Value Modeling and Trade-Off Analysis of the Tactical Assault Light Operator Suit

Elliot Fairbrass, Leonard Genders, Giovanni Perez-Ortega, Clint Swisher and Vikram Mittal

Department of Systems Engineering, United States Military Academy

Corresponding author's Email: Leonard.Genders@usma.edu

Author Note: Cadets Fairbrass, Genders, Perez-Ortega, and Swisher are all members of the Department of Systems Engineering at the United States Military Academy. This paper presents research performed for a Capstone Project in support of Joint Acquisition Task Force – Tactical Assault Light Operator Suit (TALOS), US Special Operations Command (SOCOM).

Abstract: The Tactical Assault Light Operator Suit (TALOS) is a powered, armored exoskeleton designed to enhance an operator’s survivability, lethality, and mobility. The suit is a SOCOM initiative using rapid acquisition practices with a functional prototype expected in 2018. Value modeling allows the TALOS design teams to rapidly perform design trade analysis while ensuring that the proposed system is in-line with the operator’s needs. A stochastic value model was built for the power subsystem through an analysis of the requirements to develop value hierarchies, swing-weight matrices, and value functions. An Excel based tool performed trade-off analysis to determine the best design solution. This tool accounts for uncertainty in raw data values to create distributions in the cost and value of each design alternative, which is critical for assessing risk. The model was expanded to other subsystems as well as the suit as a whole.

Keywords: Trade-Off Analysis, Value Modeling, Design Alternatives

1. Introduction

1.1 Overview of TALOS

“Several years ago during a hostage rescue operation in Afghanistan, a SOF (Special Operations Forces) warrior was killed going through the door. Afterwards, one of the young officers asked me a question I couldn’t answer. He said, ‘after all these years in combat, why don’t we have a way to protect our operators going through the door?’ With all the advances in modern technology, I know we can do better. Consequently, at SOCOM we have established a program called … TALOS” (McRaven, 2015).

The Tactical Assault Light Operator Suit (TALOS) system is a powered, armored exoskeleton inspired from Marvel comic book’s Ironman. The suit provides technology that increases operator survivability, lethality, mobility, and spatial awareness in the current battlefield environment, especially in urban and room clearing operations. TALOS provides SOCOM operators a distinct battlefield advantage over enemy combatants through enhanced forced entry capabilities. As captured in Admiral McRaven’s quote, SOCOM intends to rapidly develop and field the TALOS system. The project began in 2013 with plans to field a functional prototype combat suit by 2018 (Miller, 2016). This timeline is aggressive when compared to similar Department of Defense projects (McRaven, 2015). To meet the stringent timeline, SOCOM set up a Joint Acquisition Task Force (JATF), which places a government team as the lead integrator for the project. This team consists of Special Forces operators, acquisition officials, and engineers.

1.2 Probabilistic Value Modeling--Methodology

Value modeling is a powerful tool that allows engineers and acquisition officials to design a system that is in-line with the operator’s needs. As shown in Figure 1, the value modeling process begins by performing a functional decomposition of a system. Next, the associated functional hierarchy progresses into a value hierarchy that depicts the functions, sub-functions, and objectives for the system. These objectives are then quantified into value measures, which assess how well an objective is attained (Parnell, 2011). Each value measure is linked to a value function that grades how well a design alternative performs in accordance with the system requirements, stakeholder feedback, and market surveys. The raw data for a design solution is entered into the value functions that map the raw data to a score between 0 and 100, where 0 is the minimal acceptable value and 100 is the ideal value. A swing weight matrix then assigns a weight to each value measure based on the stakeholders’ priorities. The weights add up to one, with each value measure’s weight being a percentage of the system value. These weights are then multiplied by their corresponding scores for each value measure. For each design solution, these values are summed.