Development of a Diplomatic, Information, Military, Health, and Economic Effects Modeling System

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ABSTRACT
Having a clear picture of different facets of the current situation is key in the conduct of tactical operations within a theater. To this end, the ensemble application of sentic computing and intention awareness techniques is hereby examined to develop a novel analysis framework for estimating the effects of diplomatic, informational, military, health, and economic activities in the context of a theater of operations. A set of candidate models of the flow and evolution of population beliefs and intentions is evaluated and recommended as the starting point for developing an effects modeling system for tactical commanders. In particular, the following needs were identified: (1) understanding and representing the underlying causality within the population; (2) formulating models that are both sensitive and computable; (3) validating the predictions of population beliefs, intentions, and behaviors by model.

Keywords: Diplomacy-Information-Military-Health-Economics (DIMHE), Effects Modeling System, Intention Awareness, Military Information, Sentic Computing

1. INTRODUCTION
As conflicts become more systemically complex, leaders and military officials must use multidimensional analysis to assess the state and future of a conflict, rather than relying on more traditional metrics such as military progress and capabilities. This especially holds true of recent asymmetric conflicts, in which the effects of each military operation must be carefully considered in order to avoid undermining the grand political strategy.

In response to this fundamental shift in the application of military power, the U.S. military coined the term effect-based operation (EBO). EBOs are “operations that are planned, executed, assessed, and adapted based on a holistic understanding of the operational environment.

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in order to influence or change system behavior or capabilities using the integrated application of selected instruments of power to achieve directed policy aims (Smith, 2003).” This has led to the development of new doctrine models, such as diplomacy, information, military, health, and economics (DIMHE) and other conflict prediction systems (Howard, 2007). Such systems require that tactical commanders consider all of these factors in mission planning and execution.

The goal of DIMHE, which extends the diplomacy, information, military, and economics (DIME) paradigm by taking into account also health impacts, is “to avoid counter-productive and conflicting activities in the conduct of tactical operations within a theater (Applied Systems Intelligence Inc., 2007).” The importance of extending DIME with health effects is premised by the pursuit and the implementation of electronic health records for both peacetime and contingency/wartime operations by the U.S. military in the past two decades. Similarly, many other national militaries have embarked upon like efforts. During international conflicts and peacekeeping operations, the member countries of the North Atlantic Treaty Organization (NATO) routinely contribute personnel and resources to staff multinational operations for direct combat, combat service support, and health care delivery.

During these types of operations, it is common to have soldiers from a number of countries receiving care in a facility staffed by multinational medical personnel from across the NATO countries. The documentation of health care delivery often mirrors the capabilities within individual countries (e.g., paper-based, electronic, and hybrid) and can be dependent upon the lead country staffing the health care facility in support of the mission (Do, Lasome, & Parramore, 2011).

In an attempt to enable the U.S. Army to assess and manage the social aspects of stability operations in overseas conflicts, this paper identifies and characterized at least five classes of models that could be applicable to the DIMHE effects modeling (DEM) system. The identification of possible models was supported by a broad, but necessarily limited, literature search that spanned political theory, demographics, group behavior research, biostatistics, genetic theory, health science, opinion mining, social networking, and group beliefs and motivations. From this search, a classification of models into five types was made. These model classes are broad, with considerable variation in breadth, depth of detail, and time span across the model instances found. Each of the model classes was intended to provide an approach to modeling the population, its beliefs and motives and its likely behaviors. Model classes were formulated based on the political, military, economic, social, infrastructure and information (PMESII) analytical tool, which forms a container for the effects of DIMHE phenomena (Hillson, 2009). The five classes hereby defined are:

- **System Dynamic Models:** This class of model generally consists of a system of differential equations that describe the relationships between attributes of the system state as the system evolves through time. Given an initial state \(X(0)\), a future state \(X(t)\) can be calculated. In practice, only the smallest systems of up to a few dozen equations can be solved unless the systems are assumed to be linear (all higher order derivatives = 0). Much larger systems can be represented and solved under the assumption of linearity, which often is acceptable for short time periods and small variations in the state attributes (Forrester, 1994);

- **State Transition Models:** A state transition model represents the state of the population beliefs and PMESII as a hierarchical state graph with nodes representing system state and links representing transition probabilities between the states (California Department of Forestry and Fire Protection, 2012). The hierarchical structure of the graph embeds subgraphs within nodes, so that substates can be defined within a state and so on. A node in a subgraph represents a total state for the population system be-
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