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# Quick assessment tool for assurance of structural safety in the building process

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## Summary

From forensic investigation it is known that many structural failures can be attributed to human errors and organizational factors. To provide project leaders with information on the current state of factors in the building process influencing structural safety, we developed a quick assessment tool. Logistic regression was used, based on data of influencing factors from a national questionnaire, to derive a function that predicts the probability of a successful outcome, regarding structural safety. The results show that a function with only the factors collaboration, risk analysis and control could predict a successful project correctly in 85% of cases, with collaboration as most determining factor. Although this method has limitations, it gives a quick indication of the degree in which problems regarding structural safety are to be expected. We believe that this tool has the potential to develop into a risk management tool.

**Keywords:** risk management, structural safety, building process, quality assurance

## 1. Introduction

For building industry it is important to know what human and organizational factors to what extent are influencing the successfulness of building projects regarding structural safety. When these aspects could be assessed during the building process, adequate measures can be taken to adjust the process and bring the project to success.

The goal of this study therefore is to design a quick assessment tool for managers which indicates during the design and construction process to what extent a successful project can be expected, regarding structural safety.

## 2. Method

For the possible indicators a list of human and organizational factors was set up, based on management literature and safety science [1].

These possible indicators include factors on project level (communication, control, allocation of responsibilities etc. between companies), on company level (same factors as project level but within the company) and human factors (like technical competencies, management skills and attitude, see figure 1). A suboptimal performance on each of these indicators could, theoretically, lead to an increased risk of structural failure. The list of indicators was tested in a pilot, which proved that the list was useable [2].

Subsequently, the importance of the resulting 39 indicators for structural safety was explored in a survey study with 236 respondents in the Netherlands [3]. We investigated which human and organizational factors determined the difference between a successful and less successful project regarding structural safety.

In the current paper we will use the data of this national survey on structural safety to create a quick assessment tool for exploring the structural safety of a project. The method of logistic regression was used to derive a function that predicts the probability of a successful outcome of a project, based on just a small number of predictors.

### 3. Results

From four models with various predictors, finally, one model was selected with the predictors collaboration, risk analysis and control. This model results in a good prediction (85% of the successful projects were correctly predicted), with a relatively low number of variables (only 3).

The regression-function from this model can be presented as:

$$p(y) = \frac{1}{1 + e^{-(-2,679 + 0,422 * X1n + 1,275 * X1p + 0,662 * X2n + 1,18 * X2p + 0,295 * X3n + 1,892 * X3p)}}$$

With:

p(y) = probability of a successful project regarding structural safety

X1n = neutral assessment of the factor risk analysis

X1p = positive assessment of the factor risk analysis

X2n = neutral assessment of the factor control

X2p = positive assessment of the factor control

X3n = neutral assessment of the factor collaboration

X3p = positive assessment of the factor collaboration

X1 to X3 have a dichotomous value 0 (not given) or 1 (given)

The method gives a quick indication of the degree in which problems regarding structural safety are to be expected. It is easy to use the derived formula; application in an app is possible. Clients, contractors or structural engineers can easily assess their projects on collaboration, risk analysis and control and an indication is provided to what extent the project is vulnerable to structural deficiencies.

Although, the used method has some limitations, this tool has the potential to develop into a useful risk management tool. In future studies, data on project characteristics can be included and more cases can be collected. By constantly updating the logistic regression function with new data, the model will get learning capacity.

### References

[1] TERWEL, K. C. and VAMBSEKRY J.N.J.A., Possible Critical Structural Safety Factors: a literature review.

Forensic engineering 2012: Gateway to a safer tomorrow. A. M. Dolhon et al. San Francisco, ASCE, 2012.

[2] DIJKSHOORN G. W., TERWEL K.C., GULDENMUNDT F., Determining critical factors to avoid failures in the building process. Safety, Reliability and Risk analysis: Beyond the horizon - ESREL 2013. R. D. J. M. Steenbergen et al. Amsterdam, Taylor & Francis Group, 2014.

[3] TERWEL, K. C. and JANSEN S. J. T. "Critical factors for structural safety in the design and construction phase."

Journal of performance of constructed facilities, ASCE, accepted for publication.