Generic Fire Risk Assessment in residential and industrial buildings

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The aim of fire safety regulations is to reduce the consequences, i.e. human and financial losses, as much as reasonably possible. Fire safety can be increased by passive and active fire safety measures. These measures can be regarded as decision alternatives in the context of setting fire safety regulations for society. Because fires cannot be avoided completely, certain consequences always have to be anticipated. The expected value of the consequences corresponds to the fire risk and can be influenced by fire safety measures. Every fire safety measure is associated with costs and, if related to the corresponding risk reductions, a certain benefit. The main task is to find acceptable fire safety measures which reduce the risk to life and financial consequence efficiently.

A rational acceptance criterion for decisions with influence on life safety can be derived based on the Life Quality Index (LQI). This societal index can be seen as a utility function expressing societal preferences for investments into life safety. If the acceptability of fire safety design in terms of risk to life is fulfilled, then it is reasonable to compare the costs of fire safety measures with its benefits, i.e. to perform an economic optimization of the overall costs. This leads to a choice of efficient fire safety measures regarding risk to life as well as financial losses.

In terms of setting efficient regulations for fire safety design a quantitative risk model is required that is applicable for a whole building portfolio. This can be done by using a generic risk model. A generic risk model considers risk indicators as well as fire safety measures and can be evaluated for each building of a portfolio whose fire risk shall be assessed. Risk indicators are defined as any observable or measureable characteristic of a building containing information on the risk, e.g. geometry of a room, area of the compartment, occupancy type of the building, etc. The risk indicators and the fire safety measures may be associates with uncertainties due to lack of knowledge and randomness. Probabilistic engineering models allow to consider these uncertainties consistently and to represent the physical processes of a fire hazard.

From a bayesian point of view the generic risk model can be considered as prior information on the expected consequences. Using observed portfolio loss data with the corresponding risk indicators the risk model can be updated, e.g. by reducing uncertainties in the model. This leads to an unbiased generic risk model that is able to estimate the risk based on observed data and engineering models.

Finally the generic risk model can be used to find cost-efficient fire safety regulations for prescriptive as well as for performance based fire safety design.