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Shortening of Delivery Time for University-Class Lean Satellites

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Abstract

The introduction of the CubeSat standard has led to exponential growth in the number of small satellites launched in recent years. This is evidenced by statistics, which show such growth predominantly for satellites weighing 10 kg or less. Several factors can be attributed with the proliferation of small satellite launches, including the use of commercial off-the-shelf (COTS) components and the acceptance of higher risk during their development stage, both of which have enabled faster delivery of these satellites from concept to launch. Such non-traditional, risk-taking approaches to minimize cost and time required to achieve mission success led to the emergence of a "lean satellite" development and management philosophy, recognizing that it was not the size or the mass that drove the delivery time, but rather, the development philosophy itself. With the concept still in its infancy, the statistical analysis of the delivery time indicates likelihood of developing satellites faster, possibly in less than a year. Also, study of the mission success of the satellites shows that spending more time in building a satellite does not necessarily contribute to making the satellites reliable. Frequency coordination and compliance to safety requirements being some of the key challenges currently affecting the development time, recommendations are proposed herein, derived from the experience gained in development of lean satellites at Kyushu Institute of Technology for future lean satellite projects of universities around the world.

1. Introduction

When the CubeSat standard was introduced, many might have thought of it as a mere educational tool for universities, which lacked the capacity to provide any real value to small satellite users. About a decade later, the number of small satellite launches per year increased exponentially. The growth observed is predominant for satellites within the 1–10 kg category (Figure 1), most of which are CubeSats. In contrast, only a gradual growth is observed in the satellite launches per year for those weighing between 11 and 500 kg (Figure 2).

The small satellites, especially the CubeSats, are being widely accepted across all space sectors as a key technology for advancement in the satellite industry. This has led to a paradigm shift in the space sector. A key feature of these small satellites (or CubeSats) is the use of commercial off-the-shelf (COTS) components, which has led to reduction in the cost of developing a satellite. In addition, the notion of failure being

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