system sustainment strategy include:

Life Consumption Monitoring for Electronic Systems - Through a combination of tracking environmental stress history and Physics of Failure models, the remaining life in a system can be forecasted. Life consumption monitoring enables either prognostics (predicting the probability of success or failure under some future stress) or variable maintenance scheduling.

PHM Business Case Development for Electronic Systems – Models that enable the determination of when scheduled maintenance makes sense for electronic systems, and how to optimally interpret Prognostic Health Management (PHM) results for electronic systems, where PHM refers to health monitoring and life consumption monitoring approaches. Specifically this enables business case construction.

Technology Obsolescence and Technology Insertion Forecasting – Forecasting obsolescence risk and date ranges for technologies ranging from electronic parts to materials, intellectual property, and software. Using forecasted obsolescence and value functions, determine the optimum technology insertion points during a system’s lifetime.

System Design Refresh Optimization – Development of a methodology for determining the design refresh (redesign) schedule for long field life electronic systems based on forecasted technology obsolescence and a mix of obsolescence mitigation approaches.