

Modeling of Complex Systems Through in SysML in Italian Navy (ITN)

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ABSTRACT

In the last two years 2014 - 2015 the General Staff of the Italian Navy has been engaged in the definition of a modernization of the fleet, which led to the acquisition process of the following new ITN Ships:

- 1 type LSS units (Logistic Support Ship);
- 1 type LHD units (Landing Helicopter Deck);
- 7 type PPA units (Pattugliatori Polivalenti Altura).

During the design development phases, that has led to the definition of the ship/system architecture and user requirements system acquisition, the “traditional” design methodology (based, as usual, on a paper-based approach), has been efficiently supported by a more innovative methodology, based on “model-based” concepts, derived by Systems’ Engineering culture. The model adopted, that has been borrowed from the NAF (Nato Architectural Framework) and derived by the MDAF (Italian Ministry of Defence Architectural Framework), is a standardized process that allows to efficiently develop and manage complex systems of systems (SoS) during the entire life cycle (i.e. starting through the user needs elicitation up to the systems dismissal). The main aim of the NAF’s method is to represent a SoS as a model in which is possible to highlight every different aspect of the System through different point of view. Adopting the “model” is then the better way to develop a system that is the best compromise between performance, time and costs highlighting risks and gaps. The NAF’s method allows, at the beginning of the development of every new project, to support the Systems Engineer in the definition of the system requirements inside the model starting from the real understanding of the user needs through the realization of the so called “use cases”. A “use case” is the way in which the system satisfies one or more user needs in a practical way (i.e. operative context) understandable from the final user. The Italian Navy has adopted the previous method and model in particular in the definition of the System requirements of the Combat System (C/S) of the new military ships in which, in comparison with the past, many technological innovations and new developments have been introduced (e.g. fixed radar sensors, infrared search and track S/S, ...).

As anticipated, the operational and technological innovation foreseen in the acquisition process of new military ships has required, in particular for some specific areas of the Combat System, the use of a more innovative design approach,

based on model-based design concepts. The model adopted by the Italian Navy use the “constructs” made available by the SysML, which outputs are the “explanatory views” that take into account the analysis of the context (e.g. identification of stakeholders, the user's need, the application of operational concepts, ...) and the functional analysis (use case diagrams, sequence diagrams, architectural diagrams). An example of what has been done will be shown in a “case study” that has been realized with the aim of explaining a preliminary design of a particular and innovative subsystem of C/S of the new Naval Ships: the Sensor Management System (SMS). The SMS is a subsystem which main purpose is to become the “Command and Control” system of the radar sensor’s suite of the new Naval Ships of the Italian Navy. This subsystem, thanks to the functional integration of new sensors of ITN Ships, gives the possibility to increase the functionality of each sensor and to conduct a cooperative search and tracking action, against some particular targets (such as asymmetric threat) that are very difficult to detect using “traditional” searching method.

The use case will demonstrate that the methodology is absolutely essential if you want to accomplish complex successful systems of systems. In fact, the use of modeling tools in the development of a project has given the possibility of extrapolating, starting from generic user needs, the real requirements of the system to a very deep level, that could also be used in order to directly drive the production process of the system itself. The modelling tool and the method adopted is considered essential both in the design, in the development phase and in the rest of the entire system’s life cycle phases. However, it should also be stressed the fact that what has been analyzed and applied to a real case is just the use of a method and a tool to carry out project activities of systems engineering in a coherent manner. In fact, the tool and its use, without an internal structured process from both the user/customer side and the supplier/producer side is bound to be ineffective. The recommendation is that every complex project of SoS should be developed by every organization by adopting the method and the suitable model tools in order to finally get successful products to be delivered to final users. It should be stressed out that the product must also be competitive in an international environment where, especially in the big international organization, these kind of method and tools are being used since many years. A successful project means a successful organization. And the sum of the successful organizations represents the success of every nation.

AUTHOR BIOGRAPHY

Oswaldo Brogi, Vice Admiral was born on 13 February 1955 in Vinci (Florence), Italy. He attended the Naval Academy in Livorno from 1974 to 1978, achieving a master's degree in Electronic Engineering in April 1981 at Pisa University. Since October 2010 and until June 2012, he was appointed Director of Military Shipyard of Augusta. Navy Arsenal in Augusta (Sicily, Italy) is one (out of three) of the main Italian Navy Arsenals, in charge of the whole lifecycle maintenance of the Navy Units assigned in Sicily area. The Arsenal is an autonomous Command, roughly budget 20M€, equipped with several civil infrastructures like dockyards and 500 personnel assigned (both civilian and military). The Arsenal has been supporting UNIFIED PROTECTOR sea operations for 5 months. It was a great experience where leadership and initiative sense were prevailing. He also the Chairman of Bluemassmed Tech Group (2008÷2012), an European Project to develop Common Information Sharing Environment/Maritime Situational Awareness (CISE/MSA) amongst EU States. He managed more than 500 experts belonging to 37 administrations of 6 Member States and played the important role in promoting multinational cooperation through a concrete exchanging of the Mediterranean MSA using new C3 systems developed in Service Oriented Architecture (SOA). Promoted Vice Admiral has been appointed Advisor to the Italian Navy Admiral and from February 2014 is the Head of General Office for Naval Operating System's Design. Among those modern and effective solutions to counter pirate attacks, identify alternative combustibles like green diesel (biodiesel) or even natural gas, find the best employment of the satellite capabilities have been evaluated and applied. In particular, it deserves to be highlighted the insights made on: (i) space matter: i.e. the development of an updated national space strategy, relevant

with the next European one; (ii) cyber defence matter: i.e. the definition by engineering methods of an innovative single secure net, where the cyber community accesses management and the net efficiency monitoring is guaranteed by an effective governmental "Computer Emergency Response Team – CERT"; (iii) design activities about the ship new buildings: i.e. engineering feasibility studies for the technical operational requirements and for the preliminary architectures of the naval operating systems by the "Ministry of Defence Architectural Framework – MDAF". Since December the 30th 2013, Vice Admiral Brogi is the Head of the Naval Weapons Corps which main task is the governance of the resources employed for the design of the Naval Operating Systems/Combat Systems and their logistics support.

Nicola Cariello was born in Bitonto (BA) on the 14th of December 1975. He was normal course cadets at the Naval Academy (years 1995-1999) and then promoted to Ensign in 1999. He graduated from the University of Pisa in Telecommunication Engineering in 2002. He was head of Technical Operations component and Weapons Technician one on board ITS DDG "Durand de la Penne" (August 2002 - December 2005) and promoted Lieutenant in 2003. He got • master's degree in Systems Engineering from the "Tor Vergata" University - Roma. Currently he is in service with the Navy General Staff - General Office for the design of operating systems (UGEPROGESO) in Rome as a clerk at the Office - Planning; within the current job he managed the development of the technical specifications for the contract New Naval Units relatively new command and control and the cockpit naval. He has also started to develop the functional design of PPA C/S architectural baseline using MDAF (Ministero della Difesa Architectural Framework) through the use of Artisan Atego tool.