

The Integrator

INCOSE North Star Chapter



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Systems Engineering at its Best!

Model-based Systems Engineering Contemporary MBSE activities: an Australian defence perspective

The Defence and Systems Institute, has been applying SysML-based approaches to capture architectural descriptions for a range of software-intensive defence systems. We have found that utilization of the tools assists in capturing design descriptions providing they are used on a regular basis. We found that one of the major benefits is the automatic configurations management and that the use of the tools facilitates the production of a more comprehensive system description that also combines some inherent behavior modeling.

Two limitations were, however, identified. Firstly, the tools we used captured a sequential representation of the activities of the system without any depiction of the time relationships of and between activities. We found that this can make it hard to understand the temporal performance of the system. Secondly, the diagrams within the model were delivered within documents rather than as modeling entities. We found this negated the some of the benefits of the model-based approach, specifically inherent model and version consistency and automatic change propagation.

The Australian Department of Defence, through groups such as the Defence Science and Technology Organisation (DSTO) and the Defence Systems Integration – Technical Advisory, is pursuing substantial research programs in MBSE (DSI-TA, 2010). This work is focused on understanding the current penetration of MBSE into the department and the implications of forthcoming MBSE practice on major systems integration projects that are being initiated.

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Chapter President's Corner

Paul Frenz, General Dynamics-AIS
INCOSE North Star Chapter 2011 President

Systems Engineering in a changing world. (Innovation, Safety, Education). That is the theme for the North Star Chapter for 2011. Why this theme? Everywhere we look, we no longer see business as usual. Several engineering businesses in the Twin Cities have cut back or are moving operations. We are continually asked to do more with less. And I don't see it returning to business as usual after the Great Recession. Change happens. Fortunately you can do something about it. Are you keeping yourself relevant to your employer or for future employers? When is the last time you read a technical or management book? Have you sought out additional education or training? Are you networking with other professionals? The North Star chapter monthly meetings and tutorials provide opportunities to help address these needs. The North Star chapter's monthly meetings are held at a diverse group of businesses (defense, medical devices, aerospace, health care, innovators, etc). Not all meetings I attend are directly applicable to what I do day to day but I always take away something that I can apply in the future. Remember that as systems engineers, we are expected to bring the breadth of knowledge to our project roles. So as we move from industry to industry and topic to topic, I encourage you to attend as many meetings as your schedule permits.

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INCOSE 2011 Symposium website:

<https://www.incose.org/symp2011/>

[North Star Chapter Website](http://www.incose.org/northstar)

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Quotable Quotes:

"Sometimes you just have to take the leap, and build your wings on the way down." **Kobi Yamada**

Campbell (2010) surveyed MBSE use within the Australian Department of Defence and has identified extensive utilization of MBSE across a number of projects. He mentions that there is substantial use of CORE for modeling joint and maritime systems and this has been found very useful at the front end of projects and far more efficient than document-centric approaches. He also cites that the Architecture Analysis Design language (AADL) has been used in the aerospace domain. The AADL users surveyed think that it is a good tool for smaller projects.

Of particular note is Whole-of-Systems Analysis Framework (WSAF) that has been developed by DSTO to support capability analysis and for the generation of capability development documentation (Robinson and Graham, 2010). WSAF employs MBSE principles within the guidelines of the Defence Architecture Framework to address the issues of knowledge management, requirements elicitation and documentation traceability in the capability development process. WSAF has been used for several projects with success and there are plans to expand its application to new projects.

Campbell's paper identifies the following points in relation to the introduction of MBSE into defence projects in Australia.

- There is rising interest in the use of MBSE in Australian defence projects and some early adopters.
- The success of the DSTO WSAF toolset in producing excellent documentation has been clearly demonstrated; this success is acknowledged by the customer.
- Reported benefits of MBSE include:
 - more accurate architectural designs
 - better traceability
 - reduced work effort
 - more easily produced traceable documentation.
- MBSE and the tools that have been developed to employ it are compatible with the traditional SE approach. However, successful use of the MBSE approach requires a degree of formalism and rigor that is often missing in early project activities.
- Architectural design and specification is a key element of MBSE and should be the starting point for all design work.

Campbell found that the main inhibitors to more widespread adoption of MBSE are entrenched culture, general resistance to change, and the steep learning curve. He notes that the cultural effects arise as much

from the need for management to commit to a significant upfront effort as a project gets underway as from any other cultural trait and while the steep learning curve was the barrier most often mentioned, the need for training was not evaluated as being particularly necessary.

Given that project problems have frequently been traced to inadequate attention to systems engineering fundamentals, it would appear that MBSE, with its inherent early capture of operational needs, systems requirements, and the evolving architectural design, has the potential to drive a cultural change that could make a significant difference to project outcomes.

Conclusions. Some 20 years after coming to appreciate the limitations of document-centric approaches, I am now more convinced than ever that contemporary MBSE approaches can increase the rate of knowledge acquisition by project participants, improve the quality of system designs, improve knowledge management, improve project communication, provide automated reasoning, and improve the application of systems engineering practices.

The Defence and Systems Institute at the University of South Australia has identified MBSE as a major focus area for research and teaching. We see MBSE as the vehicle that can create the paradigm shift needed to direct more attention onto the tenants of systems engineering at the early stages of major projects and as such it has the potential to make a valuable contribution to successful project outcomes.

**The University of South Australia View
Stephen Cook, Director Defence and Systems Institute**

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