Chapter 14
Designing Usable Interactive Systems within the Railway Domain: A Human Factors Approach

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ABSTRACT
Train drivers as well as signallers interact with several computer based information and communication systems to ensure safe and effective train operations. So far the technical progress mostly determines the design of such interactive systems and requirements out of a human factors perspective are not integrated. Beside the development of technical functions it is essential to take the usability as a quality attribute of every interactive system into account. If the usability is not considered during system development, it could occur that there are several functions available within a system but the user does not know how to use them in an efficient way. This chapter describes a psychological approach to design or redesign usable interactive systems within the railway domain. Some examples will be discussed to demonstrate the approach and the results.

INTRODUCTION AND BACKGROUND
In the beginning of the railways more than 175 years ago operation and use of the technology was limited by the technical possibilities at that time. The operation was done manually and safety systems were more or less inexistent. Increasing speeds and complexity of the operation heightened the workload on the operators. A long history of invention and improvement of safety systems led from that time to today. Nowadays many technical systems support the driver as well as the signal-
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Nevertheless human operators play still an important part of the railway system. The railway system is traditionally characterized by technical developments and innovations but the human factors influencing the performance of the operators have long been paid little attention. Through continuous automation it was often tempted to reduce the influence of human actions more and more - but not all tasks can be replaced or hedged by technical systems. Therefore human contribution is still an essential part of the railway system. In recent years the technical progress changed the work of many railway employees. While switches and signals were previously set by the local signaller with mechanical levers, today the route setting is done with the computer-based electronic interlocking workstation (Figure 1).

Similarly, the train driver does not enter the train data no longer by means of mechanical switches, but using an interactive system. Today the interaction with different interactive systems defines the work of many employees in the railway domain. Train drivers as well as signallers interact with several computer based information and communication systems to ensure safe and effective train operations. The user interface of such an interactive system can be defined as the language through which the system and the user interact with each other. This usually concerns the design of the display and the feedback provided by the system (system to user language). Furthermore the users indicate to the system what they want to do via input devices such as a mouse or a keyboard (user to system language). So far mostly the technical progress determined the design of such user interfaces within the railway domain and requirements from a human factors perspective are barely considered. However, it is not always sufficient simply to ensure that essential information is given and that specific functions are available within a system. Beside the development of technical functions it is essential to take the usability of the user interface as a quality attribute of every interactive system into account. Although usability is often understood as ‘user-friendly’ it does not actually imply that a system ‘is friendly to the user’. Usability encompasses much more: it is a quality attribute of a user interface that is more or less present in every user interface. This includes the user interfaces of the railway domain as well. Therefore usability aspects should be considered in the design of interactive systems within the railway domain as well. The usability engineering approach - which will be described in more detail within this chapter - provides structured methods for the integration of usability aspects within system development.

ISO 13407 defines that Usability is ‘the extent to which a system can be used by a specific

Figure 1. Changes in the signalling workplace