

Evaluation of frigate bridge concepts using Virtual Environment techniques

*Peter J. Werkhoven, Wilfried M. Post, & Patrick A.J. Punte
TNO Human Factors Research Institute
Soesterberg
The Netherlands*

Abstract

Virtual Environment (VE) techniques were developed and applied for studying different bridge concepts for a new frigate of the Royal Netherlands Navy. Firstly, thorough function-analysis and task-allocation studies were carried out. Secondly, officers of the Royal Netherlands Navy could virtually see and walk through the bridge and bridge wings of the frigate and evaluate functionality, safety and comfort. Force feedback from a real railing and real walls was precisely matched with the virtual world to prevent unnatural behaviour. Several scenarios were tested revealing errors in the bridge design that could have caused serious problems. The VE techniques used proved to be cost-effective.

Introduction

The Royal Netherlands Navy is in the process of designing new bridge concepts for the Air Defence and Command Frigate (ADCF), in collaboration with TNO Human Factors Research Institute (TNO-HFRI). This process consists of thorough function-analysis and task-allocation studies followed by an iteration of bridge-design and evaluation. For the evaluation of bridge concepts we have used Virtual Environments (VE) that have proven to be a powerful immersive computer-simulation technique. Using high-end VE helmets (head-mounted displays), long-range trackers and image generators, officers of the Royal Netherlands Navy could virtually walk through the bridge and bridge wing. Viewing was in colour and stereoscopic. Some dynamic aspects were simulated in a simple manner such as lowering a lifeboat, replenishment at sea and man over board procedures. To facilitate real leaning in VE a mock-up railing was provided which could be felt exactly at the position where the railing was seen in the virtual world. We call this combination of VE-techniques and partial mock-up 'hybrid mock-ups'. Extensive check-lists and interviews revealed the officers' appreciation of the visibility of the surroundings, of parts of the ship and of personnel seen from several positions near windows or from behind consoles. Also several bridge layouts were studied (including a "closed" and an "open" bridge design). Problems regarding the width of window posts and the positioning of some radar equipment could be quickly recognised. These observations supported a choice of concept and have resulted in the redesign of some aspects of the frigate bridge.