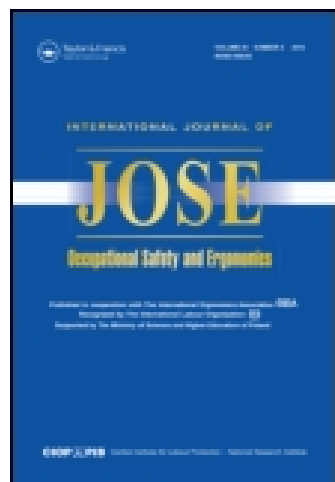


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Developing a Questionnaire for Measuring Safety Climate in the Workplace in Serbia

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This study was conducted because a real method for measuring safety climate had never been developed and assessed in Serbian industry. The aim of this paper was to start the process of developing a safety climate questionnaire that could be used in Serbia. As a starting point a 21-item questionnaire was adopted after an extensive literature review. The questionnaire was distributed at several Serbian factories; 1098 workers responded. After a statistical analysis of the data obtained with the questionnaire and a critical comparison with the available reference results, a final questionnaire with 21 questions, divided into 7 groups, was developed. The 7 groups of questions (factors) were safety awareness and competence, safety communication, organizational environment, management support, risk judgment and management reaction, safety precautions and accident prevention, and safety training.

safety climate measurement construct validity discriminant validity reliability

1. INTRODUCTION

After a thorough analysis of the literature on workplace safety climate [1, 2, 3, 4, 5, 6], it can be concluded that since 1980 when Zohar proposed the first comprehensive safety climate model [7], there has neither been a consensus on how many factors were required to measure safety climate nor which factors were the most effective. According to Lin, Tang, Miao, et al. [8], the divergence of factor structures may be explained by the use of different industrial populations or the fact that factor selection is left to the discretion of each researcher.

A few themes recur in most research: worker attitude to safety and risk [6, 9, 10]; management commitment to safety climate [5, 11] and procedures in an existing safety system in the company, e.g., training, compliance and communication.

In recent papers, there have been numerous discussions on the relationship (and differences)

between safety climate and safety culture [8, 12]. Mearns and Flin [3] and Lin et al. [8] simply condense the relationship between safety culture and climate. According to those authors, safety climate often has a different meaning depending on the cultural background, and it is differently related to safety culture. Safety culture is part of organizational culture and it tends to focus on deeper and less readily accessible core values and assumptions of the organization on safety and human resources. On the other hand, according to Wiegmann, Zhang and von Thaden [13], since Zohar first used the term [7], the literature has not presented a generally accepted definition of safety climate. In fact, some definitions of safety climate are almost identical to the ones of safety culture. However, many definitions of safety climate and safety culture differ in a number of important ways. One definition of safety climate, which is the most adequate for this paper, is “Safety climate is viewed as an individual

attribute, which is composed of two factors: management's commitment to safety and workers' involvement in safety" (p. 102) [14]. Safety culture describes the way in which safety is managed in the workplace; it often reflects "the attitudes, beliefs, perceptions and values that employees share in relation to safety" (p. 93) [15].

Having the conceptual difference in mind, it may not be possible to develop an empirically grounded safety climate model in a specific cultural context and expect this model to have ecological validity. Safety climate assessments should be based on factors characteristic for the location of the investigation. A questionnaire developed for investigations in one country (or region) would not be adequate for collecting data in another one. Furthermore, safety climate can have different meanings in different cultures.

Serbia is a small country in south-eastern Europe, where the issue of safety climate in industry is still not well known and understood. The lack of literature on safety climate in Serbian industries is evident. The only way to start investigations of safety climate in such an environment is to adopt methodology developed in earlier research, with an intention to adapt it to the Serbian context. In such a situation, a decision which model would be the most appropriate is necessary. Some models were developed in the west [1, 4, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31], others in the east [32, 33, 34, 35, 36, 37, 38, 39, 40, 41].

Having considered everything, we decided to use methodology originally developed in the west, and subsequently adapted to Chinese context [8]. We did this because China is a country in transition towards coexisting capitalist and socialist systems. There is a wide presence of both public and private companies. In such an environment, a specific working culture and safety climate appear. Serbia is going through a similar transition. In Serbia, private capital exists along publicly owned companies, which remain from the socialist regime. Serbian work climate and safety climate are still far behind the west.

Accordingly, this investigation adopted a questionnaire developed by Lin et al. [8], which had been used to measure safety climate in the work-

place in China. This questionnaire was a basis for a further adaptation of this model to the Serbian context. Most items from the original questionnaire remained unchanged; however, some new issues were added. Afterwards, the results of our investigation were compared with Lin et al.'s results [8]. Conclusions on the relevance of the chosen model for measuring safety climate in the workplace in Serbia were drawn.

The investigation in this paper aimed to start the process of developing a safety climate questionnaire that could be used in Serbia. A real method for measuring safety climate had never been developed and assessed in Serbian industry. For this investigation, we decided to use a questionnaire survey of the workers' opinion on important safety climate issues. The following sections present the study population, the development of the questionnaire, methodology, data analysis and a discussion of the results.

2. METHODS

2.1. Population

The study was conducted in central Serbia (the Morava region). Several industrial sectors were selected: food industry, shoe manufacturing, electrical construction, polyvinyl chloride (PVC) joinery, cosmetics industry, textile industry, recycling, cement production and furniture industry. Accordingly, the study was conducted in nine organizations, representing the nine industrial sectors in central Serbia. Since this part of Serbia is relatively small, these nine industrial sectors covered most areas of industrial production of this region. Such a diversity of industrial sectors is required to achieve one universal safety climate questionnaire that, after having its ecological and prognostic validity confirmed, could be used all over Serbia. Subsequently, a random sampling procedure was conducted to select individual workers in each organization; 1311 individual workers of those organizations potentially exposed to occupational hazards were selected. The questionnaires were distributed to organizations; 1098 questionnaires were returned (response rate: 83.75%). Table 1 shows the subjects' demographics.

TABLE 1. Subjects' Demographics

| Variable | N | % |
|---|-----|------|
| Organization | | |
| food industry | 312 | 28.4 |
| shoe manufacturing | 66 | 6.0 |
| electrical construction | 168 | 15.3 |
| PVC joinery | 39 | 3.5 |
| cosmetics industry | 81 | 7.4 |
| textile industry | 135 | 12.3 |
| recycling | 69 | 6.3 |
| cement production | 135 | 12.3 |
| furniture industry | 93 | 8.5 |
| Position in company | | |
| production workers | 750 | 68.3 |
| workers indirectly involved in production | 114 | 10.4 |
| administrative workers | 153 | 13.9 |
| managers | 81 | 7.4 |
| Education | | |
| primary | 246 | 22.4 |
| secondary | 756 | 68.9 |
| tertiary | 96 | 8.7 |
| Work experience (years) | | |
| <5 | 600 | 54.7 |
| 6–15 | 321 | 29.2 |
| 16–25 | 96 | 8.7 |
| >26 | 81 | 7.4 |
| Gender | | |
| male | 564 | 51.4 |
| female | 534 | 48.6 |
| Age (years) | | |
| <29 | 282 | 25.7 |
| 30–44 | 627 | 57.1 |
| 45–54 | 150 | 13.7 |
| >55 | 39 | 3.5 |
| Accident involvement | | |
| yes | 168 | 15.3 |
| no | 930 | 84.7 |

Notes. PVC = polyvinyl chloride.

Compared to Lin et al.'s [8] demographic indicators, we added two items: position in the company and educational level. It is an interesting finding that almost all demographic indicators were in the same ranges for both Chinese and Serbian workplaces. For example, 85.4% of the investigated Chinese workers had been involved in some sort of accident event.

2.2. Questionnaire

Our first questionnaire was Lin et al.'s [8]. At the beginning of our investigation, we adopted it with the aim to make a conclusion about its applicability to measuring safety climate in the Serbian workplace. Before using the original questionnaire among the selected population, we ran a pilot study among 300 workers in the food industry (56 participants), shoe manufacturing (65 participants), electrical construction (58 participants), PVC joinery (60 participants) and cement production (61 participants). The trial and first-run exploratory factor analysis showed that the original 21-item questionnaire, after a small regrouping of questions within the factors, could be used as a safety climate scale in Serbian factories.

A 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*) was used to collect the workers' responses. Yes/no responses, lists of options, check-the-box responses, etc., were used to self-report incident involvement and demographic data. Since the questionnaire used questions and answers based on scales, we included a not-applicable option for situations in which the respondents did not know what to respond or did not have an opinion on the issue. They rarely used this option. Many studies had used that format [42, 43, 44, 45], thus it was also acceptable for this research.

2.3. Construct Validity

In the original version of the questionnaire, the questions focused on seven factors [8]: SC1 (safety awareness and competence): 5 questions; SC2 (safety communication): 4 questions; SC3 (organizational environment): 3 questions; SC4 (management support): 3 questions; SC5 (risk judgment): 2 questions; SC6 (safety precautions): 2 questions; SC7 (safety training): 2 questions.

After the first run of the principal component factor analysis, some factors remained unchanged, whereas some questions had to be redistributed between the factors, compared to the original questionnaire. SC1, SC2, SC3 and SC7 were not changed. On the other hand, some questions from SC4, SC5 and SC6 had to be rearranged. Thus,

we developed the final questionnaire (Appendix A). The names of factors SC1, SC2, SC3, SC4 and SC7 remained unchanged; the other two were changed: SC5 risk judgment and management reaction, SC6 safety precautions and accident prevention.

2.4. Validity and Reliability

Sampling adequacy was measured with the Kaiser–Meyer–Olkin test. Bartlett’s test of sphericity was used for evaluating correlations among safety climate items. Construct validity was tested with exploratory factor analysis, and discriminant validity was checked by comparing the safety climate scores among groups varying in age, work experience, accident involvement, position in the company, educational and the type of the organization. To evaluate the internal consistency of the safety climate questionnaire, we used Cronbach’s α , Spearman–Brown coefficient and Ω . Cronbach’s α is used when questions are rated on internal scales such as a 5-point Likert scale, used in this investigation; it represents mean correlations among items. Spearman–Brown coefficient represents the reliability coefficients that can be attained from all possible combinations of dividing the questions into two sets (split-half). For example, you divide the questionnaire into odd and even numbered questions and correlate them. Ω is calculated from the factor analysis results [46]. The minimal proposed value of these coefficients is .70.

2.5. Data Analysis

The data obtained using the questionnaire were analyzed with SPSS 18. The comparison of the difference in safety climate scores among different demographic groups (age, work experience, gender, position in the company, education, accident involvement, type of organization) was done with the multiple analysis of variances (MANOVA). To define the final safety climate model, the principal component analysis was performed retaining all the factors with Eigenvalue greater than one. Once the

factors were extracted, the Varimax rotation was performed. Further structural analysis and final defining of the safety climate model were done with LISREL 8.30 software¹.

The analyses showed that the Kaiser–Meyer–Olkin measure of sampling adequacy was .81 indicating that these data were appropriate for factor analysis [47]. Bartlett’s test of sphericity was significant ($\chi^2 = 2974.56, p < .001$), which indicated that there were correlations among safety climate items and the correlation matrix was not a unit matrix.

3. RESULTS AND DISCUSSION

3.1. Safety Climate Factors and Demographic Subgroups

The final questionnaire, resulting from the first run of the factor analysis, was used to evaluate the opinion of the entire population (1098 Serbian workers). The second run of the principal component factor analysis was performed on the data obtained with the questionnaire. After the Varimax rotation, seven common factors were extracted and accounted for 69.93% variance. The common factors were determined with Eigenvalue greater than one and the screen plot. Table 2 shows principal component extraction of 21 items of safety climate.

During further investigations, the safety climate data were analyzed considering simple statistic differences (Table 3). The aim was to investigate whether there was a significant difference in safety climate among the demographic subgroups. To do so, we distinguished four age groups, two gender groups, four categories of work experience, two accident involvement groups, four positions in the company groups and four educational level categories (Table 1).

Compared to Lin et al. [8], we included three new demographic parameters. The first one was gender. Significant differences emerged on four scales (SC3, SC4, SC6 and SC7); there were no significant differences on the other safety climate scales. The position in the company was another

¹ <http://www.ssicentral.com/>

TABLE 2. 21-Item Safety Climate Factor Loadings and Community

| Item Code | Factor Loading | | | | | | | Community | | |
|-----------|----------------------------|----------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|----------|
| | Original Questionnaire [8] | Final Questionnaire (This study) | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | | Factor 6 | Factor 7 |
| SC1-1 | | SC1-1 | .605 | .004 | .470 | -.170 | -.046 | -.429 | -.099 | .812 |
| SC1-2 | | SC1-2 | .624 | .066 | .456 | -.208 | -.010 | -.368 | -.171 | .810 |
| SC1-3 | | SC1-3 | .574 | .152 | .126 | -.244 | -.053 | .122 | -.322 | .549 |
| SC1-4 | | SC1-4 | .537 | .134 | .368 | -.259 | .028 | .482 | .139 | .761 |
| SC1-5 | | SC1-5 | .396 | .199 | .531 | -.194 | .117 | .394 | .013 | .684 |
| SC2-1 | | SC2-1 | .134 | .565 | .134 | .266 | .312 | .131 | -.118 | .585 |
| SC2-2 | | SC2-2 | .010 | .731 | .010 | -.223 | .191 | .336 | -.089 | .742 |
| SC2-3 | | SC2-3 | .078 | .607 | .078 | -.183 | .266 | .388 | -.215 | .676 |
| SC2-4 | | SC2-4 | -.147 | .634 | -.147 | -.128 | .059 | .263 | -.042 | .657 |
| SC3-1 | | SC3-1 | .022 | -.220 | .785 | -.097 | .007 | -.064 | -.162 | .706 |
| SC3-2 | | SC3-2 | -.001 | -.280 | .773 | -.290 | .023 | -.068 | -.026 | .766 |
| SC3-3 | | SC3-3 | .050 | -.276 | .789 | -.191 | -.114 | -.124 | -.029 | .766 |
| SC4-1 | | SC4-1 | .071 | -.073 | -.107 | .582 | .016 | -.090 | .250 | .746 |
| SC4-3 | | SC4-2 | .334 | .391 | .144 | .647 | .006 | .095 | .042 | .671 |
| SC4-2 | | SC5-1 | -.409 | .160 | -.039 | -.179 | .667 | .242 | -.025 | .570 |
| SC5-1 | | SC5-2 | -.414 | -.440 | -.191 | .011 | .578 | -.220 | .095 | .709 |
| SC6-1 | | SC5-3 | -.159 | -.249 | -.191 | .001 | .652 | -.066 | .111 | .574 |
| SC5-2 | | SC6-1 | .010 | .117 | .251 | .111 | -.169 | .520 | .011 | .764 |
| SC6-2 | | SC6-2 | -.066 | -.159 | -.191 | .001 | .262 | .659 | .001 | .632 |
| SC7-1 | | SC7-1 | .112 | -.027 | -.540 | -.067 | .005 | -.047 | .473 | .767 |
| SC7-2 | | SC7-2 | .246 | .096 | -.553 | .124 | .009 | .016 | .442 | .739 |

Notes. SC1-1 ... SC7-2 = see Appendix A. The values in bold are the highest values of factor loadings for each variable (question), which determines in which group it should be allocated.

TABLE 3. Safety Climate by Age, Gender, Work Experience, Position in the Company, Education, Accident Involvement and Organization (Discriminant Validity)

| Demographic | Significance | SC1 | SC2 | SC3 | SC4 |
|----------------------|--------------|-----------|-----------|-----------|-----------|
| Gender | <i>F</i> | 9.06 | 8.36 | 2.82 | 10.38 |
| | <i>p</i> | <i>ns</i> | <i>ns</i> | .005 | <.001 |
| Age | <i>F</i> | 4.73 | 4.78 | 1.30 | 4.97 |
| | <i>p</i> | .050 | .023 | <i>ns</i> | .005 |
| Work experience | <i>F</i> | 8.81 | 10.94 | 3.83 | 20.26 |
| | <i>p</i> | .002 | <.001 | .015 | <.001 |
| Position in company | <i>F</i> | 4.28 | 2.49 | 7.86 | 3.05 |
| | <i>p</i> | .003 | <i>ns</i> | <.001 | <i>ns</i> |
| Education | <i>F</i> | 0.89 | 0.92 | 3.74 | 2.73 |
| | <i>p</i> | <i>ns</i> | <i>ns</i> | .027 | .035 |
| Accident involvement | <i>F</i> | 9.48 | 0.55 | 1.50 | 3.25 |
| | <i>p</i> | .038 | <i>ns</i> | <i>ns</i> | <.001 |
| Organization | <i>F</i> | 11.89 | 8.61 | 7.72 | 23.20 |
| | <i>p</i> | .001 | .002 | <.001 | <.001 |

| Demographic | Significance | SC5 | SC6 | SC7 | GSC |
|----------------------|--------------|-----------|-----------|-----------|-----------|
| Gender | <i>F</i> | 4.83 | 3.09 | 2.99 | 6.13 |
| | <i>p</i> | <i>ns</i> | <.001 | .018 | <i>ns</i> |
| Age | <i>F</i> | 1.84 | 5.92 | 2.20 | 3.87 |
| | <i>p</i> | <i>ns</i> | .013 | <i>ns</i> | <i>ns</i> |
| Work experience | <i>F</i> | 2.68 | 15.80 | 4.44 | 8.56 |
| | <i>p</i> | <i>ns</i> | <.001 | .007 | .013 |
| Position in company | <i>F</i> | 9.47 | 7.77 | 4.01 | 5.79 |
| | <i>p</i> | <.001 | <.001 | .046 | .048 |
| Education | <i>F</i> | 2.60 | 2.07 | 0.56 | 2.12 |
| | <i>p</i> | <i>ns</i> | <i>ns</i> | <i>ns</i> | <i>ns</i> |
| Accident involvement | <i>F</i> | 2.43 | 1.78 | 12.12 | 4.36 |
| | <i>p</i> | <i>ns</i> | <.001 | <i>ns</i> | <i>ns</i> |
| Organization | <i>F</i> | 7.31 | 32.23 | 8.05 | 14.25 |
| | <i>p</i> | .015 | <.001 | <.001 | .002 |

Notes. SC1 = safety awareness and competence, SC2 = safety communication, SC3 = organizational environment, SC4 = management support, SC5 = risk judgment, SC6 = safety precautions, SC7 = safety training, GSC = general safety climate.

new demographic parameter. There were significant differences in five of the seven factors (SC1, SC3, SC5, SC6 and SC7). The level of education was the third new parameter. For this parameter, there were significant differences only on two scales (SC3 and SC4).

This study was conducted in nine organizations representing nine industrial sectors of this region of central Serbia. The results of the analysis were highly significant on all scales. If we were to compare these results with Lin et al.'s [8], only scale SC7 did not have any statistical significance in their work. Furthermore, in their investiga-

tions, age was not statistically significant on any scale. Accident involvement had almost the same significance in both investigations.

The results of various groups of demographic parameters (work experience, position in the company and organization) demonstrated that the developed safety climate instrument had discriminant validity which was higher in some organizations than in others. This may be related to different risk levels in different organizations (industrial sectors) and departments. Moreover, different risk levels are associated with various tasks and activities among different positions in the company.

TABLE 4. Interconsistency Coefficients of the Safety Climate Questionnaire

| Scale | No. of Items | Cronbach's α | Spearman-Brown Coefficient | Ω |
|-------|--------------|---------------------|----------------------------|----------|
| SC1 | 5 | .769 | .794 | .731 |
| SC2 | 4 | .692 | .693 | .665 |
| SC3 | 3 | .855 | .858 | .746 |
| SC4 | 2 | .760 | .698 | .709 |
| SC5 | 3 | .678 | .678 | .618 |
| SC6 | 2 | .656 | .664 | .698 |
| SC7 | 2 | .885 | .895 | .753 |
| GSC | 21 | .785 | .746 | .702 |

Notes. SC1 = safety awareness and competence, SC2 = safety communication, SC3 = organizational environment, SC4 = management support, SC5 = risk judgment, SC6 = safety precautions, SC7 = safety training, GSC = general safety climate.

Since the type of industrial sector had a significant influence on workers' opinions on each safety climate question (Table 3), this demographic parameter was used as the grouping variable. Because of the large number of data lines, the workers' responses to safety climate questions, grouped according by industrial sector, are presented in Appendix B (Table A1). The results in Table A1 show that compared to the other industrial sectors, workers in recycling strongly emphasized the negative issues of their organizational environment. On the other hand, the most satisfied workers with regard to safety climate were the ones from PVC joinery production.

3.2. Reliability of Measuring Safety Climate

The reliability of the measurement method depends on its internal consistency. As already indicated, the consistency was assessed with Cronbach's α , Spearman-Brown coefficient, and Ω . According to Cronbach's α , internal consistency was .79 for the entire population. Spearman-Brown coefficient was .77 and $\Omega = .70$. Most coefficients were higher than .70 and adequate for psychometric requirements for a measurement. Thus, the method for measuring safety climate was appropriate. Table 4 shows each coefficient of the safety climate scales.

3.3. Structure of Safety Climate Model

Figure 1 presents the results of the structural analysis. To make it clearer, it shows only the values

of the structural equation, but not the measuring models. In accordance with the suggestions and indicators given by Hair et al. [48], the goodness-of-fit (GF) model had to be considered first. Within a GF model, it is required to consider three indicators: the measure of absolute fit, the measure of increased fit and the measure of decreased fit. Table 5 presents the results for the proposed model together with the recommended values for satisfactory fit [49].

Due to the absolute correspondence of the models, the indicators that can be applied in an incompetent strategic analysis are GFI (goodness-of-fit index) and the index of corresponding values and approximate error expressed as RMSEA (root-mean-square error of approximation). In GFI, the

TABLE 5. Summary of Fit Values

| Statistic | Value | |
|-------------|------------|-------------|
| | This Model | Recommended |
| χ^2/df | 2.55 | <3.0 |
| RMSEA | .09 | .08–.10 |
| GFI | .92 | >.90 |
| AGFI | .96 | >.90 |
| NFI | .96 | >.90 |
| NNFI | .92 | >.90 |
| CFI | .93 | >.90 |
| IFI | .92 | >.90 |
| RFI | .92 | >.90 |

Notes. RMSEA = root-mean-square error of approximation, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normed fit index, NNFI = non-normed fit index, CFI = comparative fit index, IFI = incremental fit index, RFI = relative fit index.

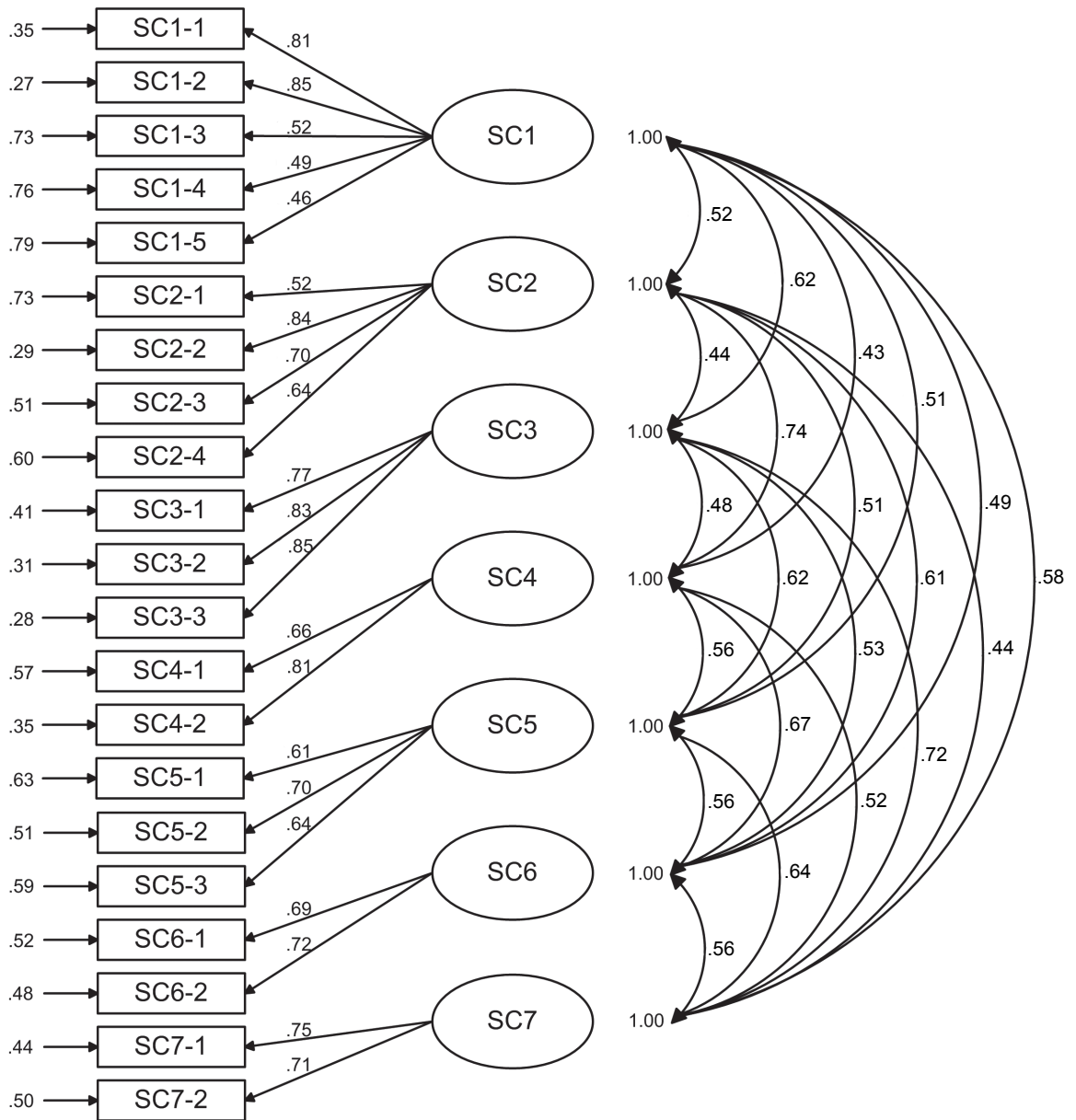


Figure 1. Structural model of investigated safety measurement scales. Notes. SC1 = safety awareness and competence, SC2 = safety communication, SC3 = organizational environment, SC4 = management support, SC5 = risk judgment, SC6 = safety precautions, SC7 = safety training; SC1-1 ... SC7-2 = see Appendix A.

higher the value, the higher the correspondence. In this case, the obtained value was .92. This indicator is acceptable since it is over .90 [42]. RMSEA is an indicator based on an appreciative error that occurs due to the expected degree of freedom within the population. The lower the indicator, the higher the correspondence. Acceptable correspondence is under .08. Some authors accept this value as even under .10. In our model, this indicator has the value of .09 which, accord-

ing to the latter group of authors, is an indicator of good correspondence.

Table 6 shows intercorrelations among the seven safety climate factors that were entered into the final model. Because of the large sample size, each correlation coefficient was significant at .01. Most coefficients were near or over .50, indicating high intercorrelation among all seven safety climate factors.

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TABLE 6. Intercorrelations Among the 7 Safety Climate Factors Entered Into the Final Model

| Coefficient | SC1 | SC2 | SC3 | SC4 | SC5 | SC6 | SC7 |
|-------------|------|------|------|------|------|------|------|
| SC1 | 1.00 | | | | | | |
| SC2 | .52 | 1.00 | | | | | |
| SC3 | .62 | .44 | 1.00 | | | | |
| SC4 | .43 | .74 | .48 | 1.00 | | | |
| SC5 | .51 | .51 | .62 | .56 | 1.00 | | |
| SC6 | .49 | .61 | .53 | .67 | .56 | 1.00 | |
| SC7 | .58 | .44 | .72 | .52 | .64 | .56 | 1.00 |

Notes. SC1 = safety awareness and competence, SC2 = safety communication, SC3 = organizational environment, SC4 = management support, SC5 = risk judgment, SC6 = safety precautions, SC7 = safety training.

3.4. Demographics and Safety Climate Factors

As indicated in section 3.1., one aim of this research was to investigate whether there was a significant difference in safety climate among the demographic subgroups. Table 3 shows there were significant differences in each demographic subgroup in some of the seven safety climate factors. For example, for gender, there were significant differences on four scales (SC3, SC4, SC6 and SC7), but not on the other scales. Thus, gender influenced opinions on questions on those four factors. Figure 2 presents the influence of gender on the answers to questions on SC3. It shows that female workers strongly emphasized the negative issues of the organizational environment, compared to their male co-workers.

An identical analysis was performed for all demographic subgroups that influenced workers' opinions on safety climate factors (Table 3). However, presenting all the results in this manuscript would require too much space. Therefore, they will be discussed in detail in another manuscript, a continuation of this one.

4. CONCLUSIONS

A study of safety climate in Serbian industrial settings, like the one in this paper, had never been conducted before. We attempted to measure the value of and beliefs on safety among Serbian workers. The study presented evidence that the perception of safety climate in Serbian industrial settings can be reliably measured with a 21-item questionnaire, involving seven factors (safety

awareness and competency, safety communication, organizational environment, management support, risk judgment and management reaction, safety precautions and accident prevention, and safety training). This paper suggested that, compared to the previous research, Serbian workers put more emphasis on safety training, organizational environment, safety awareness and competency, and management support. Therefore, the factor of safety training is the first of the seven factors, and explains the largest variance in the perception of safety climate. According to Serbian workers, other factors such as safety communications, risk judgment and management reaction, and safety precautions and accident prevention have less influence on general safety climate. To establish a general tool for measuring safety climate in the workplace in Serbia, our subjects came from several industrial sectors. Thus, the developed 21-item questionnaire can be used as a safety measurement tool for the whole of Serbian industry. This tool was based on the results from different parts of the world and then modified to fit Serbian workplaces.

Further research will focus on a structural equation model, which will result from the structural analysis presented in this work [50]. An additional factor, the level of safety in one workplace, will have to be included. It will determine the workers' attitude towards the risk level at their workplace and real occupational accidents that took place there. Subsequently, the seven factors from this study will be used to form a hypothetical frame of the structural equation model.

Additionally, as already indicated, each demographic subgroup had strong influence on some

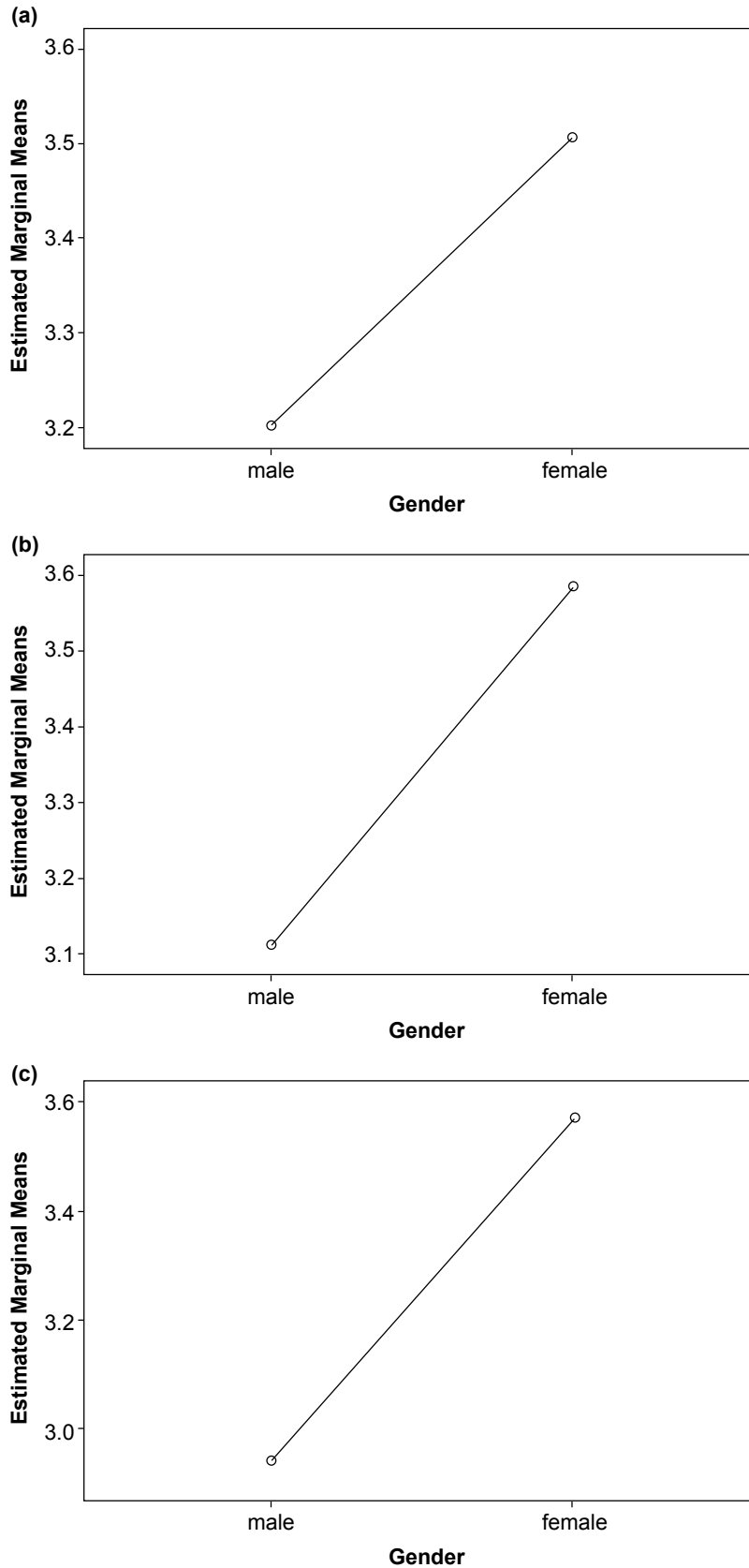


Figure 2. Workers' opinions on organizational environment (SC3) by gender: (a) "Sometimes there is too much work to do without following safety procedures", (b) "Sometimes work pace is too fast to follow safety procedures", (c) "Sometimes I have to ignore safety requirements for the sake of production".

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of the seven factors. This will be analysed in detail and discussed in a future study. This study considered workers from nine industrial sectors, so the type of organization was one of the demographic variables. Consequently, the influence of this variable on all seven safety climate factors will be studied in future. This will include testing the ecological validity of the new questionnaire: the questionnaire will be used in each of the nine sectors separately, with larger groups of workers in each sector. The results will then be compared among each other and with the results obtained in the present work. The ecological and prognostic validity of the model developed in this work will be assessed in this way. Moreover, the results will have practical value for occupational health prevention in each sector.

This study suggests that using the new questionnaire may improve safety climate in Serbian companies. According to the workers, it is now easy to isolate the most significant safety climate issues for each industrial sector and to address them in practice. Also, workers from all the investigated sectors would like to see an improvement in the safety training. Representatives of all companies involved in this investigation will see the results.

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APPENDIX A. Safety climate questionnaire (21 items)

SC1: Safety awareness and competency

SC1-1 I am clear about what my responsibilities are for the workplace safety

SC1-2 I understand the safety rules in my job

SC1-3 I can deal with safety problems in my workplace

SC1-4 I comply with the safety rules all the time

SC1-5 When I am at work, I think safety is the most important thing

SC2: Safety communication

SC2-1 I am involved in safety issues at work

SC2-2 Co-workers often exchange tips with one another on how to work safely

SC2-3 I often discuss safety issues with my supervisors

SC2-4 I can get safety information from the company

SC3: Organizational environment

SC3-1 Sometimes there is too much work to do without following the safety procedures

SC3-2 Sometimes work pace is too fast to follow safety procedures

SC3-3 Sometimes I have to ignore safety requirements for the sake of production

SC4: Management support

SC4-1 Management believes safety is of the same importance as production

SC4-2 Management takes care of safety problems in my workplace

SC5: Risk judgment and management reaction

SC5-1 Management acts only after accidents have occurred

SC5-2 I am sure it is a matter of time before an accident occurs in my workplace

SC5-3 There are conflicts between production procedures and safety measures

SC6: Safety precautions and accident prevention

SC6-1 My job is quite safe

SC6-2 In those dangerous jobs, there are always measures to prevent accidents

SC7: Safety training

SC7-1 I am trained in safety knowledge

SC7-2 Safety training fits my job

APPENDIX B. Responses to the safety climate questions by industrial sector

TABLE A1. Responses to Safety Climate Questions By Industrial Sector

| Industrial Sector | Safety Climate Measures | | | | | | | | | | | | | | | | | | | | | |
|-------------------------|-------------------------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|------|------|
| | SC1-1 | | SC1-2 | | SC1-3 | | SC1-4 | | SC1-5 | | SC2-1 | | SC2-2 | | SC2-3 | | SC2-4 | | SC3-1 | | | |
| | N | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | |
| Food industry | 312 | 4.49 | 0.70 | 4.62 | 0.73 | 4.24 | 0.86 | 4.46 | 0.73 | 4.64 | 0.61 | 3.97 | 1.15 | 3.82 | 1.09 | 3.59 | 1.21 | 4.14 | 1.14 | 4.14 | 3.26 | 1.25 |
| Shoes manufacture | 66 | 4.78 | 0.52 | 4.74 | 0.54 | 4.30 | 0.77 | 4.52 | 0.59 | 4.74 | 0.62 | 3.96 | 1.30 | 3.87 | 1.01 | 3.48 | 1.12 | 4.13 | 1.01 | 4.13 | 2.87 | 1.25 |
| Electrical construction | 168 | 4.62 | 0.65 | 4.67 | 0.58 | 4.38 | 0.83 | 4.75 | 0.62 | 4.75 | 0.70 | 3.85 | 1.31 | 3.91 | 1.18 | 3.02 | 1.28 | 4.05 | 1.11 | 4.05 | 3.96 | 1.02 |
| PVC joinery production | 39 | 4.85 | 0.38 | 4.54 | 0.52 | 4.31 | 0.48 | 4.54 | 0.52 | 4.85 | 0.38 | 3.92 | 0.64 | 4.46 | 0.78 | 4.08 | 0.86 | 4.85 | 0.38 | 4.85 | 2.54 | 0.97 |
| Cosmetic industry | 81 | 3.96 | 1.02 | 4.19 | 0.68 | 4.26 | 0.59 | 4.52 | 0.58 | 4.30 | 0.91 | 3.19 | 1.30 | 3.78 | 1.16 | 3.33 | 1.18 | 4.30 | 1.03 | 4.30 | 3.22 | 1.16 |
| Textile industry | 135 | 4.51 | 0.73 | 4.49 | 0.76 | 4.51 | 0.66 | 4.56 | 0.62 | 4.13 | 0.79 | 3.91 | 0.87 | 4.33 | 0.83 | 3.71 | 0.94 | 3.91 | 0.97 | 4.07 | 4.07 | 0.39 |
| Recycling | 69 | 3.87 | 0.55 | 3.78 | 0.67 | 3.35 | 0.83 | 3.22 | 0.80 | 3.04 | 0.71 | 2.96 | 0.83 | 2.70 | 0.82 | 2.57 | 0.84 | 3.22 | 0.74 | 3.22 | 2.74 | 0.62 |
| Cement production | 135 | 4.30 | 0.96 | 4.37 | 0.93 | 3.91 | 1.17 | 4.02 | 1.04 | 4.53 | 0.86 | 3.63 | 1.45 | 3.23 | 1.36 | 3.47 | 1.26 | 3.26 | 1.33 | 3.40 | 3.40 | 1.16 |
| Furniture industry | 93 | 4.63 | 0.60 | 4.54 | 0.56 | 4.46 | 0.74 | 4.63 | 0.60 | 4.60 | 0.65 | 3.31 | 1.30 | 3.71 | 1.36 | 2.49 | 1.04 | 4.03 | 1.27 | 4.03 | 2.77 | 1.42 |
| total | 1098 | 4.46 | 0.76 | 4.49 | 0.73 | 4.23 | 0.87 | 4.41 | 0.80 | 4.46 | 0.82 | 3.72 | 1.22 | 3.77 | 1.18 | 3.33 | 1.21 | 3.96 | 1.15 | 3.96 | 3.35 | 1.19 |

| Industrial Sector | Safety Climate Measures | | | | | | | | | | | | | | | | | | | | | |
|-------------------------|-------------------------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|-------|------|
| | SC3-2 | | SC3-3 | | SC4-1 | | SC4-2 | | SC5-1 | | SC5-2 | | SC5-3 | | SC6-1 | | SC6-2 | | SC7-1 | | SC7-2 | |
| | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD |
| Food industry | 2.96 | 1.27 | 3.11 | 1.27 | 4.04 | 1.30 | 3.91 | 1.31 | 2.33 | 1.51 | 2.75 | 1.36 | 2.73 | 1.19 | 3.42 | 1.42 | 3.92 | 1.11 | 4.33 | 1.25 | 4.47 | 0.96 |
| Shoes manufacture | 3.30 | 1.52 | 2.65 | 1.47 | 4.35 | 0.89 | 3.26 | 1.42 | 1.87 | 1.01 | 1.83 | 1.11 | 2.26 | 1.05 | 4.04 | 0.93 | 4.52 | 0.59 | 3.35 | 1.85 | 3.96 | 1.67 |
| Electrical construction | 3.93 | 1.39 | 3.85 | 1.19 | 4.11 | 1.13 | 3.89 | 0.99 | 3.16 | 1.53 | 2.98 | 1.38 | 2.96 | 1.09 | 3.25 | 1.29 | 3.84 | 0.96 | 4.04 | 1.39 | 4.51 | 0.92 |
| PVC joinery production | 3.31 | 0.48 | 2.62 | 0.96 | 4.69 | 0.48 | 4.54 | 0.88 | 2.31 | 1.03 | 1.46 | 0.97 | 1.54 | 1.05 | 4.54 | 0.97 | 4.77 | 0.60 | 4.69 | 0.63 | 4.92 | 0.28 |
| Cosmetic industry | 3.04 | 1.06 | 3.22 | 1.12 | 4.48 | 0.80 | 4.11 | 1.16 | 2.37 | 1.21 | 1.81 | 1.04 | 3.04 | 1.06 | 4.30 | 1.03 | 3.85 | 0.82 | 2.70 | 1.68 | 3.33 | 1.54 |
| Textile industry | 4.42 | 0.66 | 4.49 | 0.92 | 4.84 | 0.48 | 4.58 | 0.99 | 3.91 | 1.33 | 2.42 | 1.42 | 3.11 | 1.45 | 4.53 | 0.84 | 4.51 | 0.92 | 4.82 | 0.68 | 4.62 | 0.61 |
| Recycling | 2.61 | 0.72 | 2.52 | 0.85 | 3.04 | 0.88 | 2.74 | 0.96 | 2.43 | 0.66 | 2.43 | 1.12 | 2.48 | 0.79 | 2.78 | 1.04 | 2.87 | 1.06 | 3.70 | 0.77 | 3.57 | 0.73 |
| Cement production | 3.28 | 1.24 | 3.12 | 1.26 | 3.16 | 1.36 | 2.60 | 1.33 | 3.67 | 1.29 | 3.12 | 1.18 | 3.26 | 0.98 | 2.81 | 1.18 | 3.23 | 1.07 | 3.42 | 1.20 | 3.79 | 1.28 |
| Furniture industry | 2.97 | 1.69 | 2.40 | 1.50 | 3.63 | 1.40 | 3.51 | 1.44 | 2.40 | 1.63 | 2.17 | 1.56 | 2.43 | 1.42 | 4.00 | 1.03 | 4.31 | 0.99 | 3.63 | 1.72 | 4.26 | 1.29 |
| total | 3.34 | 1.33 | 3.25 | 1.36 | 4.02 | 1.23 | 3.72 | 1.34 | 2.80 | 1.51 | 2.54 | 1.37 | 2.78 | 1.22 | 3.62 | 1.31 | 3.93 | 1.09 | 3.96 | 1.42 | 4.24 | 1.15 |

Notes. PVC = polyvinyl chloride; SC1-1 ... SC7-2 = see Appendix A.