Introduction to Human Factors Theory and Practice

Liv Systems

This is the module booklet for "Introduction to Human Factors Theory and Practice", part of the Introduction to Human Factors Theory and Practice course from Liv Systems.

HFE Theory and Practice Course Objectives

Human Factors Engineering (HFE) theory and practice refers to the application of scientific principles and data to the design of systems, products, and environments in order to optimise their effectiveness, safety, and usability for human users.

In this course we will focus on two areas: HFE theory and practice in **analysis**, and in **design**.

Analysis

Design

By **HFE analysis** we mean the analysis of interactions and situations that can serve as the basis of an understanding of how people will be affected by the scope of our product or change.

HFE design is the synthesis of this analysis, together with theories of human-system interaction, to develop products and services that are human-centred.

While HFE methods and processes may have different names, they can be categorised as basically supporting either analysis, or supporting design.

In this course we use the term 'design' to refer to any systematic change with a particular purpose in mind. That could be the introduction of a new product. But it could also be the 'design' of a new procedure, or working method, or the introduction of a new job role.

The principles are the same whether we are designing technology or an organisational change.

HFE and Analysis

This module is about the scientific principles, models, and frameworks that are used to understand human behaviour and performance in the context of human-system interaction.

These theories, models, and frameworks provide a way of understanding how people interact with technology, how human performance can be evaluated, and how systems can be designed to support human performance.

The practical application of scientific knowledge and approaches is crucial for the design and evaluation of human-system interaction.

In the context of HFE, the scientific approach to analysis differs from using 'common sense' in several ways:

- **Evidence-based**: The scientific approach is based on systematic observation and experimentation, and the development of theories, models, and frameworks that are supported by evidence. In contrast, common sense relies on intuition, assumptions, and personal experience, which may not be based on evidence.
- **Objectivity**: The scientific approach allows for the objective evaluation of the system, through the use of systematic and unbiased methods. In contrast, common sense may be influenced by personal biases and may not provide an objective assessment of the system.
- **Generalisability**: The scientific approach allows for the development of theories, models, and frameworks that can be generalized to other systems, situations, and domains. In contrast, common sense solutions may be specific to a particular system or situation, and may not be applicable to other systems.
- **Replicability**: The scientific approach allows for the replication of experiments and studies, which helps to validate the findings and improve the confidence in the results. In contrast, common sense solutions may not be easily replicated or validated.
- **Predicting and improving performance**: The scientific approach allows for the measurement, prediction, and improvement of human performance, which helps to optimize the overall performance of the system. In contrast, common sense solutions may not provide the necessary tools and methods to measure, predict, or improve human performance.

In contrast, relying on intuition, assumptions or guesses can lead to solutions that are not based on sound scientific principles and may not be effective, efficient or safe.

Outline of HFE Theory and Practice Module

Analysis and design are two key components of Human Factors Engineering (HFE), which is the study of how people interact with systems, products, and environments.

While analysis and design are closely related and often overlap, they do have distinct differences.

Analysis in HFE involves understanding the goals, capabilities and limitations of people who will interact with a system or product. This includes examining factors such as physical and cognitive abilities, perceptual and attentional processes, and decision-making strategies. Analysis may involve conducting user studies, surveys, or experiments to gather data on human performance and behaviour.

The goal of analysis is to identify potential problems or challenges that users may encounter when interacting with a system or product. For example, an analysis may identify that a product has small buttons that are difficult to press for users with limited hand mobility, or that a software interface is confusing for users with low computer literacy.

Design, on the other hand, involves using the insights gained from analysis to create products, systems, or environments that are optimized for human use. This includes designing interfaces, controls, and displays that are easy to use, as well as creating products that are comfortable, safe, and intuitive for users.

What is HFE Analysis?

The aim of analysis in HFE is to understand the characteristics and needs of the people who will interact with a system or product. This includes understanding their goals, tasks, needs, and capabilities and limitations. By gaining a deep understanding of the users, human factors engineers can develop insights to inform the design of systems that are optimised for human needs and abilities, resulting in better usability, efficiency, and safety.

Analysis helps to identify potential issues or challenges that users may encounter when interacting with a system or product, such as poor ergonomics, confusing interfaces, or inadequate feedback.

In practice, analysis in HFE involves conducting research and testing to gain a deep understanding of the characteristics, needs, and capabilities of the users who will be interacting with a system or product. The process of analysis may include user research, human performance testing, task analysis, and usability testing.

Analysis in HFE is rooted in the belief that designing for humans means designing to ‘fit the task to the person’, not the other way around.

For example, a system designed to be used by people with different levels of physical

ability should consider the needs of people with mobility impairments, such as designing interfaces that are accessible from a wheelchair, or allowing users to control the system with their voice. Similarly, a product designed for a global market should consider the language and cultural diversity of its users.

HFE Assumption about Human Behaviour

HFE makes several assumptions about human behaviour that are relevant to the analysis phase. Some of these assumptions include:

Human's are diverse	HFE assumes that humans are diverse and that there is variability in their physical and cognitive abilities, preferences, and needs – even within the same target user group.
Humans are goal-oriented	HFE assumes that people act purposefully and have goals in mind when interacting with a system or product. Understanding the goals and tasks of users is essential for designing a system or product that meets their needs.
Humans have limitations	HFE assumes that humans have limitations in their physical and cognitive abilities. For example, people may have difficulty with memory, attention, or perception, or may experience physical limitations that impact their ability to interact with a system or product.
Humans make errors	HFE assumes that humans are fallible and may make errors when interacting with a system or product. Designing a system that minimises the risk of errors is essential for improving safety and reducing user frustration.
Humans learn and adapt	HFE assumes that humans are capable of learning and adapting to new systems and products. Designing a system or product that is easy to learn and use is essential for improving user satisfaction and reducing the likelihood of errors.

By taking these assumptions into account in HFE analysis, human factors engineers can design systems and products that are optimized for human use, resulting in better usability, efficiency, and safety.

What is HFE Design?

Design is the process of creating a system or product that is optimised for human use, based on the insights gained through analysis.

While analysis is focused on understanding the characteristics, needs, and capabilities of the users who will be interacting with the system or product, design is focused on creating a system or product that meets those needs and is optimized for human use.

Design in HFE involves taking the findings from analysis and using them to develop the design of the system or product.

This may include defining the system requirements, creating conceptual designs, developing detailed designs, and testing prototypes. The goal of design is to create a system or product that is usable, efficient, and safe for the intended users.

Design in HFE is a user-centered process, which means that the needs and capabilities of the users are central to the design process. The design should be based on a thorough understanding of the users' goals, tasks, needs, and limitations.

HFE Assumptions about Design of Systems

In practice, HFE makes a number of assumptions about the design of systems:

1. **Systems should be optimised for human use and prioritise usability, efficiency, and safety.** This means that HFE designers strive to create systems that are easy to use, efficient, and safe for users with varying levels of experience and expertise. HFE designers also aim to minimize the risk of errors and accidents by designing systems with built-in safeguards and warning messages.
2. **Systems should be adaptable and flexible to accommodate changing user needs and capabilities over time.** This means that HFE designers create systems that can be easily modified or upgraded as user needs evolve. HFE designers also aim to create systems that can be customized to meet the needs of individual users or that include features that can be adjusted to accommodate users with different preferences or abilities.
3. **Systems should be scalable and designed to meet the needs of a wide range of users with varying abilities and preferences.** This means that HFE designers aim to create systems that are accessible to users with different levels of experience and expertise, as well as to users with different physical and cognitive abilities.
4. **Systems should be compatible with the cognitive and physical abilities of users, taking into account limitations of memory, attention, perception, and motor skills.** This means that HFE designers take into account the limitations of human memory, attention, perception, and motor skills when designing systems. HFE designers also strive to minimize the cognitive and physical demands placed on users, for example by designing user interfaces that are intuitive and easy to use.
5. **HFE designers should evaluate and refine system design based on user feedback and testing.** This means that HFE designers should involve users in the design process and use feedback and testing to refine system design. HFE designers also strive to create systems that are continually evaluated and updated to ensure that they meet the evolving needs and preferences of users.