Human factors in design

Introduction

Human factors, also known as ergonomics, human factors engineering, user-centred design and inclusive design, is about ensuring a good fit between people, the things they do, the objects they use and the environments in which they work, travel and play.

Human factors needs to be considered in the design of virtually any product, system or environment. Failure to do so may lead to designs which do not fit the physical, psychological or sociological needs of the users, leading to ineffective, inefficient or unsafe designs that may lead to long term health problems.

Case study

Project: KCR West Rail EMU rail vehicles  
Client: Kawasaki, Itochu and Kinki Sharyo Consortium  
Designer: Creative Design/Davis Associates

An interdisciplinary design team working in the UK, Japan and Hong Kong developed the new rolling stock for Hong Kong’s new West Rail extension. The human factors input by human factors practitioners included the development of the driving cab and the passenger saloons. In the cab, a task analysis ensured that cab operation would be safe and efficient while accommodating the range of physical dimensions and movement of the Hong Kong Chinese population. The passenger saloons required particular ergonomics input to the seat design, the design of handrails, and placement of information displays. Drawing-based work was followed by user assessments on full-scale mock-ups.
Issues

The human sciences of psychology, anatomy and physiology provide information about the abilities and limitations of people, and the wide differences that exist between individuals. People vary in many ways: body size and shape, strength, mobility, sensory acuity, cognition, experience, training, culture and emotions. All too often, commercial or time pressures mean that human factors principles are compromised or not given adequate priority until too late in the design process. A human factors approach enables the full extent of these user characteristics and individual differences to be considered when influencing the design process.

However, in recent years, competitive markets, raised consumer expectations and new legislation, such as the DDA regulations, have lead to a more rigorous application of human factors. Fundamental themes of human factors, such as 'user-centred design', 'user-friendly', 'inclusive design' and 'usability' have become buzzwords within the design industry. Far from being a constraint on creativity, human factors methods can be applied at the earliest stages of the design process, defining user needs and identifying opportunities for innovation.

Human factors can be considered under three broad headings:

Physical human factors

Concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. The relevant topics include controls and displays, working postures, manual handling, repetitive movements, work-related muscle fatigue and musculoskeletal disorders, workplace layout, safety, lighting, and the thermal and acoustic environment.

Psychological human factors

Concerned with mental processes, such as perception, cognition, memory, reasoning and emotion, as they affect interactions amongst people and with products, systems and environments. The relevant topics include mental workload, cognition, decision-making, skilled performance, human-computer interaction, human reliability, work stress, training, cultural differences, attitudes, pleasure and motivation.

Organisational human factors

Concerned with the optimisation of socio-technical systems, including their organisational structures, policies, and processes. The relevant topics include command and control, communication, staff resource management, work design, design of working times and workload, teamwork, participatory design, community human factors, co-operative work, new work paradigms, organisational culture, virtual organisations and quality management.
Why it matters to the railway industry

In the public services, human factors are extremely important in defining standards and legislation and in ensuring compliance with the standards and legislation.

In its publication Reducing Error and Influencing Behaviour, the HSE states that, '...human factors is a key ingredient of effective health and safety management'. Health and safety legislation requires employers to implement control measures and have in place arrangements for ensuring risks continue to be prevented and properly managed. In the railway industry, human factors is now recognised as a key component in improving operational safety and efficiency. The Rail Safety and Standards Board, Network Rail and London Underground all employ human factors specialists and undertake human factors research.

The Department for Transport (DfT), commissions human factors research and sets guidelines in order to improve rail and road safety and to improve accessibility for disabled people in line with the Disability Discrimination Act 1995. Regulations such as the Rail Vehicle Accessibility Regulations 1998 draw heavily on human factors principles and research.

Human factors practitioners are trained in the necessary research techniques and are able to apply knowledge of the users' abilities and limitations in the design process. In this way, services can be delivered which are not only safe and effective, but also avoid anxiety, are pleasurable to use and exceed expectations.

Further information

- The Ergonomics Society
- Research reports on wide range of HF areas based on the aviation industry - US Federal Aviation Administration (FAA)
- Scrap book of examples of designs that do not follow human factors principles and therefore are bad designs
- Ergonomic design of control centres - ISO 11064
- Ergonomic requirements for office work with visual display terminals - ISO 9241
- Human-centred design processes for interactive systems - ISO 13407