Multilevel model of safety climate for furniture industries

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Abstract

BACKGROUND: Furniture companies can analyse their safety status using quantitative measures. However, the data needed are not always available or the number of accidents is under-reported. Safety climate scales can be an alternative. However, there are no validated Portuguese scales that contemplate the specificity of the furniture sector.

OBJECTIVE: The current study aims to develop and to validate an instrument to measure the safety climate in Portuguese furniture industries, using a multilevel structure.

METHODS: The Safety Climate in Wood Industries (SCWI) was developed and applied to the safety climate analysis, including three different scales: organizational, group and individual. A multilevel exploratory factor analysis was performed to analyse the factorial structure. The companies' safety conditions were also analysed.

RESULTS: Different factorial structures were found at between and within levels. In general, results show the presence of a group level safety climate. Scores of safety climate were directly and positively related to companies' safety conditions, being the organizational scale the one that most reflects the actual safety conditions.

CONCLUSIONS: SCWI allows identifying different safety climates between groups of the same furniture company and it seems to reflect their safety conditions. The study also emphasized the need of a multilevel analysis of the instrument.

Keywords: Furniture, Multilevel, Safety climate, Safety conditions

1. INTRODUCTION

The furniture sector represents one of the most important economic sectors of the Portuguese economy, particularly in the North of country. In 2010, this sector included a universe of 5 798 companies that employed approximately 32 000 persons [1]. However, most of these companies have a small dimension, i.e., less than five workers (microenterprises) [2]. They have also reduced professionalization in terms of management, marketing and trade policies, and most of their workforce is based on unqualified and undifferentiated workers. Moreover, the number of occupational accidents in this sector remains high. According to national accident statistics, made available for this purpose by Portuguese Office of Strategy and Planning (GEP), in 2008, a total of 5 438 accidents occurred in the sub-sector of wood and mattresses manufacturing. This represents 7.14% of the total of accidents of the Portuguese manufacturing industry. This high number of accidents is a consequence of several factors, namely the risk of the sector, the stakeholders' low safety concerns, the lack of machine maintenance, and lower workers qualification. Contradicting this scenario, this is a sector that has attempted to increase its competitiveness, and in the last years, several programs to reform this sector have been established. Concurrently, it is expected its modernization, together with an increase of the safety concerns. Nowadays, it is already possible to observe the existence of some companies with a higher volume of business, different from the traditional familiar companies, and becoming more modern and competitive.

On the Portuguese furniture industry sector, the current scenario shows the need that companies have to analyse their safety status, in order to identify the key problems and to improve its safety performance. With this purpose, quantitative measures can be used, such as the accident rates [3]. However, in some cases, such as in Small and Medium Size Enterprises (SMEs), the data needed are not always available or, in other cases, the number of accidents is under-reported and do not reflect the actual safety condition.

Therefore, the use of different measures is important. In this context, safety climate have been referred as a relevant measure to monitor safety conditions and safety performance, indicating the problems before injuries occur, and to design safety interventions and management programmes, overcoming some of the limitations of traditional safety measures [4-8]. However, there is no agreement in the literature regarding the most appropriate way to measure safety climate and no validated scales exist in Portuguese that contemplate the specificity of the furniture sector. Furthermore, it is possible to found a recent emphasis on a multilevel safety climate analysis (see e.g. Zohar & Luria [9] and Brondino *et al*. [10]). Considering the previous points, the current study aims to develop and validate an instrument to measure the safety climate in Portuguese furniture industries which should reflect the current level of safety conditions, by using a multilevel structure.

1.1. Safety climate

In the beginning of the decade of 1980, Zohar emphasized the safety climate concept [11]. According to the author, safety climate is a "summary of the molar perceptions that employees share about their work environments". From that moment, safety climate concept has become broadly used and its interest seems to be growing, with particular emphasis in the last years. However, it is important to note that there is still a longstanding discussion in relation to its concept, and there is no apparently consensus in the literature, particularly in relation to the distinction between the concept of safety culture and safety climate, being even possible to found some authors that used both concepts as a single construct (e.g. Arocena *et al*. [12] and Håvold [13]).

One of the most frequent cited safety culture definitions is the one from the Advisory Committee on Safety of Nuclear Installations (ACSNI). According to ACSNI, safety culture refers to "the product of individual and group values, attitudes, perceptions and competences and patterns of behaviour that determine the commitment to and the style and proficiency of an organization's health and safety management" (ACSNI, 1993 cited in [14]). However, several other definitions can be found in the literature (see e.g. Choudhry *et al*. [14] and Guldenmund [15]). Safety climate can also be used to describe the shared perceptions and/or attitudes[1] among members of an organization regarding safety, at a given point in time [5, 18]. It is seen as a product/sub-component [14] or an indicator of safety culture [5, 18, 19]. In this context, safety culture is a more complex and durable concept than safety climate [18], and its measurement is more difficult. Safety climate can also be seen as being more superficial and transient [17]. For that reason, this concept is the more appropriate to be considered when organizations pretends to analyse some features related with safety and to observe its evolution from time to time, as well as, to identify changes in the safety behaviour. Therefore, it is not surprizing that the majority of studies are focused on safety climate.

The importance of a reliable safety climate measure is highlighted due to its potential for explaining some safety-related outcomes. The relations between safety climate and safety-related outcomes have been proved by researches in different activities sectors. Previous studies shown that safety climate, or some of its dimensions, can be related to risk perception [18, 20, 21], safety management systems [11, 22] and, directly or indirectly, to accident rates [8, 12, 18, 22-24] and safety behaviour [20, 23, 25, 26]. Therefore, it is expected that individuals working in companies with a positive safety climate perceives less risk, have a lower probability of suffering injuries, the companies' safety management systems of are more efficient and workers present more positive safety behaviour.

In this context, previous research has developed a great effort for the construction of a valid and reliable safety climate instrument, analysing its appropriateness for predicting or drawing inferences about organizational independent variables [27], becoming a major issue in the empirical studies. However, there is still no consensus about safety climate

[1] The definition of safety climate varies according the literature in terms of attitudes and perceptions. This discussion is out of the scope of the present work, however, for a deeper analysis see Clarke [16] and Guldenmund [17].

measures, i.e., how many and which factors must be considered, and the number and which items need to be included [20, 25]. In this context, many researches have proposed different instruments to measure safety climate, as it is mentioned in the literature reviews of Guldenmund [4] and Flin *et al*. [5], which differ in relation to the number of items included, the content, the scales used and statistical analysis. Given these conditions, the factor structures obtained are also different. In this context, it is clear that the task of finding the main dimensions to be included in an instrument for safety climate measure is not easy. It is difficult to compare the factors derived from different studies, because the items included in each factor are different, as well as, its language is not the same among studies. Also the denomination of the factors varies considerably, even though if they included similar items. It is also important to note that even with similar instruments, safety climate factors may not be replicated, due to differences in the countries or industries type [7]. Hence, literature suggests that the characteristics of the instruments should to be related to the intention of the study [28].

1.2. Multilevel analysis

Most of previous studies about safety climate only considered a single level of analysis when the data are processed (e.g. Vinodkumar & Bhasi [8], Varonen & Mattila [22]). However, recently, this practice has been contested. Different authors claim that, when the scores of the safety climate are aggregated into a single level, the hierarchical structure of the data is ignored and climate relationships in an organization remain unwell specified [9, 17]. Shannon & Norman [7] add that the factor structure determined by previously researches is incorrect, since they have treated the data from survey respondents in a completely independent way. These criticisms are related with the companies' multilevel structure.

The hierarchical structure of organizations has recently induced researchers to consider a multilevel analysis of the safety climate. In this structure, and in accordance to Guldenmund [17], it is possible to distinguish three key impact levels: organizational level, group level and individual level.

At organizational level, managers establish policies and procedures to facilitate policy implementation. These procedures are executed by supervisors within each work group (group level), which decide how and which procedures to implement (supervisor discretion). Therefore, they are seen as the persons with more impact on workplace safety and health into an organization [29]. They are the persons who communicate with workers, thus, workers' behavior and attitudes toward safety and perception about management action depends on the information provided by supervisors. Supervisor discretion in interpreting and implementing company's policies and procedures can result into group variations. However, also co-workers' norms can lead to differences in the safety climate among groups [10, 26, 30]. Co-workers provide information to other workers, as well as, they can have influence on safety behaviour [10]. The safety climate group variations have already been identified on previous works [9, 19, 27, 31-33]. Zohar [3] verified that workers safety climate perceptions, and consequently safety climate scores, vary between company subunits. Glendon & Litherland [32] found differences in the safety climate of job sub-groups on 2 of the 6 factors identified. Also Cooper & Phillips [27] verified significant differences among departments, suggesting the existence of different safety climates within different departments. Later, Zohar & Luria [9], analysing cross-level relationships between safety climates at two different levels (organizational and group levels), verified that exist variations among groups in an organization. Furthermore, in both Høivik *et al*. [19] and Harvey *et al*. [33] differences in the safety climate dimensions among plants were found. These findings show the presence of multi-climates, due to group differences.

According to Harvey *et al*. [33], culture/climate is a concept that needs to be applied at the group level.

Finally, the last hierarchical level, individual level, is related to the respondents' practices. Workers are responsible to comply with the company's policies and procedures [29]. However, every worker is different, and according to Guldenmund [17] rational and perceptual processes can have influence on individual employees' behaviour. In this context, individuals can make choices in relation to whether or not perform safely [29]. For example, they can decide to follow the procedures defined by managers, the supervisors' advices, or to follow the co-workers norms. In this context, faced to this hierarchical structure, multi sub-climates can be found in a specific organization [16, 17, 34].

Considering the multilevel structure, it is essential the correct development of a measure instrument, which contemplates these levels [9, 10, 17, 35]. However, a statistical analysis that considers the specificities of a multilevel structure is also needed. But, this type of analysis was not contemplated on the majority of previous studies related with safety climate. Citing Shannon & Norman [7], "a proper analysis requires adjustment to incorporate the multilevel nature of the data, and thus, provide correct estimates of the loadings that determine factor structure, the model test statistics and the reliabilities of the scales". In this context, the multilevel factor analysis (MFA) appears as an appropriately analyse of the safety climate factors structure of a construct at aggregate levels of analysis. This process accounts both of the within- and between-group variance [36, 37]. Examples of multilevel factor analysis (exploratory and confirmatory) in different areas can be found in the literature (see e.g. Dyera *et al*. [36], Reise *et al*. [37], van de Vijver and Poortinga [38] and Sexton *et al*. [39]). However, for safety climate, only the works of Brondino *et al*. [10] and Brondino *et al*. [35] were found using this approach, particularly, a multilevel confirmatory factor analysis (MCFA).

2. METHODOLOGY

2.1. Samples

The results of the study were based on data collected from 11 furniture companies, which agreed to participate in the study. All companies are located at the north of Portugal. North of Portugal is the region with the higher concentration of furniture companies, particularly in the Porto district with 61% of the companies [2]. The analysed companies varied in size from micro (less than 10 employees), small (from 10 to 50 employees), to medium (from 50 to 250 employees) size companies, being all included on the SMEs group.

The study involved 319 workers, who perform manual labour. The samples for each company varied considerably in size, i.e., from 5 to 75 respondents, independently of the size of the companies. Among all companies, 27 initial work groups were identified. In general, for the group definition it were considered factors such as the department/sector of activity, supervisors, and physical boundaries. In micro and in some small companies it was only considered one group, because only existed one supervisor, workers were exposed to the same risks and no fixed workplaces were observed.

The participants in this study were only effective workers. This means that temporary workers were not considered here. Most of participants were males (89%), and the average age was 39.23 years old (SD = 10.40; interval range 18-63 years old). In general, workers have been with the companies in average for 10.64 years (SD = 6.99; interval range 0-35 years) and exert such activity on average for 17.91 (SD = 12.13; interval range 1-50 years).

2.2. Safety conditions analysis

A safety audit to all companies in analysis in order to characterize the companies' safety conditions was carried out, identifying and characterizing the relevant occupational hazards. According to Reese [29], there are four primary audit formats: checklist, evaluation, narrative or compliance. In this work it was adopted the evaluation audit format. To support this step a checklist was formulated and applied, based on accurate legislation (e.g. Decreto-Lei nº 103/2008 [40]; Decreto-Lei n.° 24/2012 [41]; Decreto-Lei nº 347/93 [42]; Portaria nº 987/93 [43]) and guidelines (e.g. Miguel [44]). It included a set of items (total of 112) related to workplace conditions regarding health and safety issues, tasks, equipment and machinery. The items were selected according to the major furniture sector risk factors [44], including items related with each type of machine. For example: "Radial Arm Saws with a upper guard for saw blade protection". These items were evaluated based on a 5-point Likert scale adapted from Reese [29], where 1=very deficient and 5=excellent, in order to characterize the level of deficiency of each feature in analysis. In all cases, "not applicable" situation was considered when a risk factor is not verified in the specific situation in analysis. At the end, all results were discussed with the companies' management and supervisors.

The percentage of safety conditions (SC) was estimated for each group, taking into account the filled items as follows:

$$SC(\%) = \frac{\sum_{i=1}^{n} k_i}{5n} 100 \quad (1)$$

where n correspond to the total number of filled items of the checklist, k the score of item i and 5 correspond to the maximum of the Likert scale used. The higher the percentage, better are the companies' safety conditions.

2.3. Instrument

2.3.1. Safety Climate in Wood Industries development and application

An instrument for measuring the safety climate considering a multilevel structure, called Safety Climate in Wood Industries (SCWI), was developed and applied. The development of the SCWI can be described as a four-stage process, namely: (1) design of a preliminary version, (2) pre-test of the preliminary version, (3) incorporation of comments and suggested improvements, and (4) development of a final version.

The first version of the SCWI included two main parts. The first part included socio-demographic questions, such as age, gender, department/sector, professional activity, number of years working at the company, number of years at the mentioned professional activity, and previous involvement in work accidents. The second part included 39 items for measuring safety climate, by analysing three different levels: organizational, group and individual levels. The items included are well explained in Rodrigues *et al*. [45].

According to Guldenmund [17], for developing a safety climate questionnaire it is possible to take into account two different approaches: (1) a normative or theoretical approach based on a descriptive model of safety climate, and (2) a pragmatic approach based on results of previous research that can be combined to construct a new questionnaire. In the current study, the items and scales of both organizational level and group level were adapted from the Multilevel Safety Climate Scale from Zohar & Luria [9]. The items were reworded and rephrased to suit local working practices and culture. Seven items were eliminated because were double-barrelled. Six new industry-specific items were included, assuming that this will allow the instrument to better reflect the most important organizational features in those companies and a better within and between groups comparison [34]. The final version of the organizational level included 16 items and the group level 13 items. The individual level was not considered in the Zohar & Luria [9] work'. Zohar & Luria [9] considered that safety climate is expressed in terms of both managers and supervisory influence on workers. However, in this work it was considered that the safety climate analysis could not be restricted to the management and supervisory systems, in accordance to the work of Reese [29]. Features of workplaces and influences of co-workers can also have impact on safety climate [10, 30]. In this context, the authors believe that these influences on individuals' safety climate perceptions/attitudes can also be measured at individual level. In this context, 10 items to measure individual level were included, based on literature review, in particular the work of Tharaldsen *et al*. [18].

Twenty-six items were phrased positively and 13 items negatively. The level of agreement with each item was assessed by means of a five-point Likert scale ranging from “1=Strongly disagree” to “5=Strongly agree”.

The SCWI questionnaire was delivered to five Occupational Safety & Health (OSH) experts, who were requested to review, examine and test it. Some improvements were suggested and taken into account in the final version of the SCWI.

These scales were tested in a pilot survey [45], conducted on a sample of 29 workers from one randomly selected company in order to detect any possible weak points, to get feedback about the intelligibility and unambiguousness of items and, to analyse if the questionnaire identifies sub-climates as intended. In this first version of the instrument, a sixth option was also contemplated in the scales, meaning “not applicable”, in order to analyse if some items were not applied to this specific scenario. Some improvements in the instrument formatting were carried out to facilitate its fill and an item was removed, due to three respondents consider the same not applicable. This item was included on organizational level, and was related with the consideration of person’s safety behaviour when workers’ career development/progression. Due to current economic situation of the Portuguese furniture sector, job promotions were quite scarce, thus, this item seemed to be not well fitted to the current sector reality. At the end of this process, the final version of the SCWI was obtained and it included a total of 38 items.

2.3.2. Procedures

Researchers distributed personally the questionnaires and encouraged all workers to participate with the help of the top management. Questionnaires were completed during working hours or, in some companies, at the end of the work shift, in the company or at home. Workers were notified that their participation would be considered in a voluntary and confidential basis. They were also informed that if they found difficult to answer any question, they would be able to ask for help from the researchers or from the company managers.

2.4. Statistical analysis

Due to the companies' hierarchical structure, researchers pay more attention to statistical issues, associated with the multilevel characteristics of the data in different areas, particularly studies in leadership area, which presents a long tradition regarding multilevel issues [36]. As mentioned earlier, it seems that also safety climate studies need to follow this trend. In this context, and considering the hierarchical structure of the data from this study, a multilevel analysis was performed in the current study.

This hierarchical structure has an impact on the factor structure. Therefore, to develop a valid instrument, a multilevel analysis of the data was performed, using *Mplus* Version 6.12 [46]. In this context, a Multilevel Exploratory Factor Analysis (MEFA) was applied, considering the procedure proposed by van de Vijver and Poortinga [38] and the procedure used by Reise *et al*. [37], derived from the steps proposed by Muthén [47]. Its procedure appears to be more adequate to this study than a MCFA, i.e., despite previous studies having presented some possible models, due to the particularities of Portuguese furniture sector it is assumed that the factor structure can be substantial different in this reality, being a MEFA essential at this point.

In the first stage, the groups dimension was analysed and all groups with less than 4 members were eliminated from the sample [35]. Secondly, it was performed an exploratory factor analysis of the all data, without considering the groups. The objective of this analysis was to obtain a rough sense of the underlying factor structure [37]. Then, and in order to determine the degree of the group level variance on each item, the Interclass Correlation

Coefficient (ICC) was computed. The ICC value of 1 represents a perfect agreement and ICC of 0 a situation of no agreement at all. Accordingly, ICC values bellow 0.05 or near to 1, indicate that a multilevel analysis is meaningless [36, 37]. After the computation of ICC, the pooled within-correlation matrix and estimated between-correlation matrix were computed. Finally, MEFA were conducted on each of the three different analysed scales.

The influence of socio-demographic variables on the safety climate scores was also performed. Associations between safety climate and safety conditions were also tested at the group level, aggregating all data according the pre-defined workgroups. For these analyses IBM SPSS software (version 20) was applied.

3. RESULTS

3.1. Multilevel structural model of SCWI

The ICC was computed for each of the items in analysis, in order to verify the degree of the group level variation. ICC ranged from 0.129 to 0.478 for organizational scale, from 0.296 to 0.607 for group scale, and from 0.251 to 0.601 for individual scale. All values are higher than 0.05 and relatively lower than 1, indicating that multilevel analysis can have a particular meaning [37].

Using 312 workers in 25 groups, a MEFA, using Varimax rotation, was done to analyse the interrelationships among the items and to identify groups or clusters of variables (factors). A short item description for each of the three considered levels is shown in Appendix.

For the factors identification, the Kaiser' criteria were used (eigenvalues > 1), as well as the scree plot analysis. Taking into consideration the previous, for the organizational scale the MEFA reveals a similar structure at both within and between levels, with 2 factors (Figure 1). At the within level, the factors identified were Investment/Safety System and Communication. The first factor includes items that reflect the management investment in safety issues, as well as, in continuous improvement of safety systems. The second factor is related with the management initiative in promoting safety rules and safety procedures, as well as in informing workers about occupational risks, taking into account the workers' feedback. These factors are slightly positively correlated (r=0.259). The between level presents a stronger structure since each factor contains a great number of items with high factor loadings. It is also important to note that 2 items only explain variations at between level (1.1 and 1.5). This level also presents a complex structure. That is, some items related to safety systems are correlated with the 2 factors, due to the factor loading values. For example, the item related with the investment with workers training (1.9) presents values of 0.475 for both factors. This is certainly due to a question that includes, simultaneously, issues related to investment on safety and issues related to workers' information towards risks. These factors are positively correlated (r=0.404). In other hand, it was verify that two items were not related with any factor, so they were not considered in this study.

Insert Figure 1 here

For the group scale a different factor structure was identified on between and within levels (Figure 2). In between level were included more 3 items than at the within level (2.11-2.13), and 3 factors were identified: Caring, Compliance and Effort. The first factor included items that demonstrate the supervisor concerns regarding workers' safety practices and about their involvement on safety issues. The second factor includes items related to the supervisor surveillance toward workers' safety rules enforcement. Finally, the third factor includes items that reflect the supervisor effort in the rules compliance and safety protections use. These 3 factors are slightly and positively correlated (F1-F2: r=0.373; F2-F3: r=0.233; F1-F3: r=0.154). For the within level, a single factor, named Safety Priority, was identified. This factor reflects all the actions and concerns of supervisor towards workers safety. In this level, one item was not related with any factor, so it was not considered in this study.

**Insert Figure 2 here*

Finally the Individual scale presents 1 factor at between level and 2 factors at within level (Figure 3). The factor identified at between level, Commitment, include items that show all the workers' involvement to safety.

The items in within level were divided into 2 factors, Priority and Attitude. The first factor is concern with the workers' safety priorities and the second with the workers' safety actions. These factors are slightly and positively correlated (r =0.223). In other hand, since one item was not related with any factor, it was not considered in this study.

Insert Figure 3 here

3.2. Safety climate and safety conditions analysis

The average of the obtained answers for each item by group was estimated, after recoding the negative questions, and then summed to achieve the score for each level and group, being the results presented on Table 1.

Insert Table 1 here

The analysis of the results shows differences on safety climate between groups, even in groups belonging to the same company. The group 20, related to the company I, presents the lowest safety climate score and, the group 12, related to the company E, the highest score. The latter resulted from the higher score at the organizational scale. In generally, the lowest safety climate scores (total and among levels) were related to groups allied to the cutting department (groups e.g. 6, 10, 14, 17, 21 and 25) and the highest safety climate scores were found in groups allied to storage and assembly departments (e.g. groups 7, 9, 11, 15, 19, 22, 23, and 24). However, some exceptions were found, as in the group 4, which is related with the cutting department and presents a slightly high safety climate score (121.8), mainly due to a high score at organizational and group scales. Also the group 3 of the same company, which was related with assembly department, presents different results, having a low total safety climate score (100.1).

One-way ANOVA analysis between the safety climate scores of the dimensions of all hierarchical levels in analysis and the demographic variables was performed in order to analyse differences between sub-groups, such: age, number of years that works in the company and number of years that develop the referred professional activity. Different groups were defined by the demographic variables in analysis, based on Sturges' rule [48] (6 groups for age, 4 groups for years in the company and 5 for years of activity). No significant differences were found between workers' age and the scores of safety climate factors at between level [$F(5, 306)$, $p>0.05$ for all]. Also the relationship between the number of years that workers develop their professional activity and the scores of all the factors in analysis presents no significant differences [$F(4, 307)$, $p>0.05$ for all]. For other side, it was found a significant relationship between the number of the years that workers collaborate with the company and the safety climate scores of all the safety climate dimensions analysed at between level [$F(3, 308)$, $p<0.05$ for all], where workers that collaborate with the company at less time have a propensity to score higher in the safety climate.

It was also analysed whether or not climate dimensions were directly correlated with safety conditions. This analysis was performed at group level, using aggregated mean scores on the safety climate. Firstly, an analysis of the total safety climate scores (Table 1) *versus* the safety conditions (SC%, equation 1) was performed (Figure 4). The results show a strong linear positive relation between both [$r=.858$, $F(1.23) = 64.199$, $p<0.001$], meaning that the safety climate is generally greater with better safety conditions. A further analysis was carried out, namely the relationship of each scale in analysis, as well as the correspondent dimension at between level, and the group safety conditions was performed (Table 2).

Insert Figure 4 here

Table 2 displays the linear relations between all the identified safety climate dimensions of the three hierarchical levels in analysis, with the scores aggregated, and the percentage of safety conditions. All safety climate dimensions were directly associated with safety conditions. The correlations ranged from 0.590 to 0.826, and all were significant. The shared variance (r^2) ranges from 35.8% to 68.3%. The correlations are stronger in the organizational scale dimensions, particularly in the Communication/Safety System dimension, and lower at Effort dimension at group level. Therefore, the dimensions included in organizational scale seem to be the most closely match and reflect the actual levels of safety conditions.

Insert Table 2 here

4. DISCUSSION

In order to validate a safety climate instrument, it is not only important to analyse its reliability, but is also important to assess the concurrent or predictive validity of the identified factors against some independent variables [27]. Therefore, the main aim of this study was to develop and to validate an instrument to measure the safety climate in Portuguese furniture industry sector that reflects the current level of safety conditions, using a multilevel structure. Thus, in this study, the percentage of safety conditions was used to analyse the accuracy and appropriateness of the instrument for furniture industries. The instrument development was based on previous scales, in particular in the well-known safety climate measure presented by Zohar & Luria [9]. An adaptation of the scales was done in order to adjust it to the Portuguese furniture sector. Additionally to the two levels scales proposed by Zohar & Luria [9], a third new level, the individual level, was also considered. With this level, it was expected to analyse some effects related to the context and to the co-workers' influences on companies' safety climate.

The authors opted for applying a MEFA analysis on this study in order to find the latent factorial structure. The MEFA was proposed by van de Vijver & Poortinga [38], and its procedures are derived from Muthén's method [47], and it also presents the same advantages of the exploratory analysis. This type of analysis involves decomposing the variances into between and within group estimates. Therefore, the data from individual survey are not treated as completely independent [7], i.e., the total variance and the covariance/correlation between items is influenced by the variation of item ratings within groups and by the variation between groups in their average rating [23].

This multilevel analysis had a great importance on this study. The factorial structures obtained at within and between levels were significantly different, particularly for individual and group scales. This finding is not unusual, as it was already identified in previous studies that applied a MEFA. Even a MCFA based on theoretical models found different factorial structures for the within and between levels. For example, Haenens *et al*. [49] found 4 factors for the within level and 5 for the between level. On the other hand, Reise *et al*. [37] identified the same two factors for both levels, however the items related to each factor was different. Based on a MCFA, Brondino *et al*. [35] confirm models with the same first order factors for both levels, but for two of the scales in analysis, a second order factor was only identified for one level (between or within in accordance with the scale). In general, studies reveal a more complex structure in the between level. Despite the fact that the between level analysis is more complex than the within analysis from both an analytic and an interpretational point of view [37], its results are essential to define the main structure that reflects the group safety climate differences. An analysis of the safety climate scores group variation without this analysis is certainly wrong.

Regarding the results of safety climate, and as expected, the analysis of the questionnaire shows significant differences on safety climate among groups, indicating the presence of multi-subclimates. This is in accordance with the suggested by previous studies [16, 17, 34, 35]. These differences can be related with workplace safety conditions, as suggested by Cooper & Phillips [27] to justify the differences on safety climate among departments that they found. The relationship between safety conditions and safety climate was previous observed by Varonen & Mattila [22] in a study with wood-processing companies. In this study a directly and significantly relationship between safety climate scores and the percentage of safety conditions was also found for all dimensions in analysis at between level, particularly for the dimensions identified for the organizational scale. Furthermore, the results also showed that groups related with storage and assembly companies departments present the highest safety climate scores for the different hierarchical levels in analysis, as opposed to groups related to cut sector that have the lowest safety climate scores.

The safety conditions analysis shows that most of the analysed companies present a great problem in the cutting sector related with machines without protection. Saws, drill and milling cutter machines were found without any protection or the protection raised and workers were not suing the driving-bar for cutting small pieces. This is related to the risk of contact with saws and blades, pinch, boring, projection of machine parts (for example saw or saw parts) and others objects. Also situations of high noise exposure, manual handling (risk of strain) and, materials and cables stored on passageways (risk of falls on the same level or collision with fixed objects) were identified in this sector in most of the analysed companies. These risks, according to Miguel *et al*. [44], are common in this sector in Portugal. Taking this into consideration, the worker of the cutting sector is at risk of suffering an accident. This can have influence on the safety climate, since previous studies found a relationship between accident rates and safety climate (see e.g. Vinodkumar *et al*. [8], Arocena *et al*. [12], Tharaldsen *et al*. [18], Varonen & Mattila [22] and Nielsen *et al*. [24]). Moreover, they need to comply with more rules and safety procedures than others workers, being also more likely to not meet any of them. This is also an important sector for production, because the following sectors are dependent on the results of this sector. If the production on this sector has a delay, the others are left with no material to work. So, it is possible that workers can be subjected to a greater pressure and, as a consequence, they may ignore some safety rules/procedures. Additionally, in the storage and assembly sectors, the workers exposure is more related to excessive effort and some risks related to the use of handling tools and fall of objects. The procedures and safety rules that they need to comply are also lower. Furthermore, in companies where supervisors are allied to more than one group, their intervention can be different according to the characteristics of the tasks, exposed risks and the production requirements.

The higher relationship founded between the dimensions identified for organizational scale at between level and the safety climate scores was not surprising. Workers can relate the poor working conditions with the managers' intervention, because it is their responsibility to establish policies and procedures to increase safety at workplaces [17]. If the machines are unsafe, the procedures and layout potentiate the risks at the workplaces, and workers do not have enough information about risks they are exposed to, the responsibility can be attributed to the managers, which are ultimately the main responsible for the companies' safety. Nevertheless, the dimension related with group and individual scales also presents a significant relationship with safety conditions. This show that supervisors' intervention and co-workers influences have also impact on safety climate, as suggested by several authors (see e.g. Zohar & Luria [9], Brondino *et al*. [10] and Brondino *et al*. [35]). The lowest relationship was found for the Effort dimension of the group scale. This dimension was related to the effort of supervisors in relation to the rules compliance and the use of safety protection by workers. This can be due to the existence, in some companies, of only one supervisor for more than one group, being difficult for him/her to be continually insisting on the use of protections. Furthermore, supervisors can have a lack of knowledge about risks, not presenting the adequate sensibility to lead workers to follow the rules and safety procedures. The production targets can also be related with these results. Supervisors tend to give less value to safety than to production [29].

5. CONCLUSION

The current work describes an attempt to develop and analyse the suitability of an instrument to perform a multilevel analysis of the safety climate in furniture industries. The obtained results show that the developed instrument, SCWI, allows the identification of different safety climates between groups of the same furniture company and reflects their safety conditions.

Furthermore, this work emphasized the consideration of three different levels to perform a multilevel safety climate analysis, by the use of three different scales: organizational level, group level and individual level. Through this perspective, not only management and supervisors' actions were considered as having influence on safety climate, but also co-workers and situational influences were considered, due to its effect on individual attitudes/perceptions measured by the individual scale.

The study also emphasizes the need of a multilevel analysis of the instrument. This analysis shows differences on safety climate factorial structure at within and between levels. This type of analysis are not common in safety climate researches, however, this is a type of analysis that has been very discussed in the last years and the results of its application have shown significant advantages comparing to the conventional factor analysis or confirmatory factor analysis. Therefore, it seems that this is the right direction to follow in future studies about safety climate studies.

Despite the previous, it should be acknowledge that the safety condition analysis was used to compare the companies and that this was adopted to overcome the absence of accident statistics of the considered companies, which are frequently used in several studies to validate the safety climate measure [e.g. 8, 12, 18, 22-24]. Accordingly, it is likely that the safety condition analysis does not entirely reflect all companies' risk factors that can lead to accidents, or to some unsafe acts, which could be also related to companies' safety climate.

Appendix

Identification of the SCWI items for each of the three considered levels:

Organizational Level	Item nr	Item description
The management of this company….	1.1	reacts quickly when a dangerous situation is detected, or there is an accident / incident occurs.
	1.2	insists on thorough and regular safety audits and inspections.
	1.3	is not interested in to continually improve safety levels in each department.
	1.4	does not invest in the working machines modernization.
	1.5	invests in the implementation of measures to minimize the loads manual handling.
	1.6	provides all the equipment needed to do the job safely.
	1.7	is strict about working safely when we are working under pressure.
	1.8	requires each supervisor/team leader to help improve safety in his– her sector/department.
	1.9	invests a lot of time and money in safety training for workers.
	1.10	uses any available information to improve existing safety rules.
	1.11	promotes the development of appropriate work procedures to the tasks performed by workers.
	1.12	does not consider to workers' suggestions about improving safety.
	1.13	provides workers with sufficient information on safety issues.

Group Level	Item nr	Item description
My supervisor or team leader…	2.1	makes sure we receive all the equipment needed to do the job safely.
	2.2	do not check frequently if we are all obeying the safety rules.
	2.3	discusses how to improve safety with us.
	2.4	rather than to use explanations, compels us to act safely.
	2.5	worries that I fulfil with the regulations and work procedures.
	2.6	worries that I use all the machines protections
	2.7	lets be ignored safety rules and procedures when we are working under pressure.
	2.8	frequently tells us about the hazards in our work.
	2.9	makes sure we follow all the safety rules and not just the most important ones.
	2.11	is strict about safety at the end of the shift, when we want to go

		home.
	2.12	spends time helping us learn to see problems before they arise.
	2.13	insists we wear our personal protective equipment even if it is uncomfortable.

Individual Level	Item nr	Item description
I….	3.1	believe that safety is the main priority when I do my work.
	3.2	whenever check a dangerous situation, report it immediately to one of my superiors.
	3.3	when run my work, I try to always follow the rules and work procedures.
	3.4	do not use the personal protective equipment necessary for performing tasks
	3.5	not always use the machines protections.
	3.6	refuse to ignore safety rules, even when the work is delayed and it is needed to increase production.
	3.7	disregard safety rules at the end of the shift, when we want to go home.
	3.8	clarify all my questions about the risks to which I am exposed.
	3.9	do not call the attention of my colleagues when I see them violating some rule or some safety procedure.

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Table 1: Safety climate average scores (± sd) by group and level of analysis.

Company	Number of Workers	Sample	Group	Organizational scale*	Group scale*	Individual scale*	Total average score*
A	5	5	1	35.0±2.5	28.4±3.0	28.4±1.0	91.8±4.96
B	53	42	2	37.1±6.9	35.4±4.9	34.4±4.1	106.9±8.0
			3	32.9±3.3	35.7±4.9	31.6±2.2	100.1±7.8
			4	46.2±4.7	41.8±3.8	33.8±3.3	121.8±8.5
			5	49.0±2.5	46.7±5.5	30.0±7.5	128.7±4.8
C	104	58	6	37.8±6.6	45.6±3.2	36.2±4.4	119.6±8.1
			7	46.4±7.1	41.5±4.3	33.2±3.0	121.1±8.2
			8	44.4±3.8	41.6±3.0	33.4±4.3	119.4±6.5
			9	43.7±3.8	40.1±3.0	40.5±4.1	124.2±4.8
D	20	16	10	45.6±4.8	49.6±4.1	32.8±4.4	119.8±8.0
			11	47.4±5.2	43.3±2.7	41.4±3.2	122.1±9.6
E	5	5	12	50.8±1.6	41.0±2.2	34.8±1.0	141.4±2.9
F	7	7	13	44.0±3.1	38.1±2.5	31.3±3.0	128.2±8.8
G	17	12	14	35.5±1.9	31.2±3.6	26.2±2.9	93.0±6.5
			15	33.5±1.5	40.8±5.0	30.5±2.2	104.7±7.7
H	85	75	16	55.4±4.0	42.5±2.7	36.1±2.9	136.3±7.7
			17	53.9±2.1	45.8±2.0	33.9±3.4	110.4±5.0
			18	54.0±4.8	45.3±3.6	36.3±3.9	135.7±8.0
			19	56.1±4.6	48.7±4.5	37.4±5.1	142.3±9.2
I	15	12	20	24.7±1.6	27.6±2.5	18.3±1.1	70.7±1.9
J	71	68	21	42.5±3.6	35.3±3.8	31.6±2.9	114.6±6.2
			22	48.6±2.7	39.4±3.3	35.0±1.5	124.4±3.0
			23	48.8±1.8	47.2±2.2	36.4±2.6	132.4±4.5
K	12	11	24	51.1±4.5	42.9±4.6	35.1±2.0	128.1±7.1
			25	42.8±3.8	38.5±1.5	30.2±1.1	111.5±5.0

*Average ± Standard Deviation

Table 2: Linear relation between safety conditions and safety climate dimensions

Dimensions	**r**	$\mathbf{r^2}$	**Adj.** $\mathbf{r^2}$	**df**	**F**	**Sig.**
Organizational scale						
Investment/Safety System	0.791	0.626	0.610	1	38.511	0.000
Communication/Safety System	0.826	0.683	0.669	1	40.450	0.000
Group scale						
Caring	0.755	0.569	0.551	1	30.404	0.000
Compliance	0.730	0.533	0.513	1	26.254	0.000
Effort	0.598	0.358	0.330	1	12.835	0.002
Individual scale						
Commitment	0.685	0.470	0.447	1	20.377	0.000

Figure 1: Multilevel exploratory factor analysis of the organizational scale items (items description in Appendix)

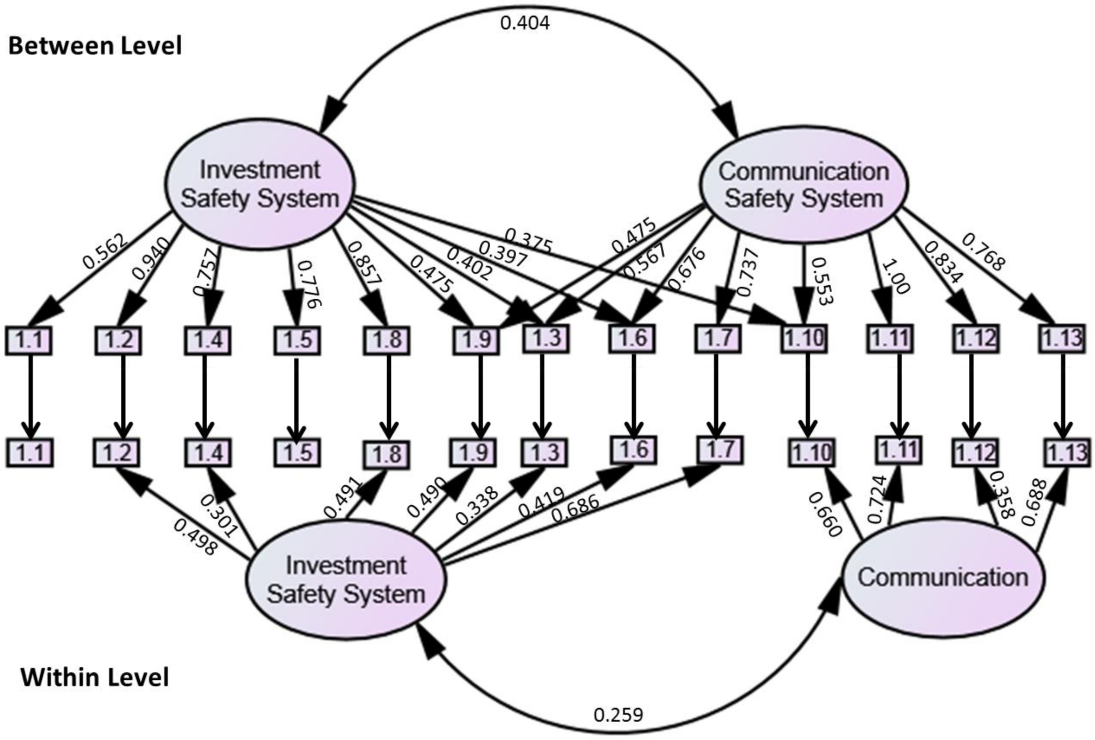

Figure 2: Multilevel exploratory factor analysis of the group scale items (items description in Appendix)

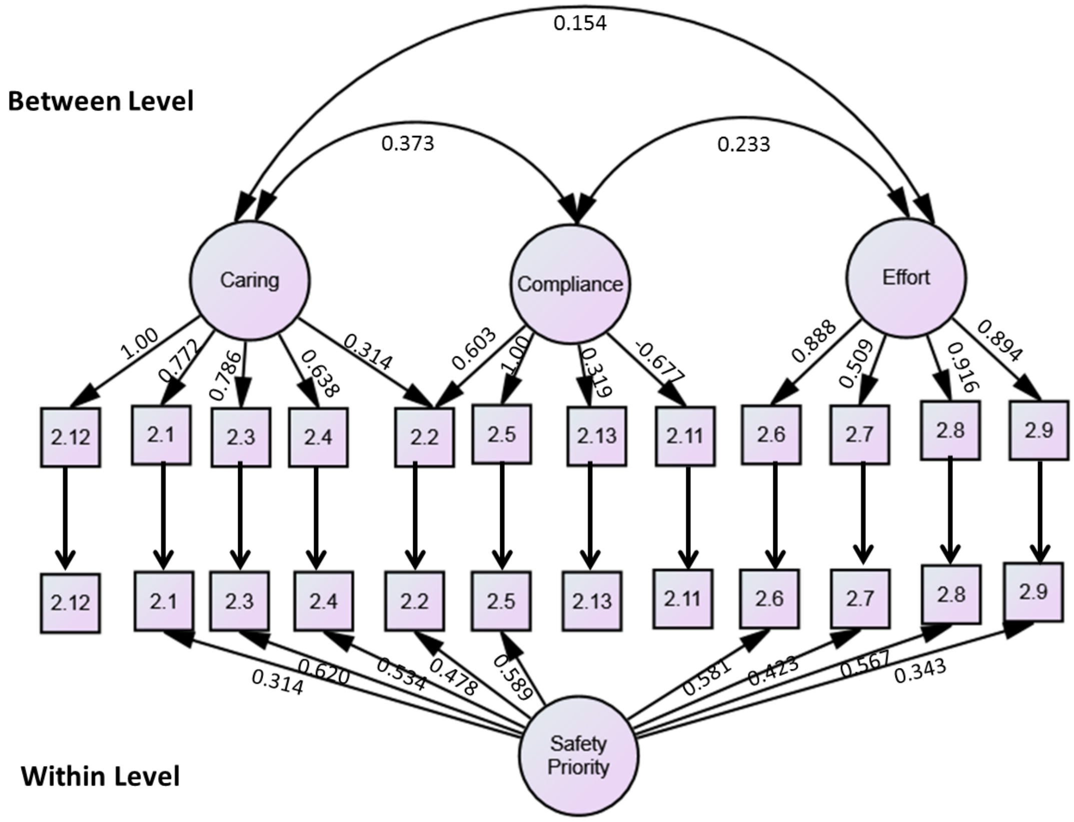

Figure 3: Multilevel exploratory factor analysis of the individual scale items (items description in Appendix)

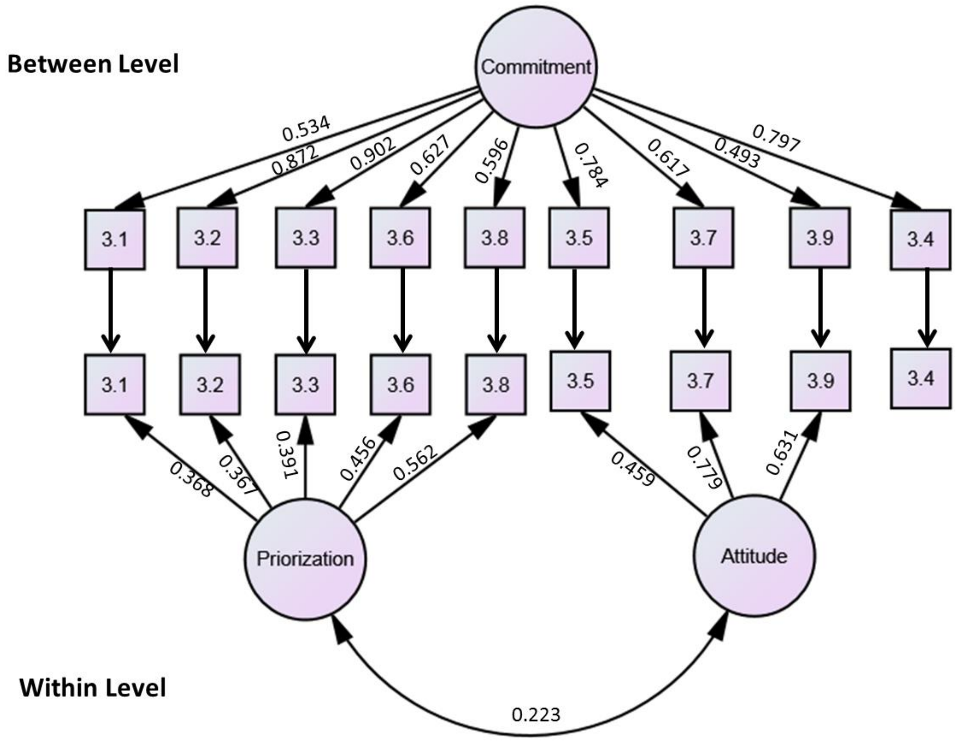

Figure 4: Linear relation between safety conditions and safety climate