Modeling Time Based Power for Military Dismounted Small Units

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Abstract: As the Army injects technology into the Soldier’s individual equipment, electrical energy requirements continue to increase. Soldiers and leaders need to be able to predict the amount of energy required for the duration of their missions. There is a need for modeling that supports future acquisition decisions related to military dismounted small unit power through assessment of energy consumption, storage and regeneration, and net energy at platoon and below levels. This research presents an electrical energy expenditure model for a dismounted infantry platoon. The model considers a 72 hour contingency and energy consumption. Equipment includes communications, navigation, and command and control systems. The scalable design of this model represents an essential contribution of this work. Results include a model capable of supporting changes in contingency plans, equipment specifications and equipment configurations.

Keywords: Small unit energy expenditure, tactical regeneration, scalable energy modeling

1. Introduction

In an ever evolving world of knowledge, a technology’s relevance to the battlefield can be defined as a function of its utility and its opportunity cost to the Soldier. Consequently, each new piece of equipment for Soldiers must be analyzed thoroughly, to ensure the benefit outweighs the cost. This capstone project specifically focuses on the electrical energy expenditure cost-benefit analysis. Project Manager Soldier Warrior (PM SWAR), a Program Management Office of Program Executive Office Soldier (PEO Soldier), identified the need for a systematic, flexible and automated model of Soldier energy needs throughout a specified concept of operations (CONOPS).

The analysts of PM SWAR’s Warrior Integration Site (WINSITE) will be the primary users of the model. Once the model’s algorithms have been refined, verified and validated, the WINSITE will be given the model and port it into a programming language consistent with their ongoing development environment. Thus, the model, regardless of programming language, must be traceable. The model must communicate any nuances and sub processes in a way that it can be replicated by the WINSITE team. Finally, the model owes a demonstrable output to any decision maker briefed on the model. The model needs to communicate its findings visually, such that it requires minimal expertise to understand the model’s conclusions. The model must be easily modifiable so that decision-makers can explore a variety of hypothetical scenarios. The model should not require substantial work to modify or account for these scenarios.

WINSITE’s fundamental requirements of this project follow: the model needs to address the variables that affect energy consumption and regeneration in an evolving operational environment, adjust its simulation accordingly and provide a user friendly interface to calculate these estimates. Specifically, the model must be flexible with respect to input parameters (PM SWAR 2016). The following parameters must be adjustable: the duration of the specified CONOP; the missions that compose the CONOP; a Soldier’s duty position; a Soldier’s behavior on missions; equipment loads that Soldiers carry; and the electrical specifications of designated equipment.

The current work seeks to adequately represent Soldier and small unit behavior with respect to energy consumption. As specified in the Operational Mode Summary/Mission Profile (OMS/MP) (PM SWAR 2016), Soldier behavior and actions govern a unit’s ability to sustain their energy sources throughout a specified CONOP. The OMS/MP specifies the tasks completed throughout a mission. Thus, the current work still needs to account for Soldier behavior.

Soldier behavior modeling derives its foundations from psychology. In “A Reference Model of Soldier Attention and Behavior,” Alt and Darken (2008) acknowledge the development of heuristics, which allows the Soldier to act in a timely manner during familiar scenarios. Silverman et. al., (2006) model the behavior of non-player character (NPC) Soldiers in role playing games using probability trees. Using a series of Boolean values and probabilities derived from a psychological analysis of actual Soldiers, the game developers can automate the actions of NPCs. These two sources suggest that Soldier modeling