

PREDICT: A Model-based Tool to Support Simulator Acquisition Decisions

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PROBLEM STATEMENT

Simulators are being used to train civilian and military personnel in a variety of occupations. Over the years, simulators have evolved to provide varying levels of fidelity, training utility, and cost. The choice of simulators is critical to ensure quality training results and to minimize unnecessary investment. Currently, there is no standard tool for determining the appropriate level of fidelity of training simulators to achieve specified training objectives, maintain trainee acceptance, and fit within budgetary constraints. Therefore, acquisition professionals and training designers often turn to end-users to provide fidelity requirements for training systems. Fidelity requirements defined by end-users provide useful insight into the level of fidelity necessary to ensure that trainees ‘buy-in’ to the simulator, but they do not necessarily help with determining how much and what kind of fidelity leads to effective training. In fact, some studies have shown that a discrepancy exists between pilots’ subjective assessment of the simulators’ effectiveness and learning and subsequent performance (Estock, Alexander, Stelzer, & Baughman 2007; Estock, Baughman, Stelzer, & Alexander, 2008; Estock, Stelzer, Alexander, & Engel, 2009). As a result, there is a need for a tool that combines fidelity requirements defined by end-users, existing theory and research about fidelity, and objective performance data from fidelity experiments to support more informed decisions regarding the acquisition and use of training simulators.

WHO CAN BENEFIT?

All simulator-based training programs struggle with the same problem—it is difficult to identify which objectives can be trained in lower- or higher-fidelity simulators, and which require training in the operational environment/system (e.g., aircraft). PREDICT (Predicting Requirements for instructional Environment Design to Improve Critical Training) was initially designed to support the F/A-18 community with simulator fidelity trade-off decisions. However, since PREDICT is mission focused (e.g., air-to-ground), versus platform focused, it can assist all aircraft platforms that fly the same missions at the F/A-18 (e.g., F-35, F-16, F-22). In addition, with a small amount

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of effort, PREDICT can be extended to other aviation platforms (e.g., helicopter) and other domains (e.g., ship simulation).

BASELINE TECHNOLOGY

Currently, acquisition and training professionals turn to end-users to provide fidelity requirements for training simulators. This end-user input is necessary to ensure that trainees ‘buy-in’ to the simulator. However, solely relying on end-user defined fidelity requirements can be problematic because: (1) end-users tend to overestimate the level of simulator fidelity required for effective training (Estock, Alexander, Stelzer, & Baughman 2007; Estock, Baughman, Stelzer, & Alexander, 2008; Estock, Stelzer, Alexander, & Engel, 2009), and (2) this typically results in specifications for a simulator that exceed the amount of money available for development and/or acquisition. As a result, acquisition and training professionals must make difficult fidelity trade-off decisions. With little guidance and no standard tool available to support these decisions, it is extremely difficult to identify appropriate level of fidelity of training simulators to achieve specified training objectives, maintain trainee acceptance, and fit within budgetary constraints. Unfortunately, this can result in a simulator that end-users refuse to use for training because they do not perceive it to be an effective device.

TECHNOLOGY DESCRIPTION

PREDICT is a model-based software tool to support informed decisions regarding the acquisition and use of training simulators. PREDICT provides two main capabilities. First, the user can provide information on the fidelity of a simulator and the tool predicts the training effectiveness of that simulator on specific training outcomes (Figure 1). Second, the user can compare the predicted training effectiveness of multiple simulators side-by-side (Figure 2).

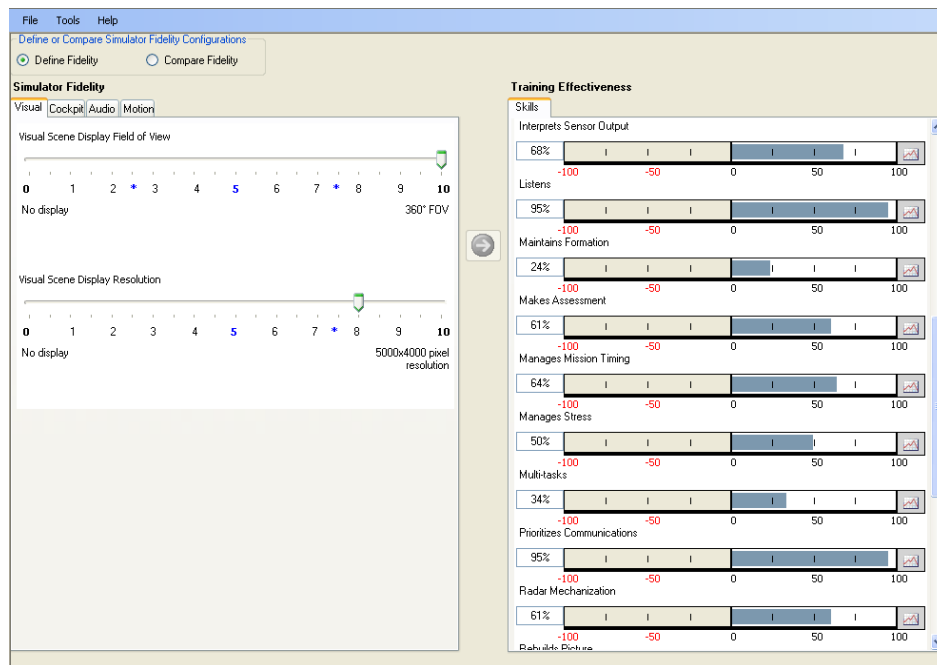


Figure 1. Predicting the training effectiveness of one simulator.

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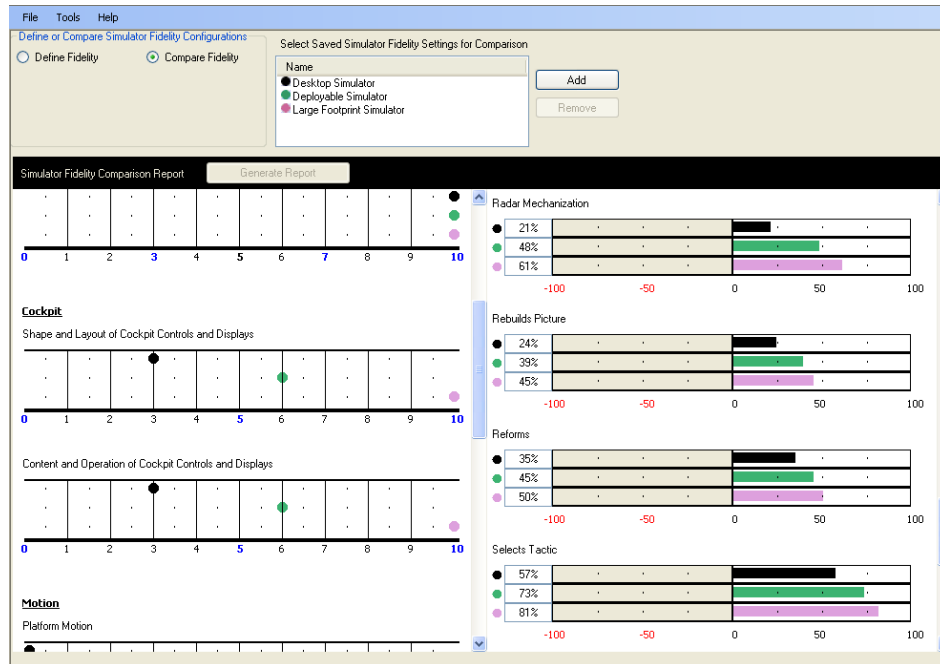


Figure 2. Comparing the training effectiveness of multiple simulators.

PREDICT provides several key benefits over the baseline technology as shown in the table below.

Features of PREDICT	Advantages	Benefits
Fuses (1) fidelity requirements defined by end-users, (2) existing theory and research about fidelity, and (3) objective performance data from fidelity experiments	<ul style="list-style-type: none"> Provides data from multiple sources (versus exclusively end-user) to support more informed decisions Provides both subjective and objective data to support more informed decisions 	More accurate assessment of fidelity requirements by combining end-user needs with objective data
Considers trainee factors (e.g., trainees experience level) and their impact on training effectiveness	Accounts for complex constraints of the training environment	More accurate assessment of fidelity requirements by considering the type of trainee
Considers interactions between fidelity dimensions (e.g., visual, auditory, motion) and their impact on training effectiveness	Accounts for complex interactions between the fidelity dimensions of a given simulator (e.g., the need for platform motion decreases as visual scene field of view increases)	More accurate assessment of fidelity requirements based on interaction between fidelity dimensions of a given simulator
Considers cost variables	<ul style="list-style-type: none"> Accounts for budgetary constraints Accounts for the cost of fidelity upgrades 	Optimizes training simulator to achieve the specified training outcomes at the lowest cost

CURRENT STATE OF DEVELOPMENT

A fully functional prototype system is developed and prepared for initial user testing that will be completed by June 2010. PREDICT will be at TRL 5 in time for the Navy Opportunity Forum in June 2010.

REFERENCES

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ABOUT THE COMPANY

Aptima Inc. was founded in 1996 with the vision of enhancing human performance within complex sociotechnical systems. The company has assembled an exceptionally qualified staff of roughly 110 professionals with over 80% holding graduate degrees. It is the largest independently operated firm of its type in the country and has been recognized by the Boston Business Journal and Fortune Magazine as among the fastest growing private companies.

Aptima brings together a unique team of people experienced at applying and evaluating applications of cutting-edge technologies in the military, national security, aviation and medical communities. The collective expertise of the firm's staff has been applied in multiple engineering domains including military command and control, complex information display, decision support, emergency preparedness, organizational design, technology evaluation, performance measurement, and cognitive skills and cultural training. This breadth provides Aptima with a wide-ranging base of market knowledge to accomplish the company's innovative research and development objectives, including:

- (1) Aptima ***develops training requirements, content, and technology***. Aptima applies a unique approach for identifying critical competencies for effective warfighting and uses them to develop crew training requirements, content, technologies, and measures of crew member performance.
- (2) Aptima ***evaluates human-systems usability and utility*** using measurement technologies and usability techniques. Our measurement technology includes tools for rapidly defining measures of human performance, and integrating performance measures and assessments from simulation systems, expert observers, and other technologies.
- (3) Aptima ***designs user interfaces*** for integrated software components. Aptima has pioneered the application of Cognitive Work Analysis and Ecological Interface Design for workstation and "multifunction display" design in complex systems.
- (4) Aptima ***analyzes complex systems*** to support the design of technologies, work processes, and organizations. We conduct these analyses using a variety of knowledge elicitation, modeling, and simulation techniques.
- (5) Aptima ***optimizes the design of warfighting teams and organizations***, including the definition of optimal crew size, roles, and responsibilities for human crew members in completing missions.

These capabilities have led to over 450 contracts totaling \$130 million. Over 85% of these contracts have been from agencies across the Department of Defense.