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Americas Conference on Information Systems (AMCIS)

December 2004

# War Games: Evaluating Interactive Simulation Software for the Battlefield and the Board Room

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# War Games: Evaluating Interactive Simulation Software for the Battlefield and the Board Room

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## ABSTRACT

We discuss an initial research concept for the application of the task-technology fit model to measure the factors that influence the utilization of interactive simulation for executive and managerial training. Interactive simulation is widely used by the military for senior leadership and managerial tasks. Simulation is also used commercially for training similar skills. We propose measuring the task-technology fit of simulation applied to training executive and managerial tasks such as strategy development, decision-making, and operational procedures. This research will empirically test which task and individual characteristics provide a task-technology fit for simulation systems. It will assist in the validation of prior information technology investment and ideally stimulate continued investment. We focus on the use of interactive simulation in the military. We feel that our results can be readily extended to commercial executive and managerial training.

**Keywords:**
Interactive simulation, task-technology fit, perceived usefulness, performance impacts

## INTRODUCTION

Selecting the correct application of technology to make an organization operate more efficiently and effectively, as well as how to measure success, are important questions to address before the implementation of any new technology. Goodhue (1995) defined task-technology fit (TTF), as "the extent that technology functionality matches task requirements and individual abilities." DeLone and McLean (2001) further studied factors involved in information system success.

Seila et al. (2003) discuss gaming simulations as involving "the interaction of one or more persons with the simulation," and provides examples such as management games used in business and war-games used to train military commanders. Proctor and Gubler (1998) define interactive simulation as a military commander interacting with entities in a simulated battlefield to influence the results of the simulated battle. We provide a unique perspective in that we investigate task-technology fit directly for the use of interactive simulation applied to training executive and managerial decision-making.

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## LITERATURE REVIEW

### Task-Technology Fit

Task-technology fit is defined as "the extent that technology functionality matches task requirements and individual abilities (Goodhue, 1995)." During prior empirical testing, individual, task and technology characteristics were found to directly influence user evaluations of task-technology fit (Dishaw and Strong, 1998; McCarthy, 2002). The research assumed that higher evaluations of task-technology fit will lead to increased performance since users evaluate task-technology fit based upon their task needs and personal abilities rather than on a set of system-based measures (Goodhue and Thompson, 1995). This link, however, was not empirically tested.

Goodhue and Thompson (1995) furthered the task-technology fit research by including utilization in the research model and examining the relationship between task-technology fit and individual performance. Task-technology fit was measured by user evaluation of several factors affecting decision making needs, operational needs and changing business needs. Also measured were task characteristics, individual characteristics, utilization, and perceived performance impact. Moderate support was found for the hypothesis that task and technology characteristics predict user evaluation of task-technology fit. The research strongly supports that both utilization, in the form of user ranking of system-dependency, and task-technology fit must be measured to predict performance.

Dishaw and Strong (1999) extended the technology acceptance model (TAM) with task-technology fit constructs. The TAM is based on the Theory of Reasoned Action (TRA), which is a behavioral study of IT usage. The variables with which the TAM is concerned with include perceived ease of use, perceived usefulness, attitude towards use and intention to use, and how they affect actual tool usage. These variables were added to a task-technology fit model that included task requirements, tool functionality, tool experience, TTF and actual tool usage.

### Modeling and Simulation Success

Proctor and Gubler (1998) investigated the use of military simulation to facilitate organizational learning. Interactive simulation occurs when a commander interacts with entities in a simulated battlefield to influence the results of the simulated battle. Action research, in the context of organizational learning theory, was performed in two live training environments using interactive simulation. At exercise completion, senior officers use an automated process called After Action Review (AAR) to evaluate the level of success achieved on the simulated battlefield. The research evaluated AAR results and found that by using interactive simulation for training there is a potential for organizational learning to occur. However, evaluation of the particular technologies used for simulation or AAR were not performed

### Interactive Simulation Systems

Interactive simulations provide a virtual environment for executives and managers. Unlike when simulation is used for closed-form decision making such as a factory layout problem, there is no single problem to be solved. The simulated environment directs a series of events whose objective is to train the executive or manager in effective decision-making within the scope of their authority. Interactive simulation can be performed either with computerized or physical simulation. Computerized simulation can consist of an automated board-type game on a single computer to a large distributed game consisting of many models and many players. In physical simulation, physical mockups of the system are constructed and used for making decisions on plant layout, for example, or training in military tactics (Turban and Aronson, 2001).

One of the earliest types of physical simulations was a military sand table, which is a table bearing a relief model of a terrain built to scale for study or demonstration, especially of military tactics.

The Joint Theater Level Simulation (JTLS) is a computerized war game used to train military commanders and their staff in joint operations. War-game simulations may consist of models of higher headquarter commanders, peers, subordinate units and opposing forces; entities can be physical units such as tanks or aircraft, individuals or organizations.. The JTLS system "is an interactive, multi-sided wargaming system that models a joint and coalition force air, land, and naval warfare environment" (Rolands, 2003). JTLS is used during military exercises for high-level military staff training by the United

States Joint Forces Command (USJFCOM), the Joint Warfighting Center (JWFC), and several international military training organizations.

The JTLS system's primary operator interface is the Graphical Input Aggregate Control (GIAC), shown in Figure 1. The GIAC displays the state of the simulated entities and provides an interaction mechanism for the exercise and training controllers. For example, exercise controllers use the GIAC to redirect the simulation when necessary to add realism. Trainees use their own operational systems in the war game; they do not use JTLS directly. Their systems interact (interface) with the simulations during training exercises. The information (status on aircraft, etc.) from the JTLS GIAC is transmitted to these operational systems during the exercise. The trainee's operational systems are similar in look and feel to the GIAC.

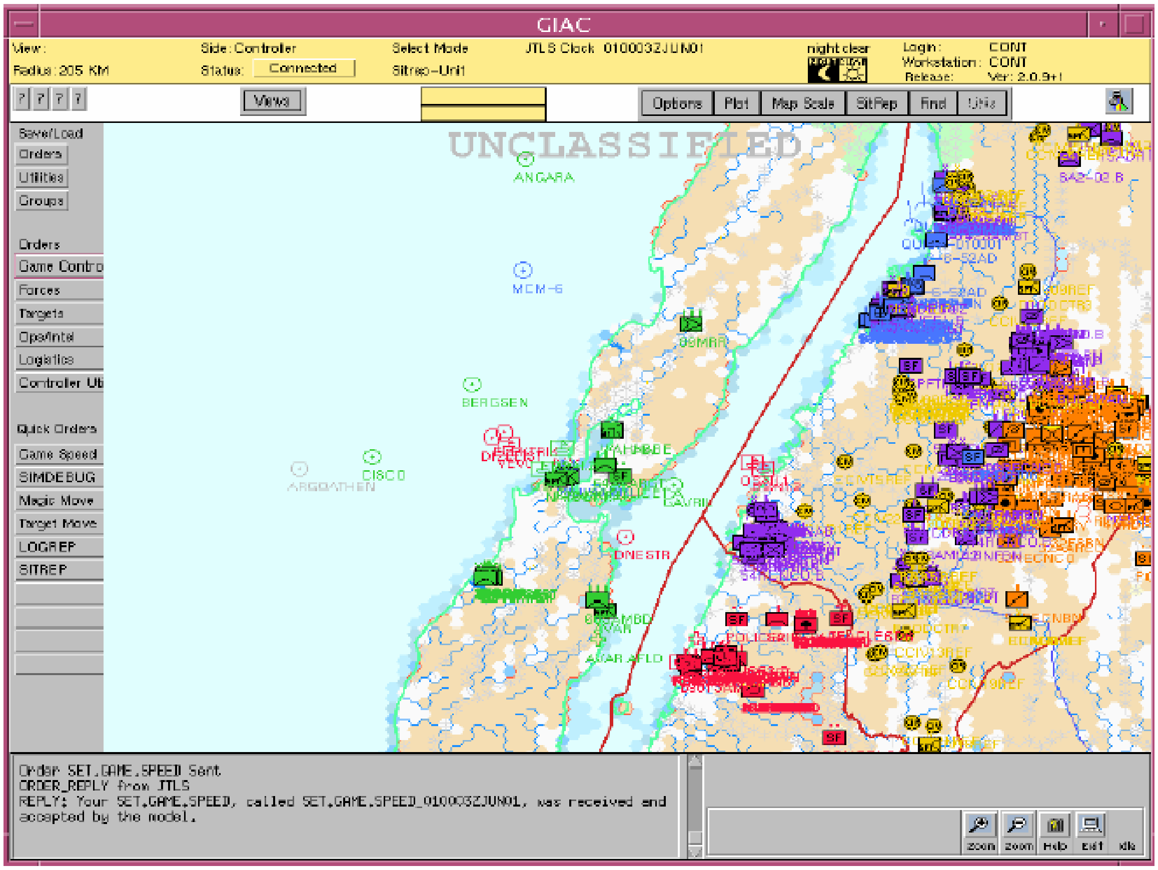



**Figure 1 Joint Theater Level Simulation GIAC Display**

**(Developed by Los Alamos National Laboratories)**

The JTLS also includes a message processor, shown in Figure 2. The message processor displays messages that are compiled from the simulation and sent to the military trainee for use in decision-making, as well as messages from the trainee's system for action in the simulation. The information sent from the GIAC and the message processor is simulation data that emulates the type of information the commander would receive in a real wartime scenario. Although the simulation interacts with both controllers and trainees, our research focuses on the task-technology fit of the simulation for the trainee.

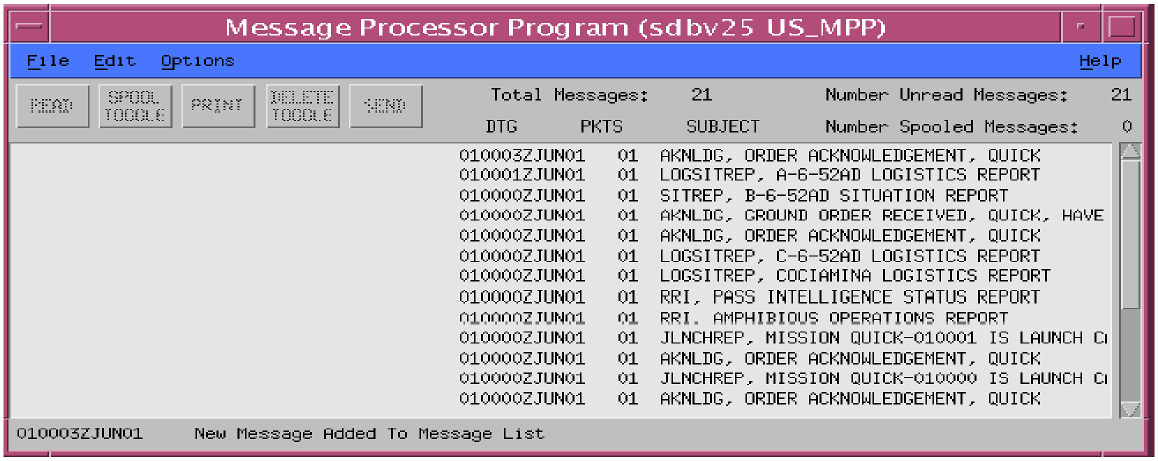



**Figure 2 Joint Theater Level Simulation Message Processor Program**

## Research Questions

We intend to test whether or not there is fit between the use of interactive simulation and post-training effectiveness. Furthermore, we will test which simulation environments have the best task-technology fit.

- A physical board game where the trainee and opponent have no computer interaction and use physical models to control or influence the game, e.g. a military sand table.
- A large distributed war-game where trainees use their every-day computer systems to directly interface with a semi-automated opponent simulation (e.g., JTLS).

Interactive simulation is routinely used to train both executives and managers. To measure task-technology fit, it is important to distinguish between task requirements. Executive and managerial tasks are different. Manager's tasks are tactical and operationally (process and procedure) oriented, where executives tasks are more strategically oriented. We will further study whether interactive simulation is better suited to managerial or executive training.

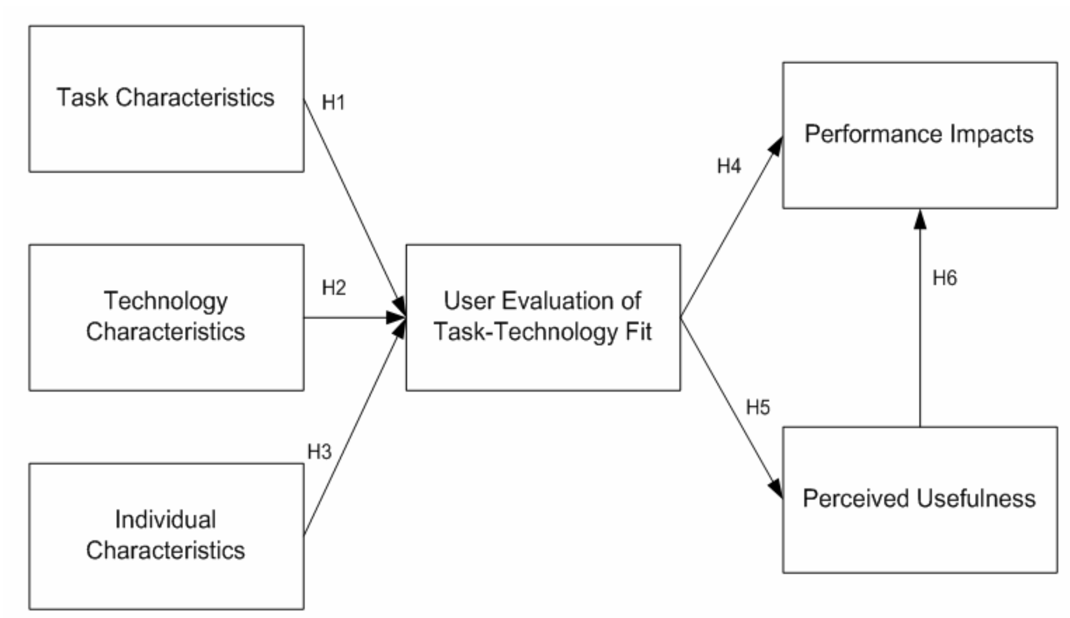
The research questions to be investigated are as follows:

- Do interactive simulation systems support executive and managerial training?
- Does the task-technology fit of interactive simulation systems impact the performance of executives and managers?
- Is the task-technology fit of computerized interactive simulation greater than physical simulation for executive and managerial training?
- Does the task-technology fit of interactive simulation systems affect the interactive simulation system's perceived usefulness?
- Does the perceived usefulness of interactive simulation affect executive and managerial performance?

## METHODOLOGY

Although in common use, technical implementations of interactive simulation have not been empirically tested for effectiveness. A modified task-technology fit model will provide a means to test the use of interactive simulation technology for effective executive and managerial training. The methodology will consist of a survey of a convenience sample of recently retired and active U.S. military commanders at the executive (e.g., General Officer) and managerial (e.g., Lt. Colonel and Major) levels, to collect user evaluation of the task-technology fit of simulation for training. We make this distinction based upon the assumption that the scope of a General's responsibility is typically strategic, whereas the scope of Lt. Colonels and Majors are typically managerial, i.e., tactical/operational. Colonel's classifications will depend on their primary responsibilities[2]. Prior task-technology fit research has been validated using linear regression techniques; we intend to use similar methods.

We draw from Dishaw and Strong's (1999) combined task-technology fit, technology acceptance model to derive our research model. Task characteristics, technology characteristics, and performance impacts are from the task-technology fit model, and perceived usefulness is from the technology acceptance model.




Task, technology and individual characteristics will be operationalized by user evaluations of data quality, locatability, authorization, compatibility, timeliness, reliability, ease of use, and relationship. To study whether interactive simulation is better suited to managerial or executive training, we will operationalize the task-technology fit for managerial or executive training by including the task characteristics of operational procedures or strategy development. Perceived usefulness and performance impacts will be measured by user evaluation.

All variables will be measured using questions derived from existing validated surveys, and four sample populations will be used (executive/computerized simulation, executive/physical simulation, managerial/computerized simulation, and managerial/physical simulation).

## Importance of the Topic

Simulation is widely used by the military for training executive and managerial decision making. The military spends billions of dollars investing in the development and use of these tools. Simulation is also used commercially for training similar skills. This research is important for two reasons. First, empirical research can assist in the validation of previous investment in the technology and stimulate continued investment, and can lead to decisions to reduce or redirect investment into more

[2] Colonel's classifications will depend on their primary responsibilities. We will ask at least three military experts to evaluate rank and position to indicate executive or managerial responsibility. We will do an inter-rater reliability test to determine whether an individual will be considered an executive or manager.

appropriate technologies. Second, while this study will focus on the use of interactive simulation in the military, we feel that the results will readily apply to commercial executive and managerial training.

## The Need for Further Research

Methods for verification and validation (V&V) of discrete event simulation are widely covered in operations research and simulation textbooks such as Law and Kelton's (2003). However, these methods do not measure how successful the use of simulations have been in meeting objectives, i.e., "are we solving the right problem?" The use of interactive gaming simulation may not have been empirically tested for effectiveness or success in terms of how well the technology fits the task. After Action Review (AAR) is one method that is commonly used, but its focus is on determining whether the training objectives were met, not whether simulation was the appropriate tool for the training task.

## Contributions Expected from the Study

Previous studies have investigated task-technology fit for knowledge management systems (McCarthy, 2002), software maintenance tools (Dishaw and Strong, 1998; 1999), and group support system effectiveness (Zigurs and Buckland, 1998; Shirani, Tafti and Affisco, 1999). We plan to extend that work by investigating the task-technology fit of interactive simulation for training. This will also result in more interdisciplinary research between the Information Technology and Management Science/Operations Research/Operations Management communities. Our research will further explore the task-technology fit model and consider the relationship between the task-technology fit models, technology acceptance, and the models of success.

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