

Preface

Even in the early stages of mankind individuals and their tribes needed usable information to protect them against threatening environmental factors on the one hand and to be able to seek certain places providing food and survivable climatic conditions on the other hand. Prehistoric man's habitats represented his information system or in other words: information was inherently connected to objects and incidents. It did not appear explicitly. Using his sensory organs, instincts and mental maps he oriented himself in these habitats based on environmental information, e.g. position of the sun/moon, vegetation and soil conditions. His senses and mental models were adapted ideally to his environment for the purpose of survival: to a large extent, his mental models and natural surroundings were congruent. Environmental changes usually occurred gradually so sensory organs and also cognitive and physical resources/capacities could develop and adapt accordingly. Many actions, for instance information search, e.g. for a certain scent indicating rich food or changes in the sky, e.g. as an indication of an approaching thunderstorm were identified on an instinctive basis as a reaction to key stimuli and resulted in corresponding actions, here in search for food. From today's perspective we can rule out any lack of information in this former time. For now, mankind has survived! Perhaps, if man had obtained "better" information, resulting in his supremacy, he might have caused greater damage to himself, nature and other species.

As early drawings show, it seems that it was already at that time when humans wanted to express themselves. In the sense of information systems the character of materials and objects changed. They now carry information, independent from the above-mentioned inherent information content. Rock walls containing images of the daily life, scratched codes in clay tablets or written text on papyrus can be seen as early memories. The information became explicit and emerged visible. For a long time such recorded information could be directly connected with an object carrying the information. Rocks, paper, or in later times, celluloid can be seen as examples.

With respect to this fact the introduction of computers and the respective memory media marked a watershed. The information carriers such as paper tapes or even floppy discs, initially tangible, became more and more a latent part of a machine,

e.g. disc drive or even cloud memory in the internet, and are invisible to the user. In that sense the materialization of information is completely abolished. At best, the keyboard and monitor can only be seen as a window into stored information. The original relation of humans to information thus changed completely.

As a consequence, in contrast to prehistoric man, contemporary man has one foot in a virtual reality (VR), which is proceeding to spill over into more and more aspects of life. He is always online; moreover, he is part of the global network and thus has access to all kinds of information systems, whereby the most comprehensive system being the world wide web. As opposed to the natural environment this *artificial* environment is developing at a fast pace, demanding enormous media competence of individuals as well as the intention to participate in these rapid changes. In contrast to a natural environment the mental model and VR do not always match. Since we are not adapted to VR, the reverse conclusion is that VR must be adapted to us (cf. user-centered design). In this context, adaption does not only mean adaption to our perceptive and cognitive abilities and limitations but also to our emotions and motivation, which constitute a highly relevant scope of our experiences and actions.

The factors described above increasingly apply also to information systems in transportation. There are developments, e.g. in aviation, to *complement* the pilot's external view using so-called enhanced vision and synthetic information, thus rendering him less dependent on meteorological conditions. Furthermore, aviation checklists, for instance, are no longer provided in paper versions but rather in so-called electronic flight bags. Within the scope of this development the greatest problem is that the user or operator is inundated with all sorts of irrelevant data (not information!). In this context, irrelevant means that the data has no significance with regard to current or near future problem solutions. Usually, the user or operator does not lack data access. The challenge for him is to find relevant information to solve a certain problem and to identify this information among the diverse accessible data. In addition, information must be comprehensible and also applicable to the problem. However, the initial questions are frequently how the operator can find information: i.e. navigation or means of obtaining information.

The aspects listed are highly relevant, in particular for transportation since the respective systems are time and safety critical. This means that the period of time available for information search and subsequent problem solutions is limited and the potential damage resulting from incidents or accidents is generally very large.

We should also take into consideration that the user is subjected to high stress in this environment which can impede the process of information search and processing. Just think of combat missions of fighter jet pilots. This also explains why so-called declutter modes are installed in modern combat aircraft which enable the pilot to regulate the amount of information displayed. This is the only way he can ensure primary flight control as well as mission conduct in stressful situations. All this shows the importance of designing information systems for the respective purposes and adapting them to user or operator needs.

This book deals with the ergonomic design of information systems in transportation. It is subdivided into a theoretical and a practical part showing examples,

attempting to combine both parts in terms of coherence. After all, theory only makes sense if it contributes to sound practical solutions. However, the articles of the individual authors contemplating on the subject of information systems from their respective scientific or practical view have not been “tailored to fit”. Information ergonomics is a multidisciplinary field, relying on precision, but also the impact of various technical languages and disciplines.

Since it is the focus of this book, the term information system is defined in the first part. To this end, theories and in particular taxonomies in the field of management information systems are presented and applied to information ergonomics. Furthermore, the significance of information quality is indicated and criteria are cited for the evaluation of information. Subsequently, theoretical insight into information ergonomics are described. In this context the objective and significance are explained as well as the overlap and differentiation of similar fields, e.g. software ergonomics or system ergonomics, in terms of a theoretical deduction of information ergonomics. The chapter on the human aspect of information ergonomics complements the theoretical part of this book. There is a model developed which describes the various phases of mental information processing starting with information access, the decision-making processes during information search as well as the implementation of the information received in corresponding actions. At the same time, this model includes cognitive and motivational as well as emotional processes and should serve as a basis for the design of information systems in transportation. In particular, this should enable an in-depth view of the user side.

The second part counterbalances the theoretical approach by best practices from various sectors of transportation. One chapter highlights information and communication in the context of an automobile driving task. The chapters about civil and military aviation show state-of-the-art developments. The first part stresses the status of available information networks in civil aviation and shows consequences for the workplace of a civil pilot. The latter describes the situation from a military perspective using combat aircraft and so-called unmanned aerial vehicles as examples. Although both disquisitions deal with aviation, it becomes obvious that from an informational perspective the overlap is just marginally. Another chapter devotes specifically to a ground component of aviation, namely air traffic control. Current and future task and work place of an air traffic controller are the central part of that part. Another chapter describes consequences on man-machine-systems in railroading arising from European law.

Prospects on the future development of information systems specifically in the area of traffic and transportation are given at the end of the book.

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