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# Fuzzy approach for reducing subjectivity in estimating occupational accident severity

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ABSTRACT

Quantifying or, more generally, estimating the severity of the possible consequences of occupational accidents is a decisive step in any occupational risk assessment process. Because of the lack of historic information (accident data collection and recording are incipient and insufficient, particularly in construction) and the lack of practical tools in the construction industry, the estimation/quantification of occupational accident severity is a notably arbitrary process rather than a systematic and rigorous assessment.

This work proposes several severity functions (based on a safety risk assessment) to represent biomechanical knowledge with the aim of determining the severity level of occupational accidents in the construction industry and, consequently, improving occupational risk assessment quality. We follow a fuzzy approach because it makes it possible to capture and represent imprecise knowledge in a simple and understandable way for users and specialists.



## 1. Introduction

In an occupational safety risk assessment (OSRA), assessing risk always has an element of subjectivity. A bad judgement about a risk level will result in false alarms and inappropriate preventive actions or, in the worst cases, no action at all. Defining the severity level is a component of judging occupational risks.

According to Faber and Stewart (2003), risk is defined as the expected consequences associated with a given event. In occupational safety, a work accident is an event with consequences; risk is, therefore, the combination of the probability that this accident will occur and the severity of consequences arising from the accident. In our work, we use possibility instead of probability because it is rather difficult to make estimates with ill-defined data.

Thus, the notion of severity is useful for understanding occupational risks and mitigating them. However, as soon as one delves deeper into the question in terms of specific cases, it becomes obvious that it is rather difficult to estimate the severity factors and respective severity levels because of (1) the existing multiplicity of possible consequences for a given accident and (2) the diversity of points of view regarding possible severity assessments (potential victims, actual victims, medical staff (physicians), workers, managerial staff and safety managers). The apparently simple and easily applicable notion of conducting a severity assessment of an accident becomes complex in practice because of the assessment's imprecision and strong dependence on the analyst's perception.

How does one estimate severity in a proactive analysis with accuracy and in a practical way in the construction industry? A method to estimate the level of the expected severity of potential work accidents would be of undeniable value to construction companies seeking to improve their understanding of such events. However, because an occupational accident at a construction site could cause multiple consequences of highly variable severity, it is a difficult situation to model.

Hence, the definition of fuzzy severity functions (also called the fuzzification process) to express imprecise severity work accident consequences is the main objective of this work. Fuzzy membership functions (Ross, 2004; Zadeh, 1965) allow easy normalization and uniformization of all data; therefore, we can then use them as a measure to assess the work accident severity expected level at the construction sites. Thus, with this fuzzification process, we are capable of handling uncertainty when estimating work accident severity levels and of offering a user-friendly assessment method.

## 2. Motivation for severity measurements

To capture the multifaceted nature of accident consequences in the construction industry, a more complete approach would involve simultaneous consideration of several measurement factors. The measurement is no longer simple but is multifactorial

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