# Using the Heinrich's (Bird) pyramid of adverse events to assess the level of safety in an airline

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It is known, that in practice, in the production and transport, long before the appearance of adverse events, their precursors develop. Latent, unsafe conditions could already exist before the incident. Identifying and eliminating these latent conditions requires an objective and in-depth risk analysis. There are various models that establish the connection between the precursors of adverse events and the events themselves. One of the first, to establish this connection was Herbert William Heinrich in the field of industrial safety, defining an essentially scientific approach to solving problems associated with adverse events in the workplace. In Heinrich's Law (Heinrich's pyramid), he deduced the ratio of injuries of varying degrees of severity, outlined the domino theory about the associated sequence of events leading to an accident. Later, Bird established a relationship of 1-10-30-600, which well illustrates the frequency relationships between severe incidents, incidents and hazardous events, thus showing the way to manage safety. The presence of a stable causal relationship between the levels of the Heinrich pyramid (Bird's pyramid), as a result of which it can be assumed that inconsistencies in the activities of services and personnel lead to incidents, and incidents, in turn, lead to accidents and catastrophes. The presence of such a connection makes it possible to predict the risk of events of the "upper level" by planning risk reduction at the middle and lower levels. It is proposed to use the intensity of events per unit of time as the main indicator. This intensity can be rated as a linear combination of the three pyramid-based ratings. The result will be a comprehensive enterprise safety indicator or safety level, $K_{DL}$:

$$K_{DL} = \frac{1}{3}\lambda_a + \frac{1}{3}\frac{\lambda_I}{K_I} + \frac{1}{3}\frac{\lambda_N}{K_N} \qquad (1)$$

where: $\lambda_a$ — the intensity of accidents at the enterprise;

$\lambda_I$ — the intensity of incidents;

$\lambda_N$ — the intensity of inconsistencies in the activities of the facility, its services and their personnel;

$K_I$ , $K_N$ — ratios of the ratio of the number of incidents and nonconformities to the number of adverse events, respectively, for the studied period of time.

At its core, $K_{DL}$ is an accident risk assessment based on the risk assessment of all events that have occurred in the enterprise over a certain time. The assessment will be the more accurate, the more accurate the database of inconsistencies in the activities of the organization and its personnel (safety breaches) used in the construction of the pyramid. It is important to note that $K_{DL}$ allows you to set numerical criteria for risk tolerance for "high-level" events and then expand them on the remaining levels. This safety metric can also be used to plan and evaluate improvements after corrective action plans are completed. Successful corrective action plans should exclude future incidents and nonconformities, resulting in a proportionate reduction or elimination of incidents (catastrophes and accidents).

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