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MACROECONOMIC SYSTEM ENGINEERING: THE FOUNDATION FOR BUILDING A  
SUSTAINABLE SPACE BASED ECONOMY**Abstract**

For decades the industry has been thwarted by the absence of a credible economic path to profitability in beyond orbital space. The development of infrastructure capable of supporting humans and sustainable economic activities is deemed costly and without sufficient market demand. In this paper we develop a *Macroeconomic System Engineering* (MSE) framework that provides the foundation for an evolvable and sustainable space economy.

For a sector to have macroeconomic effects, it should account for 1 percent of GDP. Space activities in the US reached 0.23 percent of GDP in 2013. If the space industry grows at its current rate of 2 percent faster than the economy, it will not be until 2087 that it achieves a GDP level of macroeconomic significance. Achieving a higher rate of growth will be challenging but it has been done by other industries. The primary missing ingredient in economic forecasting for beyond orbital space is *market demand*. High-fidelity *risk assessment* and *rate of return* from any space based economic activity are also required for any credible forecast. What if we could assess, with high levels of confidence, what the market demand, risk posture, and economic return is from any space venture? Could the rate of growth of the industry be increased so it would achieve macroeconomic prominence by 2050?

The answers are critical to the evolution of the industry. It would underpin the amplification of capital flows based on credible estimates of the space economy. The MSE framework provides the architecture, methods, and tools required to enable high confidence predictability of a space economy. Our discussion begins with the market research we are conducting on civilian demand for a future space economy. The core of our framework is predicated on demand for space tourism and/or settlement. We then show how this civilian demand creates a foundation for adjacent activities (transportation, fuel production, refueling, mining etc.). We calculate and compare how a sector transitions from a microeconomic enterprise to a macroeconomic player in the broader economy. We show that “stand-alone” economic growth scenarios may underestimate “integrated” scenarios that are based on an evolvable market as a function of core civilian demand. We conclude our discussion with an evaluation of the MSE analysis of the space economy versus that of existing terrestrial high growth markets, and show that as the industry matures, the level of uncertainty in the forecast converges to that of any other dynamic sector.