Human Factors in Public Information Systems

Karl W. Sandberg
Mid Sweden University, Sweden

Pan Yan
Luleå University of Technology, Sweden

INTRODUCTION

News reports do not frequently mention many problems or accidents caused by human error. The specialty of human factors seeks to avoid human error by making certain that computers and all other equipment are designed to be easy to understand and use; costly human errors are thus minimised. This article provides a basic overview of the subject of human factors as it pertains to problem and error avoidance in computerised public information systems. When computer/system design does not adequately consider human capability, the performance of the computer/system and the user will be below desired levels.

BACKGROUND: HUMAN FACTORS, THE DISCIPLINE

Human factors has helped to make information systems less costly and easier to use. Some background on this discipline will help to show the relationship it has with information systems.

Human factors is the science of the relationships between humans, their activities, and the context in which those activities take place. The specialty of human factors came into being during WWII when it was found that the sophisticated equipment being designed did not perform as expected; there was a strong and immediate need to understand why many humans were unable to effectively use equipment and/or systems. Teams of researchers learned that the design strategies used did not consider human performance limitations—for example, some designs presented too much information at the same time or in the wrong order for humans to be able to successfully operate controls. Or, the arrangement of controls made them difficult to reach quickly and easily. From this discovery came the concept that *human* users, their work *activities,* and the *contexts* of the activities had to be thought of as different parts of a whole system and that each depends upon the other for successful operation (Bailey, 1996).

After WWII the discipline of human factors became a specialised knowledge area as it became apparent that the human element of any system had to be considered if the capabilities of new technologies were to be efficiently exploited. The older strategy of modifying designs over a long period of time through user experiences was inadequate; rates of change had become so rapid that products were obsolete before improvements could be added. Now, the strategy often used by successful design environments is to include human factors in design and development. When properly managed, products or systems that use human factors knowledge are more efficient, safer, and more pleasing to use because they are designed to accommodate human performance capabilities (Norman, 1988).

Human factors is an extremely broad technical and scientific discipline; founders of the first national and international human factors organisations came from such diverse fields as engineering, design, education, computer technology, psychology, and medicine. Through its diversity human factors is able to draw upon and combine knowledge from any area when working with human and system performance issues. Due to the complexity of human behaviour, human factors specialists emphasise in their work an iterative empirical approach. First, an initial recommendation or interface design is made and then laboratory or field studies are conducted to test this initial design (the prototype). Changes are made when deficits are identified; modifications are made; and further testing is then performed. This process continues until significant problems are no longer found. Finally, validation is achieved through observation in the field after system deployment.

This emphasis on empirical work tends to shape how human factors specialists perform their roles. Irrespective of the specific methodology chosen for gathering data about tasks, users, and the use of products, human factors work tends to result in product improvements likely to be economical, easy, and efficient to use from the beginning of use; the cost of and need to go back and fix problems when human factors is not used is avoided.

Human factors can also be called ergonomics. As the term "human factors" is in more common usage in the computer field, it is used for this article.

Human Factors and Computers

As with other technologies, WWII helped to stimulate the development of computers. The first models of computer used to manage information were primitive in comparison to the computers of today. They were designed by scientists and engineers to be used by scientists and engineers. These computer systems were difficult to operate and had to be closely watched during operation; users had to understand the technology for successful operation and tolerate problems, as technology-advanced computers became easier to operate. With today's systems, the typical user does not need to understand technology; what is important is that a user understands how to tell a computer exactly what information is needed.

This progress in computer technology means that average users of computers and information technology (IT) are no longer just scientists or engineers; instead, they can be anyone who understands how to operate the computer information system they are using. While computer and IT systems are much easier to use, this does not mean that there are not challenges faced. When working with information stored electronically or operating something with the help of a computer, problems can occur when a user misunderstands information presented to them, or they fail to correctly tell the computing system what is wanted. Literature on computers and electronic technology describes instances where there were serious negative consequences when information presented by a computer was misunderstood or systems were mistakenly told to do something different than what was wanted. The shooting down of Korean Airlines flight 007 in 1983 demonstrates some of the problems that can occur between the operator and a computer. Before take-off a crew member entered wrong data into an on-board computer. A warning was ignored as it appeared to be caused by another factor other than the entry of incorrect data. Subsequently the incorrect data caused the pilot to fly off course and into a sensitive area where the aircraft was shot down by a missile. Had the system been designed differently, so that the human activity context was better considered, then it would be likely that a tragic chain of events would not have been started.

To prevent such events from occurring, an emphasis on understanding how to design systems, where it is difficult for people to make mistakes or misunderstand, has emerged as a specialty within the field of human factors. The concept of *human-computer interaction,* or HCI, as a specialty within human factors emerged. In simple terms, HCI is the search for ways to make computers and complex information services accessible, usable, and acceptable to the non-specialist user.

At first, the emphasis of HCI was on physical aspects such as the size, location, and qualities of computer screens and controls. How people think when using computing and IT systems was added as it became more and more evident that how users think and understand is extremely critical in computer design. The subspecialties of *cognitive engineering* and *usability* followed—the former concerns understanding how people think when understanding systems, and the latter concerns how well people can understand and use systems.

Human factors and its related disciplines are now recognised as an important part of the computing system design process. Most computer and related system design approaches try to consider the needs and capabilities of users. With new products and technologies constantly entering the market, new problems are continually encountered—this underscores a continuing need to address human factors when designing computers and computing systems (Cooper, 1999).

The migration of paper-based forms to computer-based public information systems is the type of problem now faced. Work currently in progress in Sweden has found that the way a form looks on paper cannot be used on a computer screen. A computerised system had been developed that used exact copies of paper forms on computer screens. User error rates were extremely high, and the computer system was more costly to operate than its paper-based predecessor. The computer system had been designed without involvement of human factors specialists. Human factors specialists were asked to help correct system problems. The initial results of the human factors assessment reduced error rates and costs; work continues to bring performance to a desired level. The human factors specialists questioned and observed users. From those, it was possible to identify simple solutions to performance problems.

Public Information Systems, Computers, and Human Factors

Since public and private information systems use the same technology and function to exchange information between users and systems, is there any difference between the two? Should they be treated differently? Do the two have different needs?

Questions about difference and how human factors is connected are perhaps best answered by looking at the populations served and the reasons for the creation of any particular system. Private information systems generally serve segments of entire populations (exclusive) and make little or no attempt to accommodate those who lack needed skills. In contrast, public systems must at least have the goal of being usable by every member of a population (inclusive). The exclusive nature of private information systems means that during development and