

Setting threshold values for warning alarms: considerations and recommendations

Avi Harel, Ergolight, Human Factors in Systems Engineering

This article discusses the dilemma of how to balance between the risks of missing alarms and the risks of alarm fatigue. This dilemma may be phrased as an optimization problem, namely, how to set the alarm threshold such that the expected risks of upcoming hazards are minimized.

The effect of alarms

The optimization problem may be phrased using a model of the people's reaction to hazards: awareness of the hazards, associated risks, possible ways to react, and the potential protection associated with the various reaction options. The model is based on the theory of information and the theory of learning. It assumes the following premises:

1. To enforce awareness of a hazard, the system should inform about its risks.
2. An estimate of the potential risk is essential for deciding whether to react
3. An estimate of the hazard timing enables to prepare for the reaction
4. The reaction to a hazard may be improved by repetition
5. Experience of missing alarms enforces searching for alternatives
6. Excessive alarms typically result in alarm fatigue.

Risk evaluation

It may be useful to examine these requirements in two extreme setups:

- High-rate alarming, such as during vehicle driving or medical monitoring.
- Low-rate alarming, such as in environmental disasters.

The risks of low-rate alarm exposure are:

- a. Alarm users might be aware of a critical hazard only after it is too late
- b. They might not have sufficient opportunities to practice how to identify the hazards, whether or how they need to react, or how fast

The risks of high-rate alarm exposure are alarm fatigue, namely, decreased vigilance, which might result in slow reaction or ignoring critical alarms.

Long-term optimizing the alarm threshold

A way to optimize the alarm threshold is by gradual adaptation of the alarming rate according to the accumulated exposure to hazards. First, we set a low threshold, enabling a high rate of exposure, which facilitates the learning of how to recognize the alarms and their attributes, as well as the practicing of the reaction to the alarms. Subsequently, when the users already understand the meanings of the alarms and know how to react, we may raise the threshold, resulting in reducing the alarming rate, and avoiding alarm fatigue thereof.