



Application of Lean Engineering Principles to Space Mission Development



Study Abstract

Lean is a mindset and a collection of strategies, tools, techniques and behaviours that are used to differentiate between value-adding and non-value-adding activities with the goal of eliminating or minimising the non-value-adding ones. **Lean Engineering (LE)** aims for a continuous process improvement of the entire product development process. Special attention is paid to three typical types of inefficiency: waste, overburden, and unnecessary variation. It offers therefore an improvement tool for business leaders as well as an important contributor to establish and maintain sustainable working practices. LE therefore differs in this aspect from the more widely known Lean Management and Lean Manufacturing.

To investigate "**Lean in Space**" Astrium Satellites has conducted on behalf of ESA a first general study on LE, i.e. to assess its application to space engineering activities and evaluate potential benefits. The 10 month activity was structured in three parts: 1) Assess the State of the Art of LE; 2) Evaluate of Applications and Methods; 3) Investigate and Recommend Future Activities.

Lean experts from Astrium and Airbus summarised Lean principles, methods and tools and outlined the general objectives. Past and current applications and benefits were discussed. Then, potential improvement opportunities within ESA projects were evaluated including using a questionnaire and interviews to do a first localisation of process steps that seem to be connected to an important level of inefficiency. Here, the entire project life cycle was aimed at, **especially phases B/C/D but also Phase A/B** and interactions in between. Industrial processes as well as external workflows, e.g. involving subcontractors or the Customer, were both addressed and a number of issues revealed that should be addressed in future ESA activities on Lean. Finally, the findings were used to define possible next steps recommended to be taken in order to facilitate introduction and utilising this exciting philosophy into Space project execution. Here, three future activities were outlined in more detail as typical examples of the available range of possibilities.

The key outcome from the study is: The current mission development process, although partially highly optimised, is lacking of a global reflection. Many issues found can be viewed from Lean perspective and can likely be improved by using Lean principles, methods and tools in conjunction with other means such as Concurrent Engineering (CE). CE as a systems engineering approach provides the basis of developing efficient processes and tools for supporting '**right-first time**' solutions, and Lean Engineering provides the basis to enhance these processes by eliminating waste and contribute to systems engineering to focus on its core activity: Engineering.

Lean therefore capitalises **knowledge-based and fact-based decision-making** during the entire development process to avoid the worst wastes caused by design-loopbacks late in the project. Understanding the user true needs and their impact and understanding the risks and using **design maturity** as key indicator for measuring project progress mark the transformation from the traditional project execution paradigm towards a Lean Engineering one. This has the potential for a significant improvement towards working with mature concepts and robust designs, thus, enabling better cost and schedule adherence in the future.