



The Influence of Trainings on Employees' Knowledge about Risk Management – A Statistical Analysis of the Construction Business

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Abstract: This paper deals with the knowledge about risk management. In particular, it examines employee's knowledge about handling risks in the construction sector. As part of his Ph.D. studies, the author conducted a survey with the help of a standardized questionnaire among personnel working in the construction business. Respondents, who have taken part in a training course, and such, who have not, have been compared and interesting facts about these groups were found out and will be illuminated in this paper. After a short introduction first the examined matters and the purpose of the research are explained. This is followed by specifications of the circumstances of the survey and the composition of the sample. This part also includes a description of the standardized questionnaire that was used for the research. Results were analyzed with statistical methods, such as ANOVA, t-test or correlation of different variables. As turnout, new insights are gained about employee's knowledge in terms of risk management and influencing factors that have an effect on people's know-how and skills. The findings are finally assessed in form of a summary. The reader gains information about risk management in the construction industry and the utilization of statistical methods for data analysis.

Keywords: Risk; Risk Management; Statistical Data Analysis; Construction Industry

1 Introduction

Crisis situations do not happen from one day to the next. There are signals that point to them and risks pose only the last phase of a long process. The question of why some companies fail to foresee their economic troubles is a legitimated one. Did they recognize the changes that took place in the company's environment but their decision-makers failed to see the significance? Or was the management not suited to properly handle the situation? It is often not the executive of the company, but rather a normal member of staff, standing at the bottom of the corporate hierarchy, that first encounters the risk factor and attempts to manage it. However, these persons cannot be expected to

have risk management skills and knowledge. They often do not have theoretical knowledge and sometimes even their practical experience is lacking.

The knowledge of business companies' staff about risk management is influenced by several variables, with the influence being of different levels. It is therefore not equal for all employees. For a company it may be advantageous to know these variables in order to find a suitable employee for each task or to entrust each employee with such tasks that they can solve for sure. By deliberately changing some variables, the company has the opportunity to improve risk management. It is therefore interesting to research about the influence of variables on the knowledge of employees.

2 Theoretical background

Precondition for dealing with risks is at first an understanding of what the term risk means at all. In the general perception, risk has a negative connotation. Several authors connect risk with a target hazard risk or the deviation from a pre-determined target. *Neubürger* [1] defines risk as "*positive difference between the expected and actual target achievement.*" Accordingly, a chance means the negative difference between the expected and the realized level of target achievement. However, another definition of risk shall be mentioned, which was worked out by *Ehrmann* [2]. His explanation is even suitable to be used as valid for the scope of this article as definition of the term risk. According to the author risks are:

- connected to decisions,
- originate from the uncertainty relating to the assumptions during decision-making,
- mean a danger or hazard.

In addition to the term risk, risk management must be illuminated as well. According to *Eichler/Bungartz* [3] there is a very comprehensive, but at the same time also very compact definition of the process of risk management, which, for reasons of comprehensiveness and conciseness appears to be suitable to determine the process of risk management for the scope of this article: "*Enterprise-wide risk management is understood as the process of strategy formulation, the enterprise-wide identification of significant risks and opportunities, managing these risks, taking into account the risk appetite of the company, to ensure the achievement of corporate goals, done by the supervisory board, the upper management, the operational management and the employees.*" *Haller* [4] places significant risks in the center of his definition of risk management, which is oriented in his view to:

- In all management activities and in all aspects of leadership to recognize and assess the significant risk better,
- To tackle as important considered risks with suitable instruments and procedures,

- To pull general leadership and organizational consequences in terms of risk management.

Companies in the project business are to be characterized by several specifics, which also applies to the requirements with regard to their risk management. This can be further differentiated in terms of the industry in which the company operates in. Construction industry is characterized by some specific distinctions in particular. The classic risks of project management, such as risks of quality, cost and time of course apply to the construction industry, too, but the sector can be described in detail through some further anomalies that *Horsch* [5] summarizes as follows:

- Every building project can be characterized by uniqueness
- Very often the construction contract is concluded first, and only after that the execution planning with detailed designs is done
- Large construction projects involve a high degree of technical complexity, for which the construction companies partly do not have core competences (any more)
- The technical complexity is tangent to the contractually owed functioning
- Each individual order represents a high financial volume (which is why the credit line is impacted by issuing of a contract performance guarantee and warranty bond)
- The contractual and legal warranty obligation is long (usually five, for some components even ten years), in their nature often unpredictable (for example in bad faith) and - depending on the subsequent use of the object - in addition to reparation of defects also damages-triggering.

3 The aim of the research and expected results

In the center of this article is a comparison of employees in the construction industry with regard to their attendance of a training about risk management. To be found out is the influence of this variable on the knowledge of the employees. Basically, it can be assumed that it has a positive effect on the knowledge, if an employee takes part in a training on risk management. During this, various special content can be taught, the use of assistive tools could be practiced or real-world examples can be discussed. The attendees can be trained on those areas, which are of particular importance for the management of a business company and a variety of knowledge can be systematically expanded. In any case, between participation in a training and knowledge about risk management a direct positive relationship should exist, which is to be varified in this work and also forms the content of the hypothesis:

Hypothesis: There is a connection between an off-the-job-training on the one hand and employees' knowledge about risk management on the other hand.

4 The applied research method

Data-collection by questionnaire is a very common instrument of scientific research and offers several advantages. In research using a questionnaire, compared to qualitative research, done by for example conducting interviews with comparatively few respondents, other targets are in focus. On the one hand, a large number of people can easily be interviewed and on the other hand the information obtained can be statistically analyzed and conclusions with respect to the research subject can be drawn. To achieve this goal, the use of a standardized questionnaire is recommended, in which all questions are formulated uniformly and the answer choices are already predetermined.

A survey among a large number of employees in the construction industry with the help of a questionnaire forms one of the pillars of the author's empirical research. For a detailed review of the hypothesis, a part of the questionnaire contained questions with the help of which the participants' knowledge can be measured. Through the classification of respondents to groups of attributes, in this particular case the attendance and non-attendance of a training course, and the statistical analysis of the responses of these groups, for example through the analysis of variance, inferences are to be drawn on the impact of the variable.

5 Participants, the questionnaire and the process of analysis

All persons participating in the survey were at the time of the survey employees of various construction companies. Respondents were working on construction projects, in the administration of their companies or in executive positions. In the interest of the fact that the results of the survey can be obtained from a wide amount of data, the survey was conducted in three different countries: Austria, Hungary and Romania. In order to facilitate the respondents in the various countries responding to the questionnaire, it was created in three different languages, so that each participant could complete the questionnaire in their own native language. This measure also increases the reliability of the results, since such errors can be excluded, which arise due to any misunderstandings. The survey was conducted in spring 2011.

In order to limit the effort to evaluate all questionnaires differently, it appeared advisable to have the questions answered in multiple-choice system. Through this approach, space for individual answers to the questions was given and the questionnaire could still be standardized and then analyzed by statistical means. Taking into account the advises of *Babbie* [6] for structuring a questionnaire, the questionnaire was divided into the following parts:

- a) Knowledge about risk management
 - Questions about risk management in general (8 questions)
 - Questions about risk management in business companies (8 questions)

- Questions about risk management on construction projects (8 questions)
- b) Questions regarding personal data (4 questions)

The questionnaire included a total of 66 questions and besides the knowledge about risk management also some other topics. The other sections were mainly about reasons for risky projects and risk awareness. The results of these parts of the questionnaire are not listed here since they are very specific and would exceed the scope of this article. In order to explore the knowledge of the employees asked about risk management, the questionnaire was divided into three blocks, each containing eight assertions. The first block contained general statements with regard to risk management, in the second block statements about the company for which the respondents work could be found. Assertions about the handling of risks especially on construction projects formed the third group. Every question appeared in the form of a "right or wrong" statement, which was to be answered by the respondents. If the respondents did not know the right solution, they could also check the response "I'm not sure", meaning that questions were only answered, if the respondent knew the answer. Of course, there was only one correct answer for each question. Half of the assertions in each block was right, the other half was wrong. During the process of analysis every correctly answered question was awarded with one point, the answer "I'm not sure" was considered wrong. Through different distributions of correct and incorrect responses within the three blocks, conclusions could be drawn about the intensity of the knowledge of employees in the three areas of risk management.

The questionnaire was completed by a total of 209 participants. Multiplying the number of questions per questionnaire with the number of participants in the survey, there were about 13,800 records that had to be evaluated and were incorporated into the survey results. To process this large number of data on a professional level and be able to analyze it using statistical tools, the evaluation of the data set was operated with the help of *SPSS Statistics*, a software by the U.S. company IBM. According to *Hunyadi/Mundruczó/Vita [7]* "The SPSS software package was developed in the interest of enabling a very flexible and effective computer-based implementation of social-scientific analysis." Most of the evaluations were carried out by the method of analysis of variance (ANOVA = ANalysis Of VAriance), which analyses the effect of independent variables on dependent variables. The method is based on the calculation of variances and according to *Hajdu [8]* has the advantage that "the variance usually not separately, but in the implementation of comparisons makes sense", so it is suitable, for example, for testing hypotheses.

Among the completed questionnaires there were also such that were not filled completely or partly faulty. From the total of 209 questionnaires, all questions were answered in 137 cases, in all other questionnaires a few questions, in most cases only one single question, remained unanswered. When in a questionnaire for example two questions were not answered, then all other questions are included in the evaluation. With respect to the two questions, the total number of elements in each case has decreased by one. In order not to distort the results, the missing data has not been replaced by average values or incorporated in the analysis by using any other different method.

5.1 Results of the survey: Knowledge about risk management

First, it is worthwhile to consider the answers as a whole. Already the two extreme values are interesting. The achieved minimum score is zero, so at least one of the respondents has not given a single correct answer. The maximum score however is 20 correct answers. This means that out of the theoretically possible 24 points, the participant with the most correct answers just was able to answer 83.3% of the questions correctly. These two extreme values, which were determined from all questionnaires, generate the first impression that the knowledge of the respondents can be further improved. This impression is enhanced when one considers the average values. All respondents answered on average 11.6 questions correctly. From a number of 24 questions, this value is even slightly below the threshold of 50%. This value is backed up by the standard deviation. The standard deviation or variance according to *Hunyadi/Mundruczó/Vita* "is the average square of the deviations from the average. Accordingly, it indicates by how much the measured values deviate from the average arithmetical average. The unit is always the same as that of the original data." Standard deviation was 4 correct answers, which means that the respondents answered on average between 7.6 (31.7%) and 15.6 (65.0%) of 24 questions correctly. As shown in *Table 1*, the participants, on average, had only so much knowledge about risk management that they could answer only about half of all questions with a standard deviation of four correct answers.

Correctly answered questions	N
Minimum	0,00
Maximum	20,00
Mean	11,6054
Standard Deviation	3,9824

Table 1
Statistical figures regarding the knowledge about risk management
Source: author's own work

5.2 Results of the survey: The impact of an off-the-job-training

In the next step the variable "*Training on risk management*" was examined. This variable was queried with a question in the questionnaire, in which respondents were asked to indicate whether they have participated in a training course or not. The answer distribution is shown in *Table 2*. In a training only around 16% of all respondents have participated. It is remarkable that this value represents only a relatively small part of the surveyed employees, so there is still room for improvement. The question of participation in a training course is interesting because one would suggest that employees who have already participated in a training, have a greater knowledge about risk management. Accordingly, **the corresponding hypothesis assumed that a relationship exists between the knowledge about risk management and the participation of an employee in a training course on risks.**

Attendance of training course	Frequency	Percent %
Yes	34	16,3
No	117	56,0
No answer	58	27,8
Total	209	100,0

Table 2
Distribution of the variable „Attendance of a training course“
Source: author's own work

The results of the survey have absolutely confirmed the hypothesis. As shown in *Table 3*, those employees who have already received a training were able to answer correctly on average 14.4 out of the 24 questions, which corresponds to a rate of 60%. The employees, however, who have not yet attended a training have answered an average of only 10.8 of the 24 questions correctly, thus achieving a rate of only 45%, which is less than half. Participation in a training has increased the results of the employees by 3.6 points or 15%. Based on this result, **it must be noted that participation in a training improved employees' knowledge on risk management significantly.** This is also emphasized by the different values of the standard deviation. For those who have not yet participated in a training course it was 3.9, while among the employees who have already attended a training the same value was only 2.9. Since the standard deviation is defined as the average deviation from the mean, it indicates how high the scatter of the individual results around the average is. If the deviation from the average in one group was about 25% smaller, this can be interpreted to mean that the uncertainty of the staff was smaller and they were able to answer the questions more securely. Participation in a training has not only meant that the respondents answered significantly more questions correctly, and therefore knowledge has formed, but also that they give the answers significantly safer and therefore were better able to apply their knowledge.

Attendance of Training	N	Mean	Standard-Deviation	General knowledge	Company knowledge	Construction knowledge
Yes	34	14,41	2,9036	4,29	3,47	6,65
No	117	10,80	3,9089	3,04	2,53	5,23

Table 3
Statistic results with regard to the variable „Attendance of a training course“
Source: author's own work

This finding is confirmed by the separate analysis of the three blocks of knowledge. In each of the three blocks the employees who have already received training have

achieved a significantly higher score than the employees who have not yet participated in a training course. Taking into account the maximum score of eight the difference in case of the knowledge about the specific company was at about one point and in case of the general knowledge was at 1.25 points. In case of the knowledge about risk management on construction projects, the difference is as high as almost 1.5 points, which corresponds to a difference of over 15%. It can therefore be concluded that also the measurement of the three different types of knowledge confirmed the hypothesis, that participating in a training significantly affects the knowledge about risk management.

5.3 Results of the survey: Testing the hypothesis with the t-test

A t-test is a statistical hypothesis test in which the test statistic follows a Student's t distribution if the null hypothesis is supported. It can be used to determine if two sets of data are significantly different from each other, and is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. There are different types of two-sample t-tests to research a difference in mean, in this case the sample can be considered as independent or unpaired. The independent samples t-test is used when two separate sets of independent and identically distributed samples are obtained, one from each of the two data sets being compared. Because deviations of the estimated parameter in either direction from the benchmark value are considered theoretically possible a two-tailed test was used.

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
General Knowledge	-3,713	191	,000	-1,0148	,2733	-1,5539	-,4757
	-3,801	83,728	,000	-1,0148	,2670	-1,5458	-,4838
Company Knowledge	-3,780	189	,000	-,8730	,2309	-1,3285	-,4174
	-3,647	78,487	,000	-,8730	,2394	-1,3495	-,3964
Constr. Knowledge	-2,754	194	,006	-,8299	,3014	-1,4244	-,2355
	-2,783	83,835	,007	-,8299	,2983	-1,4231	-,2368
Total Knowledge	-4,287	180	,000	-2,7099	,6321	-3,9571	-1,4627
	-4,500	91,163	,000	-2,7099	,6022	-3,9060	-1,5138

Table 4

Results gained with help of the t-test, Source: author's own work

If the Sig. (2-tailed) value is smaller than 0.05 then there is a significant difference between the two groups. This was true for all of the values. As a result it can be stated

that those, who already participated in a training, reached a higher score in total and additionally in all of the three knowledge blocks, too. For detailed results of the t-test see also *Table 4*. It is important to mention that the two groups were not of equal size which may distort the results slightly. Originally four different answers were possible of which the first two answer possibilities and the second two answer possibilities have been added to one group in order to utilize the t-test as well.

5.4 Results of the survey: Correlation of different variables

Interesting insights into the relationship between different variables can be obtained through calculation of correlation of the variables. *Hunyadi/Mundruczó/Vita* state, that *"... it must be out-raised that neither the results of the correlation nor the regression analysis can be automatically interpreted as a causal relationship. Both methods give information only about the presence, intensity and direction of the connection of two variables."* Correlation may be positive, then the variables move in the same direction, or it can be negative, then the variables move in opposite direction. A value close to zero indicates that there is no correlation, a value close to 1 or -1 indicates a very strong correlation. Taking these conditions as given it has been examined whether correlation occurs between *"Training on risk management"* and the following criteria:

- Knowledge about risk management in general
- Knowledge about risk management in business companies
- Knowledge about risk management on construction projects
- Knowledge about risk management in total

Correlation values can be divided into five groups, according to their size and the size of the confidence interval, which describes the accuracy of the calculation:

- No or little correlation (values up to $\pm 0,14$)
- Significant correlation with a confidence interval of 5% (Values from $\pm 0,14$ to $\pm 0,185$)
- Significant correlation with a confidence interval of 1%, with values that are too small to derive theoretical relationships
(Values from $\pm 0,185$ to $\pm 0,4$)
- Significant correlation with a confidence interval of 1%, with values that are large enough to derive theoretical relationships, the contents of the correlation is, however, not definable
(Values $> 0,4$ or $< -0,4$)
- Significant correlation with a confidence interval of 1%, with values that are large enough to derive theoretical relationships and the contents of the correlation is definable
(Values $> 0,4$ or $< -0,4$)

The study therefore assumes that several conditions must be met in order to recognize a relationship between two variables. With a confidence interval of 1%, a value of 0.4 or higher must be achieved. Only in case of the completion of both criteria one can assume that both in terms of the size of the confidence interval, as well as in the level of correlation sufficient security is given in order to define the content of the correlation in a meaningful way. In all analysed cases values were smaller than (-) 0.4. Three cases resulted in values between (-) 0.2 and (-) 0.3, in one case correlation was almost zero. Thus calculation of correlation proved a weak relationship between the researched variables but besides this did not lead to any new findings. The following values were obtained:

- Knowledge about risk management in general and participating in a training = 0,004
- Knowledge about risk management in business companies and participating in a training = -0,288
- Knowledge about risk management on construction projects and participating in a training = 0,262
- Knowledge about risk management in total and participating in a training = 0,244

6 Conclusion

Employees' knowledge about risk management is influenced by several variables. Depending on the variable, this influence turns out differently. The influence on employees' knowledge could be explored with the help of a questionnaire. Therefore, the total of all respondents has been divided into subgroups. Subsequently it could then be researched whether the dependent variable, the knowledge of respondents, performs significant differences in the various groups.

The variable examined was the attendance of a training course on risk management and its impact on employees' knowledge. The survey results have confirmed the hypothesis. Those employees who have already received training were able to correctly answer an average of 14.4 out of 24 questions, which corresponds to a rate of 60%. The employees who have not yet attended training have answered an average of only 10.8 of the 24 questions correctly, thus achieving a rate of only 45%, which is even less than half. Participation in a training has increased the results of the employees by 3.6 points or 15% and thus has significant influence on the respondents' knowledge. This was also emphasized by the different values of the standard deviation. For those who have not yet participated in a training this amounted to 3.9, while it was only 2.9 among employees, who have already attended a training course. Since the standard deviation is defined as the average deviation from the mean, it indicates how high is the scatter of the individual results around the average. If the standard deviation in the group of employees with training was by about 25% smaller, this can be interpreted to mean that the uncertainty of the staff was smaller and they were able to answer the questions more secure. Participation in training has not only meant that the respondents answered significantly more questions correctly, and knowledge has formed, but also that they gave the answers with significantly more confidence and therefore were better able to apply their knowledge. The separate analysis of the three blocks of knowledge resulted

in the same outcome. In each of the three blocks the employees who have already received training have achieved a significantly higher score than the employees who have not yet participated in a training course. In the case of knowledge about risk management in construction projects, the difference was nearly 1.5 of eight points, which is a significant difference. Research has thus clearly shown that participation in a training significantly improved the knowledge about risk management.

Thesis: There is a connection between an off-the-job-training on the one hand and employees' knowledge about risk management on the other hand.

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