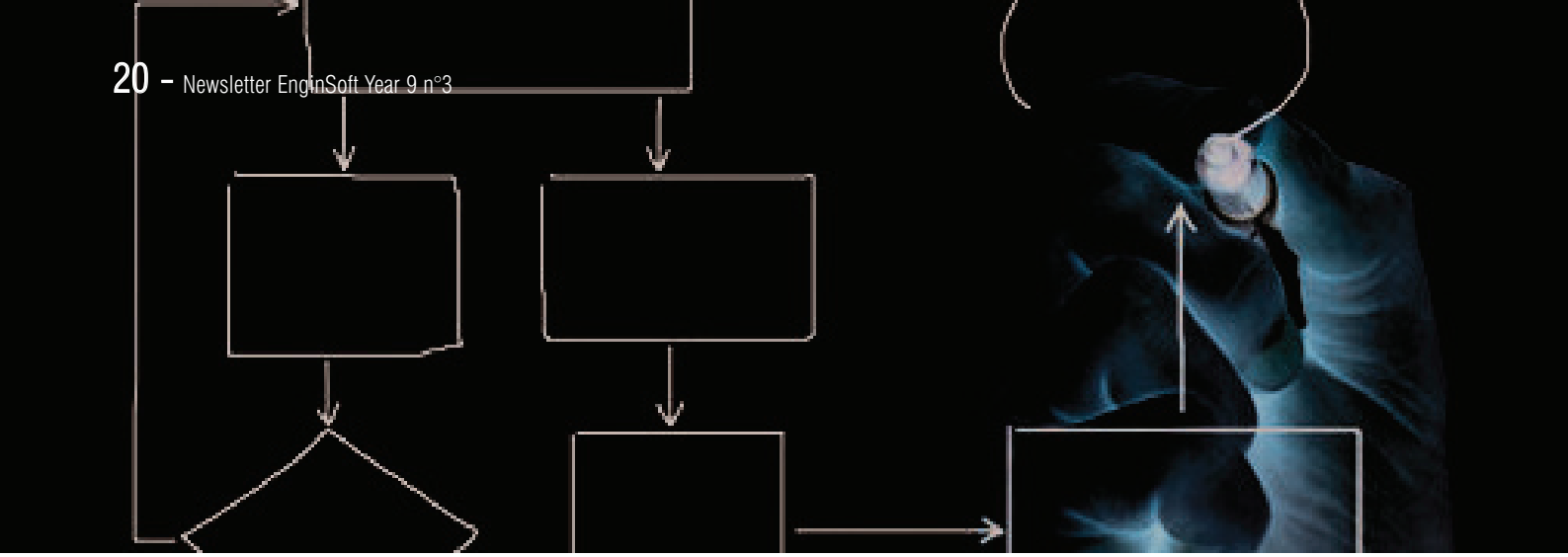

INCOSE 2012
modeFRONTIER supports implementation and validation steps in systems engineering

modeFRONTIER's application range has been further expanded to the discipline of Systems Engineering owing to ESTECO's participation in the INCOSE Symposium 2012 held in Rome. The International Council on Systems Engineering (INCOSE) is a not-for-profit membership organization founded to develop and disseminate the interdisciplinary principles and practices that enable the realization of successful systems.

Every year INCOSE organizes a challenge dealing with a common use case derived from a practical problem to be solved by the participants and demonstrated in the exhibit area. This year's challenge consisted in designing a Permanent Emergency Response Coordination Center (PERCC) for wildfires, in charge of coordinating the Departmental Operation Centers (DOC). The two main expected improvements were to decrease response time and optimize resource allocation.

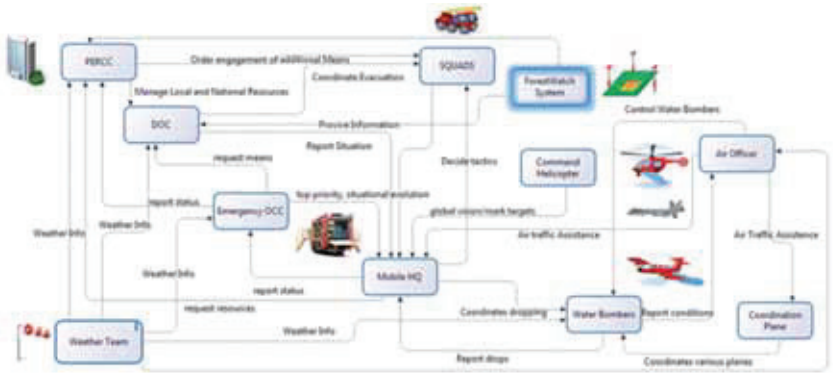

Fig. 2 - Interaction between systems and sub-systems diagram

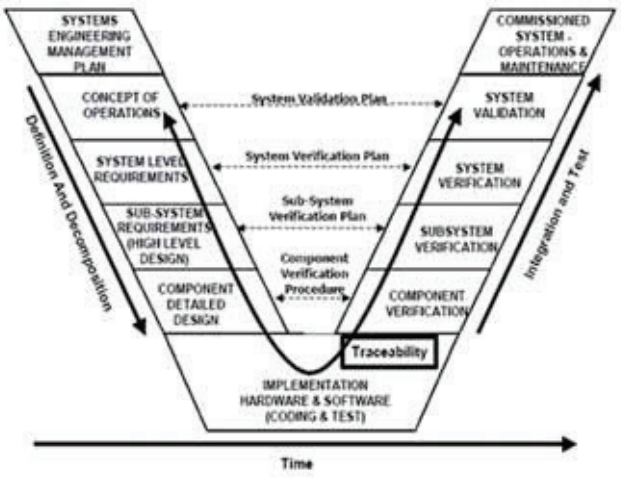

Fig. 1 - The V-model for the systems engineering process.

The solution proposal presented by ESTECO focuses on the benefits of modeFRONTIER's integration, automation and optimization tools for designing of complex systems and their deployment.

Content

System Engineering is based on a series of organized steps and procedures. The macro-steps composing this process are "Definition and decomposition" of the problem, "Implementation" of the software/hardware system and "Integration and recomposition" phase, i.e. testing and validation.

The application of modeFRONTIER proposed for the Wildfire Emergency System shows that this multidisciplinary platform can support both the implementation and the validation steps of the process.

modeFRONTIER supports the emergency management system at two different levels:

- ***At sub-system level***
  Consider a Forest Watch System composed by a network of towers, each equipped with a thermal camera with a

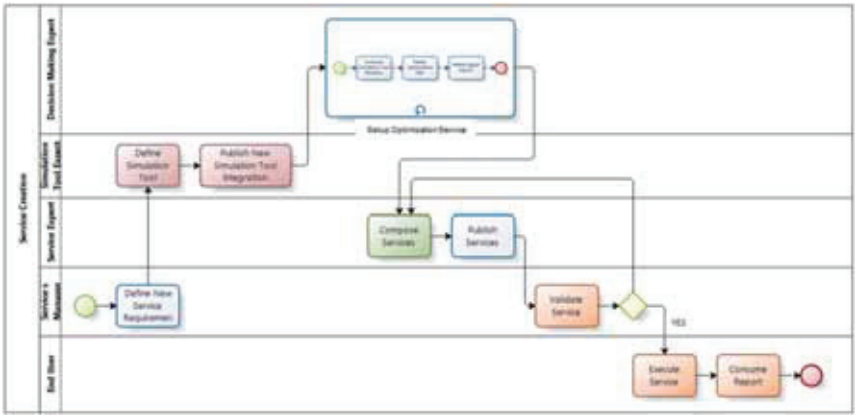

Fig. 3 - Service creation diagram

given observation radius and integrated with GPS Satellites. modeFRONTIER can find the best deployment of the Sensor network in order to maximize Efficiency and minimize Costs. The direct coupling with LabVIEW enables the integration of a number of hardware and software allowing for efficient system management. Another element to be considered at this level are the Unmanned Aerial Vehicles, which are often used to monitor and report wildfire position and extension. modeFRONTIER can be used to model and optimize UAV missions under different conditions for the purpose of covering efficiently as wide region as possible and provide valuable information about fire extension and spreading.

- ***At system level***

  At system level modeFRONTIER can be used to enhance the performance of an Emergency Coordination Center for wildfires, in charge of coordinating 11 departmental operation centers by identifying the optimal allocation of resources and minimizing the time for the resources to reach each center.

  The solution can be arranged as a Web Service for PERCC to manage and automate procedures and communications, providing the decision makers with a new optimal solution generated each time the system configuration is updated.

  Multiple services are set up and managed through a central server in order to collect all information about the status of the assets and to simulate possible scenarios autonomously. Imagine a resource allocation problem under a massive fire alert occurring simultaneously in different regions.

  Optimization is performed every time PERCC receives an update of the system status (eg. a change of risk level from any DOC on the basis of the reports of ground squads or water bombers, a change of resource availability due to holidays/illness/situational awareness, weather forecast or military/civil communications, etc.).

  The model is based on a fixed distance matrix (to compute distances between each DOC center) and on a definition of initial resource allocation, which is regularly updated.

  On the basis of the demand for resources from each DOC (in accordance with the reports, in particular when crises arise) PERCC uses the Optimization tool to calculate the resources that a given DOC should send to another DOC which requested additional units.

  modeFRONTIER's capability to easily manage complex multi-objective problems allows finding the optimal allocation of resources, minimizing the time required for the resources to reach the DOC that requested the units.

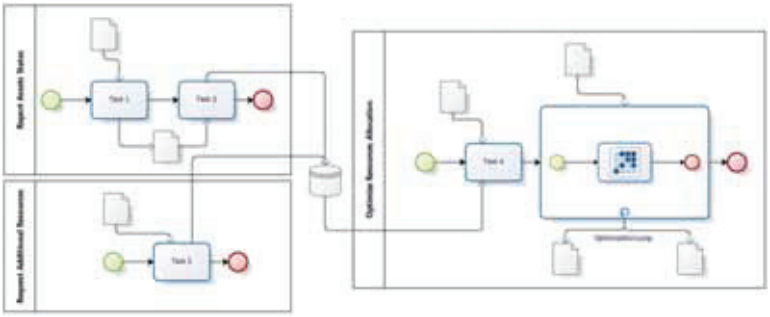

Fig. 4 - Workflow

Conclusions

The scenario outlined in this case study shows how the application of the modeFRONTIER multidisciplinary optimization platform can support both the implementation and the validation steps of a complex system engineering process. System engineers and domain experts can use this platform to execute models and check the compliance with requirements or perform trade studies throughout the design process. Executable models, even at a high level of abstraction, are cost-savers and help discover tricky problems, miscommunication issues, and missing or ambiguous requirements.

Matteo Nicolich - ESTECO SpA
engineering@esteco.com
www.esteco.com

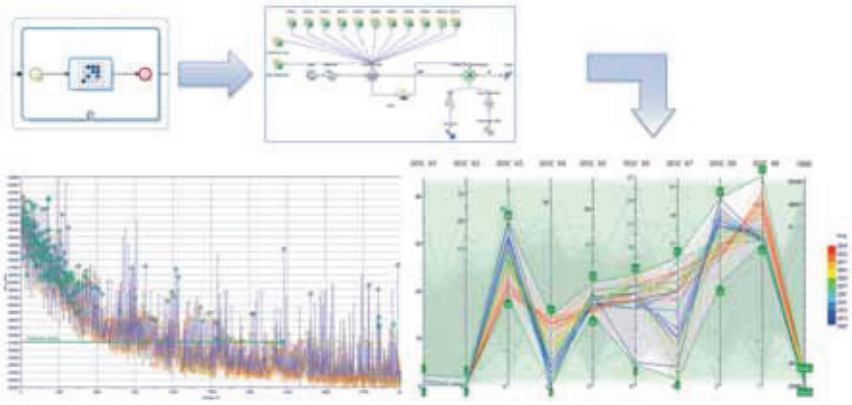

Fig. 5 - Optimal solution