

Human factors engineering in ship system design

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The report investigates common features affecting the ergonomics and safety of ship systems design and operation. Particularly, the report identifies how human engineering limitations play a critical role in ship safety. I would like to draw your attention to the recommendations of the report as I feel they are beneficial to the ship designing industry. Also, I would like to show my appreciation to my supervisor, Kevin Sturbridge, who assisted with the development of the content of my report. Thank you for the opportunity to prepare this report. Please contact me at (709) 683-1225, or

at if you have any questions regarding the report. Look forward to your feedback and my grade for this assignment. Sincerely,

Executive Summary This report examines common features affecting the ergonomics and safety of ship systems design and operation, and identifies how human engineering constraints play a critical role in ship safety. Recommendations for new design guidelines will be proposed for ship designers in the future. In an attempt to improve the future of ship design, this report analyzes machinery space access routes and machinery arrangements spatial configuration.

In addition, it examines anthropometric data and identifies current ergonomic problems that are often responsible for workplace injuries. Many ships have human engineering design constraints that make it challenging to work onboard safely. These constraints lead to numerous injuries such as slips, trips, and falls (STF). Also, poor design and extrinsic factors limit the operator's ability to complete simple tasks. Factors affecting human performance are: musculoskeletal structure limitations disturbing the

amount and direction of force application, producing and maintaining high forces for an extended amount of time, and the operators age.

Designers must consider those factors when designing the machinery space to ensure a safe work environment. To achieve a safe working environment, designers must always consider the operators who will be working on the ship. Machinery space equipment such as stairs and ladders are frequently used for accessing machinery, controls, and other decks. If not designed properly, stair and ladder routes can lead to SST injuries. The United States Navy completed a human factors engineering (WIFE) review in the machinery space of their new build designs.

The results of their review determined that the category titled 'incorrect stairs and ladder had the second largest number of deficiencies. A different United States Navy study called T-CAKE determined that 134 deficiencies were discovered for the category titled 'incorrect stairs, ladders, steps, and walkway designs'. Thirty percent of the reported injuries were from non-compliance with the American Society of Testing and Materials (ASTM) standards, and another 2% was from operator movement not being considered in the design.

Machinery and controls accessibility is another common source of injury due to the limited space surrounding it. A study on Danish vessels resulted in 293 reported injuries in the machinery space. Of those 293 cases, 211 were from general maintenance and routine duties such as controlling operating valves. In addition, spatial configuration also affects the operator's ability to perform regular duties. Studies show that 44% of total machinery space deficiencies

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are blamed on spatial configuration because of the awkward positions operators must adopt to gain access.

Oftentimes, designers do not incorporate anthropometry, ergonomics, or safety into machinery space designs, resulting in poorly designed machinery space access routes and spatial configuration. Also, ASTM guidelines are not closely followed when designing the machinery space due to several engineering disciplines working on the designs. Recommendations are made to correct the problems identified in this report, and enhance the safety Of all machinery space operators. The first step for engineers to accomplish this is to answer the six questions of the 'common sense approach'.