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WHOSE ERROR IS THIS?
STANDARDS FOR PREVENTING USE ERRORS

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ABSTRACT

The Israeli Committee for Usability Standards develops and adopts standards for preventing use errors. Traditionally, people expect the users to follow the operational instructions, and avoid errors. A common practice in case of an accident is to accuse the user for negligence and unreasonable operation. Such approach inhibits processes of safety improvements. Unfortunately, many international safety standards assume that the users can avoid making errors. The new view of use errors is that they should be regarded as symptoms for an organizational deficiency, which enables them. It is unreasonable to demand that the users avoid making errors, because they cannot. The Israeli Committee implements a new methodology for safety culture, which defines the accountability of the stakeholders in the organization about preventing use errors.

1. THE OLD VIEW

Traditionally, peoople expect the users to follow the operational instructions, and avoid making errors. In case of a use error, the user is accountable. For example, people expect that nurses respond promptly to all medical alarms, even though most of them are irrelevant. In case of an operational error, the operator is to blame. People expect that operators understand the safety implications of each option that they choose during the operation, in any future operational situation, based on unknown designers' reasoning.

In practice, users often fail to identify exceptional operational situations, to recall the operational instructions, and to predict the system behavior in these situations. Typically, in case of an accident, we accuse the user for negligence, and we accuse the operator for unreasonable operation. We consider the user errors as the source of the accident. In fact, most of the accidents are attributed to user errors. For example, it has been reported that 70-80% of the aviation accidents are due to human errors (Wiegmann and Shappell).

This approach is convenient for safety administrators, because if the user is accountable for the accident, they are not. The problem with this approach is that it inhibits processes of safety improvements. The users' typical response is to think more about their own risks, and less about the interests of the organization, or the public (Kohn). The organization avoids acting to improve safety, because such actions demonstrate the accountability of the safety administrators (Decker, 2006). For example, admitting the design mistake that cause the Airbus 320 accident in Mulhouse Habsheim in 1988 could have prevented the accident in Bangalore, India in 1990 (Casey). In this case, the safety administrators preferred to accuse the pilots instead of exploring the systemic circumstances. Also, accusing members of medical teams for accidents due to risky operational procedure is quite common.

2. THE NEW VIEW

The new view of use errors is that the organization can and should prevent use errors. It is unreasonable to demand that the users avoid making errors, because they cannot. The users behave according to a Human Factors version of Murphy's law: "If the system enables the users to fail, eventually they will".

Use errors should be regarded as symptoms of an organizational deficiency, which enables them, and not the sources for the accident. The Human Factors Engineering approach to preventing user errors is by design, by considering the limitations of the users and the operators. This approach enables learning from incidents: instead of blaming the users, we focus on exploring why they failed, in order to understand how to prevent similar mishaps in the future. Recently, a new methodology for safety culture has been proposed, which defines the accountability of the stakeholders in the organization, such that safety considerations override personal interests (Reason).

3. THE ACCOUNTABILITY BIAS

The New View approach is often criticized for encouraging carelessness during the operation, which might result in accidents. Safety administrators often apply such reasoning to justify setting the system in ways that transfer their accountability to the users, which are risky to the public (Decker, 2007). For example, safety administrators are tempted to set alarm thresholds such that the users are overwhelmed with irrelevant alarms, in order to reduce the risks of missing alarms when needed.

4. SAFETY STANDARDS

Standards are formal agreements between the system providers and the customers. Standards codify best practices and requirements, and share them across industries and disciplines. Safety standards focus on describing principles, requirements and detailed specifications, intended to reduce risks. Unfortunately, many safety standards assume the user’s accountability for their errors. For example, the IEC 60601-1-8 standard for medical alarms provides warning about possible use errors, but does not provide any effective instructions for how to prevent them. In practice, even a poorly designed alarm system complies with this standard. Consequently, the medical team is responsible for avoiding erroneous operation of error-prone systems that comply with the standard. In case of an accident, members of the medical team would be blamed, charged and executed. The safety administrators are on the safe side.

4. USABILITY STANDARDS

To prevent use errors we need to consider human factors. Usability standards are about enabling seamless system operation. Therefore, we would expect that usability standards may help prevent use errors.

The Usability Professional Association identifies two main categories of standards: One category is process oriented, focusing on processes, describing principles and making recommendations for how to achieve a results. For example, IEC 60601-1-6 is a process-oriented standard for assuring the usability of medical systems. The standard requires that the manufacturers of medical systems specify the safety requirements based on risk analysis. The other category is system-oriented, providing detailed specifications, and requirements that must be met. IEC 60601-1-8 is a system-oriented standard, intended to assure the safety of medical alarms.

Both standard categories are useful in establishing a user-centered design process or in evaluating the usability of a product. However, process-oriented standards are not effective in risk reduction, because they rely on the quality of the risk analysis, which depends on the skills of the system engineers. For example, IEC 60601-1-8 does not provides guidance and instructions for preventing use errors: instead, it relies on IEC 60601-1-6, which instructs that the manufacturer design the interaction based on risk analysis.

5. CASE STUDY

What if there are too many alarms and nobody notices the real threats? A workgroup of the Technical Committee (TC) for Usability at the Israeli Institute of Standard (SII) reviewed the current standards, to examine how they affect the way alarm systems help protect the patient's safety.

Manufacturers of medical monitors are required to comply with chapter 8 of the IEC 60601-1 standard. Therefore, the reviewers examined and evaluated the guidance and instructions in this chapter. The evaluation was based on the premise that when the users are facing too many alarms, they might fail to notice some of the real threats.

What if the alarm is off and nobody hears it? Currently available alarm systems, which comply with chapter 8, enable the users to mute the alarms. A common practice of the medical team is to disable the alarm when it is disturbing, as long as they are still aware of the patient's situation. The problem is when after disabling the alarm, they forget to enable it back. Accordingly, the review also focused on the risks of use errors.

For the evaluation, the reviewers prepared a list of typical operational scenarios, and a list of possible use errors associated with each stage of each of the scenarios. Two types of use errors were defined: perception errors and operation errors. The main finding was that the standard includes many warnings about possible use errors, but it seems that it does not provide sufficient instructions for how to prevent them or how to protect from them.

Another finding is that the guidance in the standard is expressed in terms of features instead of operational scenarios. For example, the standard guides to provide up to four different functions for muting the sound alarms: alarm off, alarm pause, audio off and audio pause. However, it does not recommend when to use each of them. It is up to the users to decide which of them is most appropriate in each situation. Obviously, under time pressure, the user might activate the wrong function. Later, they might be disturbed by the nuisance of repeated alarm and reminders. If they are overwhelmed by simultaneous alarms, their safest option could be to turn off few of the alarms. Will they then notice that their patient needs urgent attention?

The reviewers also found that the tradeoff between the rate of missed alarms and that of false alarms is skewed. Prior research already suggested that this tradeoff was biased by the manufacturers, who are much more concerned about the risks of missed alarms than about those of false alarms. A commonly accepted explanation for this is that it is easy to blame the manufacturer about casualties due to missed alarms, while the casualties resulting from excessive alarms are usually attributed to the users. The reviewers found that safety engineers and other members of the customer administration have a similar bias. They also prefer the situation in which the medical teams are overwhelmed by excessive alarms over the situation of accidents due to missed alarms.

6. FAILURE-ORIENTED STANDARDS

The findings about responsibility bias and about dealing with features instead of scenarios are not special to chapter 8. They may be found in many other standards for safety-critical systems.

The Israeli Technical Committee for Usability Standards develops and adopts standards for preventing use errors. Recently, the Committee published a guide for evaluating usability standards, which enables reviewers of usability standards to identify common barriers to effective usability enforcement. The authors believe that this guide may also help standard writers, reviewers, and readers to improve the usability of any interactive system, and in particular as it concerns patient safety.

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