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Measuring the security knowledge, attitude and behaviour of employees**

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The Impact of Training Sessions on Security Awareness: Measuring the Security Knowledge, Attitude and Behaviour of Employees

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In recent years, many companies stepped up security efforts in chemical and process facilities. The need for the implementation of technological and organizational measures is accompanied by an increased attention for the human factor of the company's security policy. In order to create a strong security culture, a high level of security awareness among employees is needed. The aim of this paper is to measure the impact of a training session on the level of security awareness. Based on the results of a quantitative research, the effectiveness regarding the security knowledge, attitude and behavior of employees is measured.

1. Introduction

Today, the need to deal with security threats in chemical and process facilities has become an important worldwide matter (Villa, Reniers and Cozzani, 2016). While the company's security policy often contains numerous technological or organizational measures, attention is needed for the human aspects of security (Festag and Hartwig, 2016). Researchers state that human errors contribute to the majority of accidents and near-misses. According to some estimates, 90% of all errors are caused by human errors (Kletz, 2001). Therefore, human factors can be described as the weakest link of a security policy (Aloul, 2012). A high level of security awareness among all employees is indispensable for a good security culture and climate within the company (Reniers, Cremer and Buytaert, 2011). Security awareness can be described as '*the extent to which organizational members understand the importance of security and the level of security required by the organization*' (ISF, 2002). Both researchers and practitioners are convinced that a security policy has to contain regulations for the improvement of security awareness. The absence of awareness programs indicate a critical gap in effective security implementation (Hinde, 2002).

In order to achieve a sufficient level of security awareness within chemical and process facilities, research has been undertaken into various learning mechanisms, such as online training, poster campaigns, email messages and face-to-face training sessions (Spurling, 1995; Wood, 1995). Researchers emphasize the importance of measuring the effectiveness of such programs in order to ensure education leads to efficient results in practice. Additionally, since risks continuously change and security awareness is a dynamic process, any awareness program needs to be repeatedly measured and managed (Chen, Medlin and Shaw, 2008). Based on the results, corrective actions can be taken in order to achieve a strong security culture within the company (Rantos, Manifavas and Fysarakis, 2012). In this study, the impact of an educational training session on the level of security awareness of employees is measured.

2. Research methods

2.1 Security awareness program

As a case study, a security training was organized for the employees of a Belgian university. In order to improve the level of security awareness, a training session based on the content of the university's security policy was composed. Even though, these security procedures and interventions differ from those in chemical and process facilities, this study focusses on the impact of a security training on human knowledge, attitude and behavior, regardless the organization's sector and characteristics. While employees of chemical companies may have more attention for security issues or greater security responsibilities, the results of this research are useful to consider for all types of companies when organizing security trainings. The training sessions included information such as the existence and use of security measures, the internal reporting points and the organizational security procedures of the university. Sessions were organized during working hours between 12h00 and 14h00. Three training sessions found place on three different dates and sites, each with a maximum capacity of 55 participants. Employees got informed about the training sessions by an announcement on the intranet and a personal mail, both with a registration link included. Registration was entirely voluntary. In total, 157 employees registered for one of the three sessions, of which 116 individuals effectively showed up.

2.2 Security awareness instrument

To analyze the impact of the training session on the level of security awareness among employees, a questionnaire was developed. First, a literature study was carried out in order to identify the existing tools that measure security awareness. Scientific research showed that security awareness is often measured by focusing on the knowledge, attitude and behavior of employees (Kruger and Kearney, 2006; Parsons et al., 2014). When studying the interaction between these concepts, authors refer to the knowledge – attitude – behavior (KAB) model of Baronowski et al. (2003) which indicates that human functioning can be fragmented in these three components. According to the authors, the components are definitely interrelated, but not necessarily linear dependent on each other. The accumulation of knowledge cascades into changes in attitudes, which in turn can lead to changes in behavior. Based on this model, questions regarding knowledge, attitude and behavior were included in the questionnaire.

In the end, the pre-test questionnaire consisted of 24 questions. First, the questionnaire contained demographic information such as age, gender and length of time working at the organization. Secondly, seven statements were developed to assess the knowledge regarding security measures and procedures of the university. The third part of the questionnaire contained six statements about the employee's attitude about security, followed by 11 items referring to the security behavior. The post-test questionnaire consisted of exactly the same questions as those in the pre-test questionnaire. Additionally, a couple of statements about the evaluation of the training session were added. For both questionnaires, a 5-point Likert scale was used.

2.3 Data analysis

Data elicited from the pre-test and post-test scores were analyzed using SPSS 24. Wilcoxon signed-rank tests were carried out to compare the changes in self-reported knowledge, attitude and behavior before and after the training session. The criterion for significance was set at 0.05. Three hypotheses were formulated in order to check if participation in the training session had an impact on the level of security awareness of employees: (i) after participation in the training session, significant improvement of knowledge regarding security can be measured, (ii) after participation in the training session, significant improvement of attitude regarding security can be measured, (iii) after participation in the training session, significant improvement of (planned) behavior regarding security can be measured.

3. Findings

3.1 Demographical characteristics

In order to assess the demographical characteristics of the respondents, the questionnaire consisted of four demographical questions. As displayed in Table 1, the research group comprised 74 employees who attended the information session and completed the pre- and post-questionnaire. A majority of women (70,3%) participated, while every respondent indicated to be older than 25 years. Other age groups were approximately equally represented. When asked about the length of the time working at the university, most respondents were working between one and five years for the organization or more than 10 years. Only three participants indicated they work less than one year for the university.

Table 1: Demographic characteristics of respondents

Gender	N	%
Female	52	70.3
Male	22	29.7
Age		
<25	0	0
25-35	15	20.3
36-45	21	28.4
46-55	19	25.7
>56	19	25.7
Time working at organization		
<1 year	3	4.1
1-5 years	29	39.2
6-10 years	7	9.5
>10 years	35	47.3

3.2. Knowledge

The pre-test and post-test questionnaires consisted of seven statements referring to the knowledge about the procedures of a bomb and fire alarm and the internal reporting tools for incidents. In general, it was found that the training session had a positive effect on the level of knowledge of the respondents. For all statements, significant differences ($p < 0.05$) between the two tests were found. The biggest improvement could be noticed when comparing the pre- and post-test results of the statements 'I know the difference between the procedure of a fire and a bomb alarm' ($z = 6.816$, $p > 0.001$) and 'I know where to report signs of radicalization among students or staff members' ($z = 6.832$, $p < 0.001$). 61 of 73 respondents (83,6%) indicated to be more aware of the difference between a fire and bomb procedure. Additionally, 63 of 74 respondents (85%) were convinced that after the training session they have more knowledge regarding the internal reporting tools for radicalization. Based on the results of all knowledge statements, it can be concluded that respondents score significantly higher on self-reported knowledge about security after their participation in the training session. Therefore, the first hypothesis can be assumed.

Table 2. Improvement in knowledge regarding security.

Statements	Pre-test M (SD)	Post-test M (SD)	z-score	p-value	Sample	Scoring higher	Scoring lower	Scoring even
I know what to do in case of a fire alarm	4.26 (0.892)	4.49 (0.530)	2.223	$p = 0.026$	74	N=21	N=10	N=43
I know what to do in case of a bomb alarm	2.73 (1.242)	4.21 (0.706)	6.590	$p < 0.001$	73	N=58	N=3	N=12
I know the difference between the procedure of a fire and bomb alarm	2.32 (1.218)	4.04 (0.841)	6.816	$p < 0.001$	73	N=61	N=3	N=9
I know how to report suspicious behavior	3.14 (1.162)	4.51 (0.503)	6.215	$p < 0.001$	74	N=51	N=2	N=21
I know where to report crimes of which I'm the victim	3.51 (1.317)	4.57 (0.526)	6.461	$p < 0.001$	74	N=54	N=2	N=18
I know how to report signs of radicalization among students or staff members	2.61 (1.259)	4.30 (0.677)	6.832	$p < 0.001$	74	N=63	N=4	N=7
I know where to go with questions about security	4.07 (0.912)	4.45 (0.708)	3.220	$p = 0.001$	73	N=33	N=9	N=31

3.2. Attitude

The questionnaire contained six statements regarding the attitudes of employees regarding the importance of security and the security responsibilities within their organization. Based on the results of the Wilcoxon signed-rank tests, the post-test answers on four of six statements revealed a significant improvement of attitude. After

training session, more employees were convinced about the security efforts of the organization, their own responsibility in security and the need to report suspicious situations. However, when asked to what extent security is found to be an important topic, a majority of 48 respondents indicated the same score. Remarkably, only 11 employees indicated a higher score after the training session, while 14 of them indicated lower scores. It's not clear which explanation applies for this decreasing trend. Hence, it must be noticed that pre-test mean (4.46) was already very high. The voluntary character of the training session can be the explanation, i.e. it can be assumed that only employees who are already convinced that security is an important topic were registered for the training session. A second interesting result was found when we analyzed the answers of the statement 'It's the responsibility of the Health and Safety Department to ensure the security, not the employee's'. Only 15 employees indicated a higher score on this statement, and 16 employees indicated lower scores after the session. Given that the responsibility of every employee was emphasized in the training sessions, a more positive result was expected. However, based on the majority of the statements, a significant improvement of the attitude of employees towards security was found. Hence, the second hypothesis can be assumed.

Table 3. Improvement in attitude regarding security.

Statements	Pre-test M (SD)	Post-test M (SD)	z-score	p-value	Sample	Scoring higher	Scoring lower	Scoring even
The security of the university is an important topic	4.46 (0.894)	4.48 (0.669)	0.044	p=0.965	73	N=11	N=14	N=48
The university pays enough attention to security	3.30 (0.903)	3.58 (0.942)	2.950	p=0.003	73	N=29	N=11	N=33
Every suspicious behavior or situation must be reported, even though it turns out to be nothing	4.01 (0.884)	4.30 (0.639)	2.868	p=0.004	73	N=28	N=10	N=35
I feel responsible for the security of the university	4.01 (0.630)	4.26 (0.578)	2.999	p=0.003	73	N=21	N=6	N=46
It's the responsibility of the Health and Safety Department to ensure the security, not the employee's	2.55 (0.981)	2.58 (1.066)	0.062	p=0.950	73	N=15	N=16	N=42
The university consists of sufficient security measures	2.72 (0.820)	3.04 (0.904)	2.749	p=0.006	73	N=32	N=15	N=26

3.2 Behavior

The questionnaire consisted of 11 statements that gauged the self-reported security behavior of employees. First five statements handled the security practices of employees at their individual workplace. Based on the answers, no significant differences were found between the pre-test and post-test. The large majority of employees indicated an even score on both pre-test and post-test. At four out of five statements, only a very limited number of respondents indicated higher scores in the post-test. The next three statements focused on reporting suspicious behavior or criminal incidents. When analyzing the answers, no significant differences were found between pre-test and post-test. The last three questions referred to the use of the employee badge and the approach of unknown people. Based on these answers, a significant differences were found. At the post-test employees scored significantly higher when asked if they would wear the personal badge ($z=2.277$, $p=0.023$). Additionally, 21 employees scored significantly higher on the statement if they would encourage colleagues of wearing the employee badge ($z=3.137$, $p=0.002$). Although there's only a small difference in the pre-test and post-test means of the last statement (see Table 4), a significant difference was founded ($z=3.738$, $p<0.001$). Based on these results, it can be concluded that the training sessions did have a significant smaller impact on the behavior of employees, when compared to the scores related to knowledge and attitude. Hence, when looking at the whole of statements, the third hypothesis cannot be assumed.

Table 4. Improvement in knowledge regarding security.

Statements	Pre-test M (SD)	Post-test M (SD)	z-score	p-value	Sample	Scoring higher	Scoring lower	Scoring even
After a workday, I take my laptop home	2.42 (1.688)	2.62 (1.735)	0.817	p=0.414	71	N=9	N=10	N=52
After a workday, I leave my laptop on my desk or in a closet at my workplace	2.55 (1.729)	2.80 (1.712)	1.085	p=0.278	71	N=15	N=13	N=43
After a workday, I take all my valuables home	4.04 (1.359)	4.07 (1.417)	0.185	p=0.854	71	N=12	N=11	N=48
When I leave my workplace, I close my door with my key	3.89 (1.309)	4.04 (1.292)	0.662	p=0.508	71	N=12	N=8	N=51
When I go home, I close my door with my key	4.70 (0.961)	4.72 (0.944)	0.513	p=0.608	71	N=5	N=3	N=63
When I see someone suspicious, I report it (or I would report it)	4.51 (1.024)	4.28 (0.759)	1.775	p=0.076	71	N=13	N=22	N=36
When I'm the victim of a crime, I report it (or I would report it)	4.95 (0.571)	4.87 (0.335)	0.727	p=0.467	71	N=5	N=14	N=52
When I'm confronted with an emergency situation, I would report it via the internal reporting tools	4.73 (0.926)	4.83 (0.377)	1.050	p=0.294	71	N=13	N=13	N=45
When I leave my workplace, I wear my employee badge visible	2.00 (1.375)	2.30 (1.553)	2.277	p=0.023	71	N=15	N=5	N=51
I encourage colleagues to wear their employee badge visible when they leave their workplace	1.20 (0.596)	1.68 (1.131)	3.137	p=0.002	71	N=22	N=4	N=45
When I meet someone in the hallway who probably is not from the university, I approach him/her (or I would approach him/her)	2.62 (1.303)	3.25 (1.065)	3.738	p<0.001	71	N=30	N=8	N=33

4. Discussion and conclusion

This study explored the effectiveness of a security awareness training on self-reported knowledge, attitude and behavior of employees regarding security. In order to measure the impact, a pre- and post-test questionnaire was carried out. For all three components, an increasing trend can be observed, which indicates that security training has a positive effect on the level of security awareness of employees. The biggest increase was found in the human knowledge. Approximately one week after the training session, the knowledge of employees regarding the security procedures and technologies within their company clearly increased. Additionally, a smaller but clear effect is noticeable when analyzing the evolution of the employees' attitudes regarding security. Lower scores were found when looking at the behavioral component.

However, one must use caution in extrapolating these results. First, only respondents who registered voluntarily for the training session were involved in this study. It can be assumed that these participants already have a larger interest in security topics than employees who didn't register. Next, the results of the study may be influenced by socially desirable behavior. Although the questionnaire was filled in anonymously, as with most self-reported data, the results may not be a pure reflection of actual score increases. And lastly, since the post-questionnaire was distributed only a few days after the training session, the results may only be valid for short-term conclusions. A follow-up questionnaire is needed to explore the long-term effectiveness of

the training. Despite these limitations, the results provide valuable information to security officers of chemical and process facilities on the efficiency of training programs in enhancing security knowledge, attitude and behavior of employees. In summary, as creating security awareness among employees is indispensable for a strong security culture within the company, more research is needed to determine the effectiveness of training programs on the level of security awareness. As this study showed a very positive effect on short term, future long-term training sessions are promising.

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