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SPACE SYSTEMS SYMPOSIUM (D1)
Technologies to Enable Space Systems (3)

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VALUE-CENTRIC/DRIVEN DESIGN – APPLICATION OF GAME THEORY PRINCIPLES IN THE SPACE INDUSTRY

Abstract

Market requirements influence a product's scope, mission, and design over a Product Life Cycle (PLC), providing the design teams and investors the best chances of success. Most design techniques, only consider the market's requirements, during the initial stages of design. It is used to constrain the product scope down to a narrow domain by creating its requirements. This Requirements-Based Engineering Design (RBED) methodology does not necessarily guarantee success when it comes to space missions: the Iridium Communication Constellation being one of the most notable commercially unsuccessful mission.

The design methodology, Value-Centric Design (VCD), however, addresses this gap by establishing the extensive attributes of decision makers and their utilities to produce a better design scope than RBED. With the global space market projected to be worth over £400 billion ($575 billion) by 2030, most countries, including the UK are encouraging Small and Medium Enterprises (SMEs) through incentives to capture the market. Therefore, it would seem important to design a space mission accounting for competition within the design method.

Current design methods, from a micro economics perspective, assume a monopoly situation; reducing the market to a single producer and customer in order to simplify the space mission requirements and it's life cycle. This paper will investigate the potential effects of competition to overall value of a simple space mission. A VCD framework will be utilised to demonstrate an oligopoly model, which includes a limited number of producers and customers, who share the market with competition. This paper will look to extend the use of value to explain the levels of competition, expanding on different decision making opportunities within the space industry and the effects expanding the design space/domain.

By applying the principles of game theory to simulate an oligopoly market, two particular methods will be employed to determine the changes in value of a space mission with respect to the decision makers. The first method will aim to sum the maximum values of each individual space industry decision makers, and second method will apply along the value chain allowing decision makers to collaborate in order to generate the maximum value over the space mission life cycle (SMLC). Finally a cross between the two methods will be developed to find the effects of competition within the different levels of the value chain.