



## The Role of Human Factors and Ergonomics in Designing Safe and Efficient Systems

Egbukichi Ugonna Johnbull<sup>1</sup>  
Nnorom Ukachukwu Samuel<sup>2</sup>  
Isiguzo Kelechi promise<sup>3</sup>  
Amah Anthony chukwuemeka<sup>4</sup>  
Orieware Doumotimi Christopher<sup>5</sup>

Federal College of Land Resource Technology, Owerri

[jupoceada@gmail.com](mailto:jupoceada@gmail.com)<sup>1</sup>

[nno\\_rom@yahoo.com](mailto:nno_rom@yahoo.com)<sup>2</sup>

[isiguzo6@gmail.com](mailto:isiguzo6@gmail.com)<sup>3</sup>

[tonyemekaamah@yahoo.com](mailto:tonyemekaamah@yahoo.com)<sup>4</sup>

[oriedoumo25@gmail.com](mailto:oriedoumo25@gmail.com)<sup>5</sup>

### ABSTRACT

*Human Factors and Ergonomics (HFE) is a multidisciplinary field that focuses on understanding the interactions between humans and other elements of a system. This study provides an overview of the materials and methodologies used in HFE, highlighting its importance in designing products, systems, and environments that are safe, efficient, and easy to use. The study's findings have implications for practice, suggesting that designers and engineers can use HFE principles and methodologies to improve user experience and accessibility.*

**Keywords:** Human Factors and Ergonomics (HFE), User-centered design, Ergonomic design, Design for safety, Design for efficiency, User experience

### INTRODUCTION

Human Factors and Ergonomics (HFE) is a scientific discipline that examines the relationships between humans, technology, and work environments. It draws on knowledge from psychology, physiology, engineering, and design to optimize system performance, reduce errors, and improve user experience (Karwowski, 2006).

#### Aims

The primary aims of Human Factors and Ergonomics are to:

1. Improve safety: Reduce the risk of accidents, injuries, and fatalities by designing systems that minimize hazards and errors (Reason, 1990).

2. Enhance performance: Optimize system efficiency, productivity, and effectiveness by designing interfaces and workflows that support user needs (Klein, 2008).
3. Increase user satisfaction: Design products, systems, and environments that are comfortable, intuitive, and enjoyable to use (Norman, 2013).

## **Objectives**

The specific objectives of Human Factors and Ergonomics include:

1. Analyze user needs: Identify the physical, cognitive, and emotional requirements of users in different contexts (Kirwan & Ainsworth, 1992).
2. Design user-centered systems: Create products, systems, and environments that are tailored to user needs, abilities, and limitations (Vredenburg, 2002).
3. Evaluate system performance: Assess the safety, efficiency, and effectiveness of systems, and identify areas for improvement (Stanton et al., 2013).
4. Develop design guidelines and standards: Establish principles and protocols for designing systems that prioritize human factors and ergonomics (International Organization for Standardization, 2010).

## **LITERATURE REVIEW**

Human Factors and Ergonomics (HFE) is a multidisciplinary field that focuses on understanding the interactions between humans and other elements of a system (International Ergonomics Association, 2018). The primary goal of HFE is to design products, systems, and environments that are safe, efficient, and easy to use (Sanders & McCormick, 1993). This is achieved by analyzing user needs, designing user-centered systems, evaluating system performance, and developing design guidelines and standards (Helander, 2006).

One of the primary aims of HFE is to improve safety by reducing the risk of accidents, injuries, and fatalities (Reason, 1990). This can be achieved by designing systems that minimize hazards and errors (Norman, 1988). For example, a study by Stanton and Young (1999) found that the use of ergonomic design principles in the design of aircraft cockpits reduced the risk of pilot error.

Another aim of HFE is to enhance performance by optimizing system efficiency, productivity, and effectiveness (Kroemer & Grandjean, 1997). This can be achieved by designing interfaces and workflows that support user needs (Baxter & Sommerville, 2011). For example, a study by Goomas and Eberts (2005) found that the use of user-centered design principles in the design of computer interfaces improved user performance and satisfaction.

In addition to improving safety and performance, HFE also aims to increase user satisfaction by designing products, systems, and environments that are comfortable, intuitive, and enjoyable to use (Jordan, 2000). For example, a study by Han et al. (2004) found that the use

of ergonomic design principles in the design of office chairs improved user comfort and satisfaction.

## **RESEARCH METHOD**

### **Materials**

HFE research and practice involve a wide range of materials, including:

1. User-centered design tools: These tools are used to design products, systems, and environments that are tailored to user needs, abilities, and limitations (Vredenburg, 2002).
2. Ergonomic furniture and equipment: These are designed to reduce the risk of musculoskeletal disorders and improve user comfort (Robertson, 2017).
3. Prototyping materials: These materials are used to create prototypes of products, systems, and environments (Kimbell, 2011).
4. Data collection tools: These tools are used to collect data on user behavior, preferences, and needs (Stanton et al., 2013).

### **Methodologies**

Several methodologies are used in HFE, including:

- a. Hierarchical Task Analysis (HTA): a method used to analyze complex tasks and identify potential errors.
- b. Plan-Do-Study-Act (PDSA): a cycle used to test and implement changes in a system.
- c. Systems Thinking: an approach that considers the complex interactions within a system and how they impact human performance.
- d. User-Centered Design: a design approach that focuses on understanding the needs and limitations of users.
- e. Task analysis: This methodology involves analyzing the tasks that users perform to identify areas for improvement (Kirwan & Ainsworth, 1992).
- f. Usability testing: This methodology involves testing the usability of products, systems, and environments (Nielsen, 2000).
- g. Ergonomic assessment: This methodology involves assessing the ergonomic risks associated with products, systems, and environments (Robertson, 2017).

## **RESULTS AND DISCUSSION**

The results of the study showed that Human Factors and Ergonomics (HFE) is a multidisciplinary field that focuses on understanding the interactions between humans and other elements of a system (International Ergonomics Association, 2019). The goal of HFE is to design products, systems, and environments that are safe, efficient, and easy to use (Karwowski, 2006). The study also found that HFE involves a wide range of materials and methodologies, including user-centered design tools, ergonomic furniture and equipment, prototyping materials, and data collection tools (Vredenburg, 2002; Robertson, 2017; Kimbell, 2011; Stanton et al., 2013).

## **Discussion**

The results of the study highlight the importance of HFE in designing products, systems, and environments that are safe, efficient, and easy to use. The study also shows that HFE involves a wide range of materials and methodologies that can be used to improve user experience and accessibility. These findings are consistent with previous research that has shown that HFE is a critical component of designing products, systems, and environments that meet the needs of users (Norman, 2013; Persad et al., 2017).

The study's findings also have implications for practice. For example, designers and engineers can use HFE principles and methodologies to design products, systems, and environments that are safe, efficient, and easy to use. Additionally, organizations can use HFE to improve user experience and accessibility, which can lead to increased customer satisfaction and loyalty.

## **Limitations**

One limitation of the study is that it focused primarily on the materials and methodologies used in HFE, and did not explore the broader social and cultural contexts in which HFE is practiced. Future research should seek to address this limitation by exploring the social and cultural contexts of HFE practice.

## **Conclusion**

The study provides an overview of the materials and methodologies used in HFE, and highlights the importance of HFE in designing products, systems, and environments that are safe, efficient, and easy to use. The study's findings have implications for practice, and suggest that designers and engineers can use HFE principles and methodologies to improve user experience and accessibility.

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