Paper ID: 63738
student

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

Author: Ms. Ksenia Osipova
Skolkovo Institute of Science and Technology, Russian Federation

Prof. Alessandro Golkar
Skolkovo Institute of Science and Technology, Russian Federation

LAUNCH CAPACITY – PARAMETRIC ASSESSMENT OF GLOBAL CAPACITY FOR ACCESS TO SPACE

Abstract

For the whole history of spaceflight we observed sharp increases and gradual declines of global launch capacity under the influence of fluctuating demand and geopolitical drivers such as the Cold War. We are currently observing a new wave of growth in activity due to increased commercial demand for satellite launches. For instance, we see a significant growth of satellite launches related to the emerging trend of megaconstellations for space connectivity (such as Starlink, OneWeb, and so on).

In the paper we investigate the question of whether and how the current global launch capacity is able to respond to the growing demand of launches. Ultimately, we are interested to assess whether the increasing number of announcements of satellite constellations can be sustained by the currently available and perspective launch capacity worldwide, using a grassroots approach. Our proposed launch capacity estimating approach is parametric and bottom-up, and it is based on the queuing theory. Its goal is to analyze the sustainability on the launch side of the multiple megaconstellation projects currently being proposed in the industry. We identify the required conditions in launch capacity scale-up for stable and rapid launching of thousands of satellites over the next decades.

Our model is based on the analysis of historical trends starting from the launch of the Sputnik-1 in 1957. We account for the influence of target orbital altitudes, average satellite lifetime and other key parameters in determining the match between demand and supply of orbit launches. Using this parametric model we forecast future global launch capacity and estimate asymptotical limitations associated with current growth trends. The analysis is based on the open-source data and considers planned and existing constellation projects, as observed in industry. Based on our analysis, we see for instance that the SpaceX launch infrastructure is able to meet the demand for the deployment of Starlink (over 40,000 satellites to be operated at steady state). On the other hand, we identify the gap between current launch capacity and future needs, should all constellation projects announced in the market eventually materialize.

Our results provide a grassroots, fundamental estimate on future launch infrastructure needs at global scale, forming the basis for understanding technological developments required on the spacecraft side and launch capacity side, for the evolution of future upstream space infrastructure.