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# Workplace Safety Culture Model [WSCM]: Presentation and Validation

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***Abstract*****—** *The literature on Workplace Safety Culture (WSC) has evolved in the conceptual dimension in a movement away from technical aspects toward more human aspects, but remains incipient regarding the creation of measurement instruments and quantitative evaluation with a totality of technological, organisational and human factors.To fill this gap, this article presents and validades the Workplace Safety Culture Model (WSCM) applied in a survey, with a total of 1196 operational employees of six factories, frommetallurgical sector. To validate the WSCM, the statistical procedure Exploratory Factor Analysis (EFA) was used to reduce the set of variables to a lower number of factors to characterize the attribute dimensions of the object in question. The results presents a reduced version of the proposed model, distributed in ten factors: Leadership, Commitment, Pressure at Work, Infrastructure, Learning, Efficiency, Management System, Feedback, Responsibility,and Communication.The results of the EFA produced a factor structure with relatively higher loads on the appropriate factors. The WSCMoffers us a robust tool to analyze an organization's WSC maturity. For the methodological improvement of the model, we suggest future research with diverse cultural contexts.*

***Keywords— Organizational Culture, Safety Culture, Workplace Safety Culture.***

## I. INTRODUCTION

The concept of Safety Culture (SC) has been studied in the last 25 years by many researchers from different academic fields. In these studies, we identified two distinct perspectives: the engineering approach, which focuses mainly on the formal aspects that influence business security (procedures, managerial systems, controls and policies), and a psychological approach, which focuses on the perceptions, feelings and attitudes of employees (Antonsen, 2009).

These two SC approaches are reflected in studies on Workplace Safety (WS), in which we identified parallel managerial practices that hinder the integration of Risk Management and Behavioral Sciences (Douglas &Wildavsky, 1983; Maguire & Hardy, 2013; Hardy & Maguire, 2016).

In this sense, in the last two decades, some researchers have found that WS problems are often not only associated with technical issues (Sneed & Henroid, 2007; Taylor, 2011). Past studies have indicated that when there is a shortcoming of understanding the value of safety and its priority within the workplace, then unsafe behavior that leads to 80-90% of accidents will likely be the result. Then, organizations are now focusing on the relevant human factors which contribute to workplace safety (Clarke, 2013; Jiang & Probost, 2016; Mullen *et al.*, 2017). Studies have demonstrated that even employees with technical knowledge of WS sometimes show behaviors that are inconsistent with the safety standards required by companies (Henroid & Sneed, 2004; Sneed &Henroid, 2007).

Based on these conclusions, some researchers have examined more closely the importance of the concepts of organizational culture and the role of intangible variables for the management of safe human behavior (Lee *et al.*, 2012).

Nevertheless, if on the one hand the literature on the theme has evolved in the conceptual dimension, it remains incipient regarding the creation of quantitative instruments for measuring and evaluating WSC that reinforce the importance to address the concept 'safety culture', with a comprehensive approach, where technological, organizational and human aspects are included. (Van Nunen *et al.*, 2018; Seo *et. al.*,2004;Seo, 2005; Reiman & Rollenhagen, 2014). To bridge this gap, this article proposes a quantitative model to measure Workplace Safety Culture (WSC), the Workplace Safety Culture Model (WSCM).The aim is to validate the instrument in order to evaluate the contribution of each construct (dimensions, indicators and variables) to explain the proposed model, applying it to the metallurgical sector.

The article is divided into six parts in addition to this introduction. In the following section, the theoretical framework is presented, relating Organizational Culture (OC) with Safety Culture (SC), Workplace Safety (WS)

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and Workplace Safety Culture (WSC). In the third part, the methodology of the work is presented, describing the WSCM, its validation and application. In the fourth part, the results of the empirical research are presented and analyzed. In the fifth section, the limitations of the WSCM are discussed. In the last section, the final considerations regarding the benefits of applying the WSCM to companies are given, along with suggestions for future research in the field.

## II. THEORETICAL FRAMEWORK

### Organizational Culture (OC)

In the history of the concept of organizational culture (OC), three distinct periods can be identified (Barbosa, 2010). In the sixties, the concept of OC was correlated with the movement of organizational development and the humanistic conception of organizational values. At the time, OC was perceived as an instrument for improving companies, but there was little interest in treating it as a competitive advantage.In the eighties, studies of Japanese companies showed the relevance of OC in the economic and business environment. In those days, epistemological discussions took place on the nature of OC, in a pragmatic and substantive dimension, in an attempt to transform the concept of OC into a variable of managerial strategy and competitiveness. Yet, new models of organizational theory and strategy design emerged (Bourantas*et al*., 1990). Researchers began to investigate values, creeds, rituals, customs and other variables that appeared to influence organizational performance. In the mid-nineties, OC came to be understood and studied as an intangible asset of firms and was associated with the role of leadership (Schein, 1992:13). A definition to provide an understanding of OC and the role of the leader may be described as:*"A pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems*".

Three fundamental levels can be distinguished at which OC is manifested (Schein, 1992): visible artifacts, espoused beliefs and values and basic underlying assumptions. When a new employee begins working at a company, the first thing he observes is the artifacts: layout, architecture, the way people dress and how they greet and relate to each other. At the second level of OC, we have the values that govern attitudes and behaviors and help us to understand why members of an organization act the way they do. Finally, at the third level, unconscious and invisible, taken-for-granted assumptions determine how the members act, feel, think and perceive the company. These are unconscious beliefs that are considered natural, premises that govern the actions, behavior and reasons for the acts of the members of the company.

### Safety Culture (SC): concepts

The term Safety Culture (SC) emerged in the wake of the Chernobyl disaster in 1986, and has been used ever since by numerous industries to describe the 'security status' of a company (Flin, 2007). It is characterized by complexity, challenging content-wise, and has become one of the most popular safety concepts(Van Nunen*et al*., 2017;Fleming*et al*.,2018).

Most definitions of SC mention the way people think or behave in relation to shared values, attitudes, perceptions and beliefs with regard to safety and reflect a view whereby safety culture is something that characterizes a company, rather than something that it possesses (Cox& Cox, 1991; Hale, 2000; Fang *et al*., 2006).

Several researchers (Hofstede, 1991; Johnson & Scholes, 1999; Cooper, 2000; Guldenmund, 2010; Nielsen, 2014) have used the three-level model (Schein, 1992) to understand SC and explain the factors that influence it (Sorensen, 2002). Others have sought to clarify the relationship between SC and safety climate (Glendon& Stanton, 2000). They address how basic assumptions are manifested in beliefs and artifacts and observed behaviors and represent what is internalized by members of a company (Johnson & Scholes, 1999). They argue that basic assumptions are reflected in the policies, structures, monitoring systems and organizational management. They use the concepts of Social Cognitive Theory to explain SC (Cooper, 2000), creating equivalence for the three-level model (Schein, 1992).

Finally, two authors from this decade made great contributions towards aligning the three-level OC model (Schein, 1992) and SC: Guldenmund (2010) and Nielsen (2014). The artifact level is related to safety communiques, slogans and messages, documents, audit and accident reports, work procedures and dress codes with regard to safety equipment (Guldenmund, 2010). Visible artifacts are manifested in behavioral indicators, structural conditions and results of safety climate research, represented by the expectations and actions of supervisors (Nielsen, 2014).

Shared values can be identified in implicit messages from the leadership prioritizing safety over productivity and in the attitudes of employees regarding safe practices, shared responsibilities concerning risk prevention and safety communications (Guldenmund, 2010; Nielsen, 2014). Finally, basic assumptions are manifested in the shared beliefs of the members of the company concerning what is and what is not safe and acceptable risk behavior.

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Based on the models of Guldenmund (2010) and Nielsen (2014)

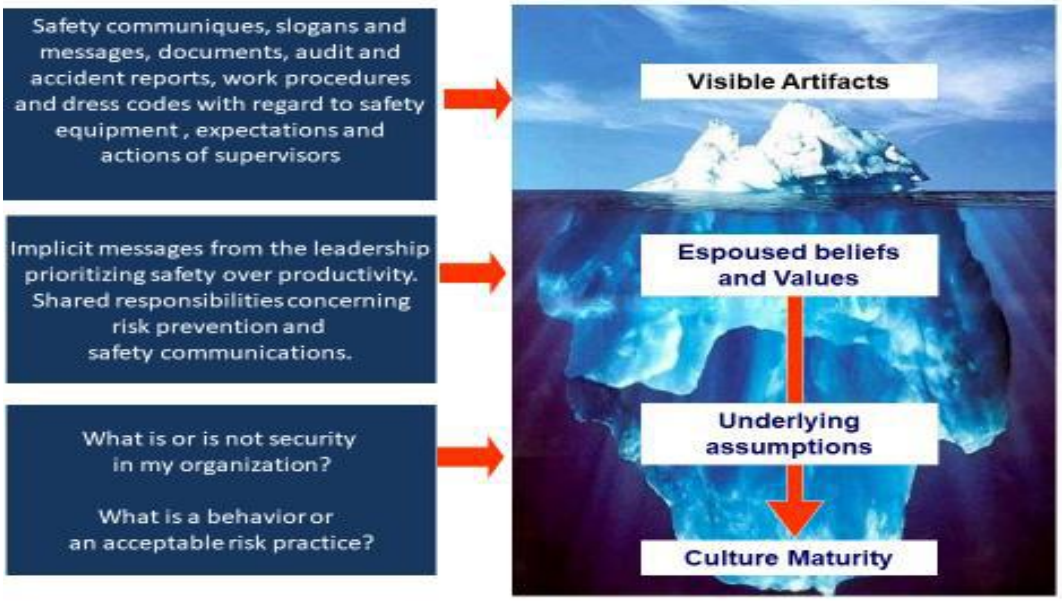


*Fig.1: OC model of Schein (1992) applied to SC*
**Source:** The authors

**Safety Culture (SC): measurement tools and maturity**

According to Fleming*et al*., (2018:3) *"Safety culture is a prevalent construct in industrial safety management and arguably one of the most important developments in industrial safety in recent history."*

Safety Culture (SC) studies have been conducted in different fields of knowledge, including organizational psychology (Wallace & Chen, 2006;Christian*et al*., 2009), risk management (Smith *et al*., 2006), people management (Wiegmann*et al*., 2004) and engineering (Varonen&Mattila, 2000). Furthermore, they have been conducted in different industrial sectors, such as manufacturing (Cooper & Finley, 2013; Zohar & Luria, 2003), construction (Biggs *et al*., 2010), health (Gaba*et al*., 2003), oil and gas (Mearns *et al*., 1998) and aviation (McDonald *et al*., 2000; Gibbons *et al*., 2006).

In those studies, we observed that the terms safety culture or climate are used at random. Some authors believe that there is no difference between the constructs (Guldenmund, 2000; Lee & Harrison, 2000), while others view safety climate as a sub-concept of safety culture (Zohar, 2000; Cooper, 2000; Glendon& Stanton, 2000; Neal *et al*., 2000).

Despite these conceptual differences, which will not be examined in-depth in this article, most authors use survey style techniques to identify and assess employees' perceptions regarding organizational issues, changing only the indicators, factors and variables that are evaluated considering that the core of the safety culture construct is about proactively managing safety (Cooper, 2016; Fleming *et al*., 2018).

In this sense, in Table 1 we list important tools for measuring SC that have been developed since the eighties.

*Table.1: SC Measurement Tools*

| Authors | SC Measurement Tools |
|---|---|
| Zohar (1980) | Multilevel Safety Climate Scale |
| Cox & Cox (1991) | Cox & Cox Questionnaire |
| Glendonet al. (1994) | Safety Climate Questionnaire |
| DuPont Sustainable Solutions (1995) | DuPont Safety Perception Survey-DuPont Bradley Curve |
| Diaz & Cabrera (1997) | Safety Climate Questionnaire |
| Reason (1997) | Safety Culture Model |
| Cooper (2000) | Reciprocal Safety Culture Model |
| Mearns et.al. (2001) | Offshore Safety Questionnaire |
| Singer et. al (2003) | Stanford Tool |

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|---|---|
| Carder & Ragan (2003) | Minnesota Safety Perception Survey |
| Silva et. al.(2004) | Organizational and Safety Climate Inventory |
| Health and Safety Executive HSE (2005) | Safety Culture Model |
| Fang et. al. (2006) | Safety Climate Questionnaire |
| Parker et.al.(2006) | Development Levels for Safety Culture Maturity |
| (TC)/Railway Association of Canada (RAC) (2007) | Safety Culture Model |
| Clark (2010) | Clarke's Model of Safety Culture |
| Chen & Li (2010) | Hospital Survey on Patient Safety Culture |
| Fleming &Scott (2013) | Safety Culture Model |
| Morrow et.al. (2014) | Safety Culture Model |
| El-nagar*et al*. (2015) | Safety Performance Index |

**Source:** The authors

The theoretical framework shows that Workplace Safety Culture (WSC) seeks to adapt the concepts of OC and SC to WSC practices (Lee *et al*., 2012).Most of the tools in Table 1 served as a basis for constructing instruments applied toWSC.

In the academic literature, several authors have sought to conduct studies of WSC measuring: (i) safety policies, strategies, and procedures designed to control the risks that may affect employees safety (Carder & Ragan, 2003), (ii) the existence of a written declaration reflecting the organization's commitment to safety (Mearns *et al*.,2003);(iii) the extent to which the firm encourages its workers to participate in activities relating to their safety (Vredenburgh,2002);(iv) the existence of training plans to develop employee competences and skills in safety(Grote &Künzler,2000); (v) the transfer of information to employees about the possible risks in the workplace and the correct way to combat them (Cox &Cheyne ,2000);(vi)the existence of procedures to evaluate the risks and establish the necessary safety measures for avoiding accidents and the existence of an organized plan in case of emergency(Wu *et al*., 2008); (vii)the extent to which the firm's managers are committed to their workers' safety (Rundmo& Hale,2003); (viii) the degree of workers' compliance with the safety procedures and the extent to which they participate in improving working conditions (Cox & Cox,1991);(ix) safety performance in terms of: number of personal injuries; material damage; employees' motivation; and absenteeism or lost time(DeJoy *et al*., 2004).

The lack of consensus in the definition of SC and the different priorities imposed by the organizations explain the difficulties of developing a unified model of measurement. (Fleming *et al*., 2018)Many safety theories and models coexist today, with different dimensions and factors of SC and WSC measuring.

Through a comprehensive literature review we identified several important safety performance indicators.

Most SC models have common factors and dimensions, but it is not possible to state that there is a correct model.It is imperative to select the model that best fits the sector or organization.There is a consensus that WS models must be multidimensional, but it is not specified exactly what dimensions these models should comprise. (Fleming &Wentzell, 2008).

In health care industries for example,Colla*et al*., (2005) identified in Patient SC(PSC) models five common dimensions: leadership, policies and procedures, staffing, communication, and reporting. Some PSC models include different dimensions such as learning, blame orientation(Cooper, 2000; Hofmann &Mark, 2006) and job satisfaction (Sexton *et al*., 2006).

Reviews by Flin*et al*. (2000) and Guldenmund (2000) covered in attitude questionnaires, identified that the number of dimensions varied from two to 19 range, focusing on five common dimensions: management, safety systems, risk, work pressure, and competence.

The human side of safety and the importance of human factors in accident causation is seen as a key factor to improve safety performance (Hale, 2000). Therefore, behavioral dimensions as leadership, commitment, teamwork, feedback, work pressure, learning, responsibility and communication were included in the majority of the WSC models.

Table 2 shows some recent SC models and their respective dimensions and factors:

*Table.2: SC Dimensions and factors*

| Authors | SC models: dimensions and factors |
|---|---|
| Aksorn&Hadikusumo(2008) | (a)worker involvement, (b)safety prevention and control system,(c) safety arrangement, and (d)management commitment. |
| Anderson (2009) | (a)managers' prioritization of safety, (b) safety communication, (c)individual risk |

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|---|---|
| | assessment,(d) supportive environment and (e) safety rules and procedures. |
| Chen & Li. (2010) | (a) Supervisor/manager expectations and actions promoting safety, (b) Organizational learning-continuous improvement, (c) Teamwork within units, (d) Communication openness,(e) Feedback and communication about error ,(f) Non punitive response to error ,(g) Staffing,(h) Hospital management support for patient safety,(i) Teamwork across hospital units ,(j) Hospital handoffs and transitions (k) Overall perceptions of safety (l) Frequency of event reporting. |
| Halligan &Zecevic (2011) | (a) leadership and commitment to safety, (b) open communication founded on trust, (c) organizational learning, (d) a non-punitive approach to adverse event reporting and analysis, (e) teamwork, and (f) shared belief in the importance of safety. |
| Ismail & Ismail (2012) | (a) leadership,(b)organizational commitment,(c) management commitment, (d)safety training and (e)resource allocation. |
| Fleming & Scott (2013) | (a) leadership, (b) safety integration, (c) accountability, (d) resiliency, and (e) learning and Safety values. |
| Cooper & Finley (2013) | (a)management/supervision, (b)safety systems, (c)risk, (d)work pressure, (e) competence, and (f) procedures/rules. |
| El-nagar*et al*. (2015) | (a) worker factors (employee risk-taking behavior and compliance to safety rules and procedures: beliefs, attitudes and perceptions of responsibility and control); workers' relationship with or the behavior toward fellow crew members, the supervisor, and the employing firm; (b) environmental factors (physical space, the working procedure, tools and methods used and resources available); (c) organizational factors (application of safety rules, safety education/training, commitment, the perception of formal and informal organizational policies, practices, and procedures , combination of reward and punishment; communication and feedback, employee's involvement and employee empowerment). |

Source: The authors

By embracing a behavior-based system, DuPont (DuPont, 2019) initiated a survey to determine why one plant site performs better than other. With the support of safety consulting professions DuPont develop the Safety Perception Survey (Stewart,1999) to evaluate employees' perceptions of their safety program.The survey consists of 24 multiple-choice questions that measure and organization's SC across three dimensions: leadership, structure, and processes and actions.The results from the survey are plotted on the DuPont Bradley Curve, a model with four maturity stages (reactive, dependent, independent and interdependent) to track the evolution of their SC (DuPont, 2019).

Fleming (2001) considered that the maturity model concept was appropriate to safety culture management within the offshore oil and gas industry and develop the Safety Culture Maturity Model (SCMM) to assist organizations in establishing their current level of safety culture maturity and identifying the actions required to improve their culture. According to the author:*"Cultural or behavioral approaches to safety improvement are at their most effective when the technical and systems aspects of safety are performing adequately and the majority of accidents appear to be due to behavioral or cultural factors*" (Fleming, 2001:4).

Cooper (2016) revised his famous Reciprocal Safety Culture Model (Cooper,2000) and claimedthat safety culture assessments would be much better served by combining the results of situational safety management system audits, behavioral sampling efforts and the results of safety climate surveys to produce an overall average score for a facility/organization. According to Cooper (2016):*"Safety Culture Maturity models could be used as a* de facto *measure of the safety culture product as they primarily focus on what organizations do"*(Cooper,2016:25).

## III. METHODOLOGY

In this third part, the methodology of the work, the **Workplace Safety Culture Model (WSCM)** is described and validated (face validity, semantic and Exploratory Factor Analysis). Its application at sixcompanies in the metallurgical sector is also described.

### Workplace Safety Culture Model (WSCM)

The proposedWorkplace Safety Culture Model (WSCM) is founded on recent studies of SC and WSC. Its theoretical premises are that: (i) WSC affects safety behavior; (ii) employee commitment and support from the leadership regarding safety issues affect safety outcomes; (iii) individual attitudes to safety influence safety

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behavior; (iv) perceptions of safety management systems influence safety behaviors; (v) the climate at work defines the directives for individual behavior; (vi) improvements in behavior and workplace safety are ambitious goals and mere training is probably not sufficient to induce significant effects; (vii) the organizational communication style and its frequency are important factors in the cognitive perception of employees; (viii) the introduction of improvements to internal safety indicators of companies changes their accident rates, improving performance in terms of safety; and (ix) the safety climate affects safety performance, with the knowledge and motivation of employees as mediators in this process.

The proposed WSCM has eleven dimensions (Learning, Feedback, Leadership, Management System, Communication, Commitment, Pressure at work, Responsibility, Infrastructure, Efficiency and Teamwork), as described in Table 3. They encompass the main aspects of WSC. The dimensions, indicators and variables used to compose the WSCM can be identified in the SC and WSC models in the organizational literature and are summarized in Table 3. Even so, the construct of the WSCM is completely original and guarantees the distinctiveness of the tool.

*Table.3: Concept of the WSCM Dimensions*

| Dimension | Concept |
|---|---|
| Learning | The ability of an organization to learn from its mistakes. Investigations of WS incidents and incidents should prioritize learning and process improvement, and avoid focusing on finding guilty. |
| Feedback | The results of the evaluations of the suggestions are communicated formally. A formal acknowledgment is made to the author of the suggestions chosen for implementation. The feedback should be of daily use. |
| Efficiency | Indicators, goals and results should be known to all. Managers continuously guide behavioral changes that impair WS. |
| Pressure at Work | Excessive demands for results that negatively affect WS practices. Limited time to comply with standard procedures. Lack of leadership support and hostile work environment. |
| Infrastructure | Assesses the availability of resources such as accessible and adequate installations, equipment, supplies and high quality training in workplace safety. |
| Management System | Aims to provide systems for the management of activities, policies and procedures to identify critical control points for the execution of WS practices, with regular and thorough inspections to gauge employees' compliance in their activities. Evaluates the level of standardization to avoid system. The balance between individual risk-aware and rule-compliant, to meet the need for concurrent standardization and flexibility required in organization. |
| Responsibility | Evaluates the role of the owner in care over WS. Emphasizes the importance of WS, taking disciplinary measures to maintain procedures. Promoting a vision of responsibility for each person in choosing safer practices. |
| Leadership | WS seen as a non-negotiable value. Leadership clearly defines organizational expectations. Their behaviors in WS actions are exemplary. It inspires confidence and is considered a model. |
| Teamwork | Assesses the degree of collaboration and mutual respect among employees to ensure WS. Initiatives and decisions that encourage cooperation between organizational areas for safer performance in practice. |
| Communication | Assesses the existence of a communication plan that aids the quality of the transfer of information and knowledge of WS between managers and employees. How, when and what to communicate regarding safety issues to employees. Employees are encouraged to speak freely about any subject that might affect WS. |
| Commitment | Assesses the use of positive (recognition) and negative (punishment) reinforcement tools for employees engaged in, and committed to, WS behaviors and improving WS outcomes.Pride in working safely. |

**Source:** The authors

To facilitate their operationalization, these dimensions were subdivided into indicators, with their respective variables, constituting a construct, bearing in mind that a construct is a tool that helps to measure a concept or a

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variable that cannot be measured directly (Fuchs, 2009). In turn, the indicators represent the indices that promote the understanding of the level of internalization of the value of WS in a company.

*Table.4: Dimensions, Indicators and Variables of the WSCMI*

| Dimension | Indicators | Variables | Authors |
|---|---|---|---|
| Learning | Learning | Accident investigations are used to identify flaws in WS systems, rather than guilty. | Jahn, (2016)Reason, (1998), Anderson (2005),Grote &Künzler (2000) |
| | Learning | The causes of accident occurrences are used to learn and improve WS systems. | |
| | Information | Employees receive information on the causes of accidents at work. | Cooper (2016), Chen & Li. (2010) |
| Feedback | Feedback | Managers give feedback to those involved when work-related accidents occur. | Cox & Jones, (2006), Burke&Signal (2010), El-nagar*et al*. (2015) |
| | Dialogue | Managers accept suggestions from employees to improve WS. | |
| | Enhancement | Good suggestions for improving WS are implemented. | |
| | Investigations | After the occurrence of accidentsappropriate recommendations are implemented. | |
| | Suggestions | Managers encourage employees to give suggestionsto improve WS practices. | |
| Efficiency | Metrics | Indicators are adequate to identify and measure WS nonconformities. | Carder & Ragan (2003), Vredenburgh (2002), Cooper & Finley (2013) |
| | Metrics | The indicators are known to employees. | |
| | KPIs Goals | The employees know the goals and the monthly results of the WS indicators. | |
| | Orientation | Managers guide when they observe behaviors harming WS. | |
| Work Pressure | Volume of activities | The charge for productivity does not interfere with WS rules and procedures. | Noroozi (2013) Singer *et al*. (2003); Mearns *et al*. (2001); Clarke (2010); Chen & Li (2010); Diaz & Cabrera (1997);Cooper & Finley (2013), Cooper (2016) |
| | Pressure at work | If there is pressure for results, this does not affect the employees' WS practices. | |
| | Pressure over deadlines | The time required to perform activities with WS is sufficient. | |
| | Dimensioning professionals | The number of employees is adequate to carry out activities with WS. | |
| Infrastructure | Orientation | Collaborators know the purpose of Personal Protective Equipment (PPE) before they start their work. | Grote &Künzler (2000), Singer *et al*.(2003); Fang*et al*. (2006); Clarke (2010); Silva *et al*.(2004); Chen& Li (2010) |
| | Processes | There is strict control over the use of PPE. | |
| | Training | Employees receive WS training at least every two years. | |
| | Equipment | Personal Protective Equipment (PPE) is always available to support the work. | |
| Management System | Management systems | Managers apply disciplinary measures when employees do not follow WS rules. | Glendon&Stanton (2000),Guo&Yiu (2015), Anderson (2005), Tzannatos&Kokotos (2009), Cooper & Finley (2013), Cooper (2016). |
| | Autonomy | Employees may refuse to continue work if they believe this may affect WS. | |
| | Reports | Employees consider it important to report a security error of a colleague. | |
| | Reports | The reported accidents are analyzed by the company. | |
| | Refuse | Collaborators have the autonomy to interrupt a work. | |
| Responsibility - lity | Recognition | Managers recognize when they observe work according to WS standards. | Anderson,(2005),Griffin & Neal (2000),Huang *et al*.(2006),Vredenburgh(20 |
| | Errors | Managers treat WS errors reported as a learning | |

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| | | opportunity. | 02),DeJoy*et al.*, (2004). |
| Leadership | Model<br>Trust<br>Orientation<br><br>Walk the talk<br>Recognition<br>Priority | Leaders are considered role models.<br>Leaders reinforce that WS is a non-negotiable value.<br>Leaders implement corrective actions immediately after learning that some unsecured practice has been performed.<br>Leaders are often seen in the operational areas.<br>Leaders recognize and celebrate the achievements in WS.<br>Leaders consider WS a priority. | Burke & Signal (2010),Wu *et al.*(2008), El-nagar*et al.* (2015),Cheyne*et al.*, (2002),Clarke (2013);O'Connor&Carlson , (2016). |
| Teamwork | Collaboration<br><br>Help<br><br>Proactivity<br><br>Trust | Employees assist colleagues in avoiding work-related accidents.<br>Managers encourage employees to help colleagues to avoid work-related accidents.<br>The managers act to solve problems that could harm WS.<br>Employees are alert to the safety of colleagues and interfere whenever necessary. | Grote & Künzler (2000), Guo & Yiu (2015), DeJoy*et al.* (2004), Chen & Li (2010). |
| Communi-cation | Quality<br><br>Content<br><br>Rules<br>Information<br><br>Communi-cation<br>DDS<br><br>Goals | Managers keep employees up-to-date on WS rules, procedures and practices.<br>Employees can talk freely with managers about issues that are affecting WS practices.<br>Information on WS rules and procedures is available.<br>Employees receive information on the causes of occupational accidents.<br>Internal communication (posters, banners, internet etc.) about WS is present in all areas.<br>Communication over WS is performed in the Daily Safety Dialogues (DDS).<br>The managers inform the collaborators the goals and indicators of WS. | Glendon*et al.*, (1994); Cox &Cheyne (2000); Glendon& Stanton (2000); Neal *et al.*(2000); Anderson (2009);Fleming (2001); Mearns *etal.*(2003); Rudmo& Hale(2003); Dejoy*et al.*(2004); Ek*et al.* (2007); Cooper (2016). |
| Commitment | Recognition<br><br>Learning<br><br>Security error<br>Report<br>Autonomy | Managers recognize when they observe work according to WS standards.<br>Managers treat WS errors reported as a learning opportunity.<br>Employees consider it important to report a security error of a colleague.<br>The reported accidents are analysed by the company.<br>Collaborators have the autonomy to interrupt a work. | Cox & Cheyne (2000); Rundmo& Hale (2003); Fleming (2001); Mearns*etal.*(2003); Ostrom (1993); Ismail*etal.*(2012); Aksorn&Hadikusumo, (2008), Carder & Ragan (2003). |

**Source:** Prepared by the authors

**Semantic Validation of the WSCM**

To validate the content of the dimensions, 265 employees participate of 26 workshops, and 36 interviews were conducted with participants from different hierarchical levels of six organizations in metallurgical sector. The workshops and individual interviews were intended to obtain real-life stories on WS that illustrated day-to-day work. After a brief reflection on the meaning of each of the eleven dimensions, during the workshops, each group, with ten participants, had 20 minutes to tell a story of something that strengthened the WS practices and behaviors at their company. In the case of the interviews, the script with the dimensions was presented a week beforehand for the interviewees to reflect on a real story that illustrated a WS practice or behavior related to each dimension.

Given the difficulties involved in aligning theory and practice for the two groups (individual interviews and workshop groups), we reformulated some variables that composed these dimensions so that the research instrument would portray everyday situations involving WS at the organizations, thus facilitating the participants' responses.

During the workshops, we also conducted a semantic assessment (pre-test) of the WSC, i.e., to ensure that the

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affirmatives proposed in the WSC were easy to understand and unambiguous.

Thus, we validated the level of objectivity of the tool and estimated the time required for its completion in conditions identical to those of the study. The analysis showed that the general evaluation of the dimensions of the WSC was reliable. However, it was necessary to calibrate some affirmatives to reduce the tendency towards automated responses.

**Face Validity of the WSC**

The purpose of Face Validity is to gauge the adequacy of the variables and the dimensions (constructs). To this end, the constructed variables were evaluated by specialists on the themes of the constructs to validate whether the variables had a correlation with the proposed dimensions (constructs) (Bagozzi*et al*.,1998).

For the acceptance of the Face Validity, an agreement of at least 80% between each specialist and the correlations serves as the decision criterion for the acceptance of the variables that theoretically refer to the presented dimensions (constructs). The number of specialists determined by some authors in the studies they conducted is at least six subjects (Bagozzi*et al*., 1998).

The specialists were invited to participate through the forwarding of a questionnaire containing the orientations necessary to correlate the variables and the constructs. The seven specialists are professors, consultants and researchers at a large university in Rio de Janeiro [Brazil], with a doctoral degree in the field of Organizations, Organizational Behavior and Human Resources, the focus of the themes in the constructs.

The results of the correlations varied between 82% and 89%,with a consensus in most of the constructs. The specialists also suggested adjustments to the texts of some variables. Following an evaluation by the authors, the suggested adjustments to the content were incorporated into the research instrument.

**Statistical Validation of the WSC: Exploratory Factor Analysis**

To validate the WSCM, the statistical procedure Exploratory Factor Analysis (EFA) was used to reduce the set of variables to a lower number of factors to characterize the attribute dimensions of the object in question (Hair Jr. *et al*., 1998).

EFA is based on the significance of the variability of data in order to identify common factors within a set of observable variables. When summarizing data, EFA captures the latent dimensions that represent the set of data in a lower number of concepts than the original individual variables (Hair Jr. *et al*., 1998). This statistical technique is considered adequate for interpreting perception in survey style research and for evaluating the validity of a construct or research tool (Williams *et al*., 2010).

To apply EFA, we followed the protocol established by Williams *et al*. (2010), as follows:

(i)Sample size: Hair Jr. *et al*. (1998) state that EFA should not be used in a sample with fewer than 100 units.

(ii)Ratio (N: p ratio): Hair Jr. *et al*. (1998) and Tinslay and Tinslay (1987) claim that in EFA at least five times the number of variables that will be analyzed should be used.

(iii)Factorability of the Correlation Matrix: To interpret the results of the Factor Analysis, the significance of the factor loadings is defined, with loadings between 0.30 and 0.40 with low practical significance. Higher than 0.40, they have some significance. Loadings higher than 0.50 are considered to have practical significance (Hair Jr. *et al*., 1998).

(iv)KMO: The Kaiser-Meyer-Olkin Sample Adequacy Measure (KMO) is a statistical test that compares the magnitudes of the correlation coefficients observed with the magnitudes of the coefficients of partial correlation, suggesting the proportion of variance of the items that may be explained by a latent variable (Lorenzo-Seva, Timmerman & Kiers, 2011). For the interpretation of the KMO index, values smaller than 0.5 are considered unacceptable. values between 0.5 and 0.7 are considered mediocre; values between 0.7 and 0.8 are considered good; values greater than 0.8 are considered optimal(Hutcheson & Sofroniou, 1999).

(v)Bartlett's Test: Bartlett's Test of Sphericity tests whether the correlation matrix is an identity matrix (each variable is perfectly correlated with itself (r=1), but does not show a correlation with the other variables (r=0).The test also evaluates the overall significance of all correlations in a data matrix (Hair Jr. *et al*., 1998).

Bartlett's Test Values with $p < 0.05$ indicate that the matrix is factorable (Tabachnick & Fidell, 2007), rejecting the null hypothesis that the data matrix is similar to a matrix-identity.

(vi) Factor Extraction: The aim of the rotation is to simplify the factor structure of a group of items, i.e., high loads of items in a factor and lower loads of items in the solutions of the remaining factors.

(vii)For this study, Principal Component Analysis was applied, because they provide the best results when the samples present non-normal distribution (Costello & Osborne, 2005; Fabriga*et al*., 1999).

(viii)Accumulated Percentage of Variance: According to Hair Jr. *et al*. (1998), variance explained is commonly as low as 50-60%.

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(ix)Eigenvalue: Represents total variance explained for each factor. Studies recommend an eigenvalue higher than one (Williams *et al*., 2010).

(x)Rotation Test: Rotation maximizes the high loads of items and minimizes low loads of items, thus producing a more interpretable and simplified solution. Considering the possible existence of correlation between the variables of the model, the oblique rotation was used, since it does not delimit the interaction between the factors. If the factors are not correlated, the results obtained by oblique rotation will be similar to those obtained by orthogonal rotations(Fabriga*et al*., 1999; Sass & Schmitt, 2010).The promax method was used to present results in line with the proposed model.

Finally, to measure the reliability of the proposed measurement, Cronbach's Alpha Coefficient is recommended as a consistent indicator to analyze the reliability of a scale (Hair Jr. *et al*., 1998; Sijtsma, 2009). Although there is no absolute value, Cronbach's Alpha values equal to or higher than 0.70 reflect an acceptable level of reliability (Hair Jr. *et al*., 1998).

To analyze the collected data and apply the aforementioned statistical techniques, the SPSS 20.0 statistical package was used.

**Survey, Sample and Data Collection**

For the survey, the entire workforce of the six factories was invited to participate. A total of 1196 (57% response rate) completed questionnaires were collected at the six factories (Table 5). These responses came from all the areas of the companies. The sub-sectors of the factories are: metallurgy, machinery and equipment, electronics and naval.

The sample is predominantly made up of professionals who have been with the company for up to ten years (75%), are between 26 and 45 years old (72%), are male (84%), have an education level up to Middle School (82%). This profile portrays Metallurgical companies (Dieese, 2011) and enables WSC to be researched as perceived by employees.

The questionnaire was applied to the WSC sample in person. The sample was chosen at random and composed of employees from different levels of the operational area of six factories in the metallurgical sector, located in Brazil. The sample selection followed the study of Fey & Denison (2003), as it demonstrated that respondents from different areas and levels of the organization tend to evaluate the organizational structure in a way similar to the leadership.

To collect the data at the companies, a survey of perceptions was conducted with the aid of a predominantly structured questionnaire based on the constructs and indicators of the WSC. The data were collected from groups of up to 50 people per hour, who were invited to the auditorium of each factory by the researchers. Participants were invited by the Human Resources areas of each company to go to the factory auditoriums, where they were instructed to complete the questionnaire which, after being completed, was placed without identification in a closed urn to guarantee total confidentiality.The questionnaire was made up of 37 questions to be answered using a seven-point Likert scale (1 = I totally disagree to 7 = I totally agree), prepared based on the eleven dimensions and their respective indicators, as shown in Table 5.

*Table.5: Sample Profile*

| Class | N | n | % |
|---|---|---|---|
| **Company** | | | |
| • **1** | 835 | 209 | 25% |
| • **2** | 975 | 273 | 28% |
| • **3** | 365 | 175 | 48% |
| • **4** | 468 | 183 | 39% |
| • **5** | 758 | 164 | 22% |
| • **6** | 670 | 192 | 29% |
| **Time with the Company** | | | |
| • **Less than 1 year** | | 296 | 25% |
| • **1-5 years** | | 365 | 30% |
| • **6- 10 years** | | 240 | 20% |
| • **11-15 years** | | 105 | 9% |
| • **16-20 years** | | 121 | 10% |
| • **Over 20 years** | | 69 | 6% |
| **Employee Age** | | | |
| • **20-25 years** | | 169 | 14% |
| • **26-35 years** | | 506 | 42% |
| • **36-45 years** | | 356 | 30% |
| • **46-55 years** | | 140 | 12% |
| • **Over 55 years** | | 25 | 2% |
| **Gender** | | | |
| • **Female** | | 194 | 16% |
| • **Male** | | 1002 | 84% |
| **Schooling** | | | |
| • **Elementary School** | | 300 | 25% |
| • **Middle School** | | 681 | 57% |
| • **High school** | | 165 | 14% |
| • **University** | | 47 | 4% |
| • **Postgraduate** | | 3 | 0% |

**Source:** Prepared by the authors

## IV. RESULTS AND DISCUSSION

The Exploratory Factor Analysis began by verifying the adequacy of the sample for the technique. The result of

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the Anti-Image Correlation Matrix showed that 95% of the correlation of coefficients had anMSA higher than 0.500, indicating that the inter-correlations of the37 variables were strong, based on the Measure of Sampling Adequacy. The most conclusive tests, KMO (0.910) and Bartlett's Test ofSphericity($\chi$2= 15539,24, sig.<0.000), confirmed the satisfactory use of the technique in accordance with Hair Jr. *et al*. (1998). These results made it possible to proceed with the data treatment and the use of EFA to summarize the variables and identify the latent dimensions.

The results of the EFA produced a factor structure with relatively higher loads on the appropriate factors. The variables loaded strongly on one factor, demonstrating that there is no overlap between the factors and that all the factors were structured independently. The highest loadings signaled the correlations of the variables with the factors in which they were loaded.

The criterion for the extraction of factors was Eigenvalue > 1, extracted using the Principal Component Analysis technique and oblique rotation using the Promax method.

In the initial theoretical and empirical model, it was assumed that the WSC was explained with eleven dimensions (communication, commitment, infrastructure, pressure at work, feedback, learning, management system, leadership, efficiency, teamwork and responsibility).

The EFA reduced the 53 variables to 37 variables, distributed in 10 factors named: "Leadership" (Factor 1); "Feedback" (Factor 2); "Infrastructure" (Factor 3); "Efficiency" (Factor 4); "Communication" (Factor 5); "Pressure at work" (Factor 6); "Learning" (Factor 7); Teamwork (Factor8); "Management System" (Factor 9); e "Commitment" (Factor 10).

All the variables presented communalities between 0.447 and 0.791, showing that at least 61.084% of the variables were explained by the factors.

The internal consistency of the factors was evaluated by Cronbach's alpha. Measuring the internal consistency is a necessary stage for evaluating both the factors and the questionnaire and knowing whether they are reliable and have the capacity to measure what is proposed. Hair Jr. et al. (1998) highlighted that an alpha higher than 0.600 on a scale of 0.000 to 1.000 is considered satisfactory for exploratory studies. In this study, the Cronbach's alpha values varied between 0.700and 0.844 (Table 6). These results have satisfactory internal consistency.

*Table.6: Denomination of the factors, eigenvalues, variance explained and Cronbach's Alpha*

| | **Denomination of the factor** | **Number variables** | **eigenvalues** | **Variance Explained** | **Cronbach's Alpha** |
|---|---|---|---|---|---|
| Factor 1 | Leadership | 5 | 3.355 | 9.067 | 0.801 |
| Factor 2 | Feedback | 4 | 2.664 | 7.201 | 0.760 |
| Factor 3 | Infrastructure | 4 | 2.574 | 6.958 | 0.776 |
| Factor 4 | Efficiency | 4 | 2.449 | 6.620 | 0.761 |
| Factor 5 | Communication | 5 | 2.309 | 6.240 | 0.804 |
| Factor 6 | Pressure at Work | 4 | 2.139 | 5.782 | 0.700 |
| Factor 7 | Learning | 3 | 2.017 | 5.452 | 0.825 |
| Factor 8 | Teamwork | 4 | 1.961 | 5.301 | 0.713 |
| Factor 9 | Management System | 2 | 1.664 | 4.497 | 0.701 |
| Factor 10 | Commitment | 2 | 1.468 | 3.968 | 0.702 |
| Total | | 37 | 22.601 | 61.084 | 0.903 |

**Source:** Prepared by the authors

The first factor, "Leadership" explained 9.067% of the variance (Table 6) and showed the importance of the role of the leadership in strengthening WSC and applying practices focused on WS (Table 7). El-nagar*et al*.(2015)point to the fundamental importance of safety leadership in every day operations, ensuring safety before profit and developing safety competencies. Effective safety leadership at all levels of the organization should be manifest in managerial behaviors and actions (Cheyne*et al*., 2002).

According to WS research (Burke & Signal , 2010; Wu et al. ,2008), when the leadership is not considered a model in the practice of safety, or it is not open to hearing and accepting suggestions from employees to ensure WS, behaviors are not internalized. The employees perform these tasks most of the time because they must, not because it is what they want. Leadership plays a fundamental role in developing an honest and trusting WS vision, taking a proactive approach to safety with clear goals and shared purposes, and explaining the "whys" of desired behaviors (O'Connor & Carlson, 2016).

The second factor, "Feedback" explained 9.067% of the variance (Table 6) and showed the way the organization deals with the information, how the organization analyses the accidents and near misses at the workplace, as well as if the organization keeps the employees informed about

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these events (Table 7). Provide a proper feedback, encourage employees to make suggestions to improve WS and act on deviations reported is very important to internalize WSC (Cox & Jones, 2006).

The third factor, "Infrastructure" explained 6.95% of the variance (Table 6) and assesses the availability of resources such as accessible and adequate installations, equipment, supplies and high quality training in workplace safety (Table 7). The infrastructure dimension was identified by a number of authors (Grote &Künzler,2000; Singer *et al.* ,2003; Fang *et al.*,2006; Clarke, 2010; Chen & Li, 2010) as relevant and, therefore, it was included in the WSCMI model.

The fourth factor, "Efficiency" explained 6.62% of the variance (Table 6) and describes the indicators the organization has in order to improve the performance of safety at the workplace and the guidance to employees, when their behavior is harming or can jeopardize WS (Table 7). As we can confirm in literature review, the WS indicators are important elements to reinforce desired behavior (Carder & Ragan, 2003; Vredenburgh, 2002; Cooper & Finley, 2013).

The fifth factor, "Communication" explained 6.24% of the variance (Table 6) and assesses the existence of a communication plan that aids the quality of the transfer of information and knowledge of WS between managers and employees (Table 7). Leadership and managers should provide adequate information about the causes of accidents, incidents and deviations occurred. Only with a transparent communication and an open dialogue it would be possible to reinforce shared values and practices. (Rudmo& Hale, 2003; Dejoy*et al.*,2004; Ek*et al.*,2007; Cooper, 2016).

The sixth factor, "Pressure at work" explained 5.78% of the variance (Table 6) and represents excessive demands for results that negatively affect WS practices (Table 7). In immature WSC, there are many activities and considerable pressure for results, no concern over what happens and demands for productivity are given priority (Noroozi, 2013; Cooper & Finley, 2013).

The seventh factor, "Learning" explained 5.45% of the variance (Table 6) and captured if the indicators and investigations of WS accidents and incidents are used primarily for and improving processes (Table 7). Accident investigations should be used to identify flaws in WS systems, and learning from the causes of accident occurrences will prevent incidents. (Anderson 2005).

The eighth factor, "Teamwork" explained 5.30% of the variance (Table 6) and assesses the degree of collaboration and mutual respect among employees to ensure WS (Table 7). Collaboration, cooperative behavior, trust and mutual respect between employees are fundamental for guaranteeing WS. Managers should encourage employees to help colleagues and employees should assist colleagues to avoid work-related accidents. (Grote &Künzler, 2000; Guo&Yiu, 2015).

The ninth factor, "Management System" explained 4.50% of the variance (Table 6) and evaluates the management of activities, policies and procedures to identify critical control points for the execution of WS practices (Table 7). When a formal safety management system is installed, safety performance tends to improve. (Tzannatos&Kokotos,2009; Cooper & Finley, 2013; Cooper, 2016).

The tenth factor, "Commitment" explained 7.60% of the variance (Table 6) and describes the support given by the organization as far as Safety is concerned (Table 7). Aksorn & Hadikusumo (2008) evaluated the effectiveness of SC programs in the Thai construction sector and revealed that management commitment and safety management system practices were very important in reducing the number of unsafe conditions. Employees need to be actively and voluntarily engaged in SC process to ensure all unsafe behaviors were reported (Ismail *et al.*, 2012). The literature review highlighted that the commitment is reflected in many wayson "good safety culture" (Ismail *et al.*, 2012; Ostrom, 1993; Carder & Ragan, 2003).

Finally, one dimension did not have any variables with sufficient factor loading: "Responsibility". As the content of the variable of these dimension is not present in the other variables, its non-loading represents a reduction in the original model. Some authors included the responsibility dimension in the risk perception dimension (O'Connor & Carlson, 2016) and others may not have identified variables related to responsibility and for this reason did not include these indicators in their studies.

*Table.7: Loadings and Communalities*

| | **Factor 1 Leadership** | **Factor Load** | **h2** |
|---|---|---|---|
| V1 | Leaders are often seen in the operational areas. | 0.760 | 0.699 |
| V2 | Leaders are considered role models. | 0.720 | 0.616 |
| V3 | Leaders implement corrective actions immediately after learning that some unsecured practice has been performed. | 0.701 | 0.560 |
| V4 | Leaders recognize and celebrate the achievements in WS. | 0.686 | 0.637 |
| V5 | Leaders consider WS a priority. | 0.658 | 0.607 |

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| | | | |
|---|---|---|---|
| NL | Leaders reinforce that WS is a non-negotiable value | Not load | |
| | **Factor 2 Feedback** | **Factor Load** | **h2** |
| V6 | Managers accept suggestions from employees to improve WS. | 0.692 | 0.609 |
| V7 | Managers give feedback to those involved when work-related accidents occur. | 0.682 | 0.608 |
| V8 | Good suggestions for improvement WS are implemented. | 0.668 | 0.560 |
| V9 | Managers encourage employees to make suggestions to improve WS practices. | 0.580 | 0.571 |
| NL | After the occurrence of accidents appropriate recommendations implemented. | Not load | |
| | **Factor 3 Infrastructure** | **Factor Load** | **h2** |
| V10 | Personal Protective Equipment (PPE) is always available to support the work. | 0.733 | 0.582 |
| V11 | Collaborators know the purpose of Personal Protective Equipment (PPE) before they start their work. | 0.728 | 0.584 |
| V12 | There is strict control over the use of PPE. | 0.633 | 0.639 |
| V13 | Employees receive WS training at least every two years. | 0.562 | 0.587 |
| | **Factor 4 Efficiency** | **Factor Load** | **h2** |
| V14 | Employees know the indicators. | 0.705 | 0.645 |
| V15 | Indicators are adequate to identify and measure WS nonconformities | 0.703 | 0.663 |
| V16 | The employees know the goals and the monthly results of the WS indicators. | 0.661 | 0.636 |
| V17 | Managers guide when they observe behaviors harming WS | 0.368 | 0.580 |
| | **Factor 5 Communication** | **Factor Load** | **h2** |
| V18 | Information on WS rules and procedures is available. | 0.656 | 0.639 |
| V19 | Managers keep employees up-to-date on WS rules, procedures and practices. | 0.635 | 0.643 |
| V20 | The managers inform the collaborators the goals and indicators of WS. | 0.626 | 0.679 |
| V21 | Internal communication (posters, banners, internet etc.) about WS is present in all areas. | 0.560 | 0.495 |
| V22 | Communication over WS is performed in the Daily Safety Dialogues (DDS). | 0.537 | 0.529 |
| NL | Employees can talk freely with managers about issues that are affecting WS practices. | Not load | |
| NL | Employees receive information on the causes of occupational accidents. | Not load | |
| | **Factor 6 Work Pressure** | **Factor Load** | **h2** |
| V23 | The time required to perform activities with WS is sufficient. | 0.722 | 0.582 |
| V24 | The number of employees is adequate to carry out activities with WS. | 0.701 | 0.584 |
| V25 | The charge for productivity does not interfere with WS rules and procedures. | 0.684 | 0.639 |
| V26 | If there is pressure for results, this does not affect the employees' WS practices. | 0.500 | 0.587 |
| | **Factor 7 Learning** | **Factor Load** | **h2** |
| V27 | Accident investigations are used to identify flaws in WS systems, rather than guilty. | 0.723 | 0.665 |
| V28 | The causes of accident occurrences are used to learn and improve WS systems. | 0.719 | 0.647 |
| V29 | Employees receive information on the causes of accidents at work. | 0.498 | 0.537 |
| | **Factor 8 Teamwork** | **Factor Load** | **h2** |
| V30 | Managers encourage employees to help colleagues to avoid work-related accidents. | 0.754 | 0.670 |
| V31 | The managers act to solve problems that could harm WS. | 0.703 | 0.684 |
| V32 | Employees assist colleagues in avoiding work-related accidents. | 0.605 | 0.657 |
| V33 | Employees are alert to the safety of colleagues and interfere whenever necessary. | 0.383 | 0.508 |
| | **Factor 9 Management System** | **Factor Load** | **h2** |
| V34 | Employees may refuse to continue work if they believe this may affect WS. | 0.882 | 0.791 |
| V35 | Managers apply disciplinary measures when employees do not follow WS rules. | 0.863 | 0.769 |
| NL | Collaborators have the autonomy to interrupt a work. | Not load | |
| NL | Employees consider it important to report a security error of a colleague. | Not load | |

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| | | | |
|---|---|---|---|
| | The company analyzes the reported accidents. | | |
| | **Factor 10 Commitment** | **Factor Load** | **h2** |
| V36 | Managers recognize when they observe work according to WS standards. | 0.713 | 0.579 |
| V37 | Managers treat WS errors reported as a learning opportunity. | 0.665 | 0.592 |
| NL | Employees consider it important to report a security error of a colleague. | Not load | |
| NL | The reported accidents are analysed by the company. | Not load | |
| NL | Collaborators have the autonomy to interrupt a work. | Not load | |

**Source:** Prepared by the authors

As one of the main goals of this study was to test the WSCM to evaluate WSC, the results showed that there is a divergence between the proposed model and the model resulting from the EFA. However, the variables that loaded in the factors indicate that there was total convergence with the face validity and the WSCM. This shows that the original WSCM was developed with stable and valid measures of WSC.

## V. LIMITATIONS OF THE STUDY

There is a clear need for reliability in the sample used, despite the results of the Bartlett and KMO tests. One limitation of the study may be related to the influence of the differences in organizational culture of the companies in question (as they are located in regional contexts with different traits of the national culture) on the results (Hofstede, 1991). Only further studies can determine the conclusive stability of the WSCM, bearing in mind the academic support of diverse authors regarding the importance of certain dimensions, such as Leadership and Commitment. For future studies and research, it is important to consider samples diversified by region in multicultural countries with large geographic dimensions.

## VI. CONCLUSION

The WSCM model meets the basic requisites of a valid measurement of WSC. It has been shown to have good reliability and convergent validity in that it correlates with tools intended to measure indicators and variables that concentrate on similar subjects, all related to WSC.

This study shows that the WSCM is an important instrument in advancing the measurement of WSC in companies in the metallurgical sector. The theoretical premises of its dimensions, indicators and variables that influence WSC provide robust support for the identification of the WSCM.

The results point to ten factors that explain 63.884% of the data variance: Leadership, Commitment, Pressure at Work, Infrastructure, Learning, Efficiency, Management System, Feedback, Responsibility, Communication.On the other hand, the statistical analyses did not support the variance of one factor identified in the literature: Responsibility.The fact that the loadings occurred with ten of the eleven selected dimensions indicates that the WSCM is very robust. However, it requires further testing for its generalization, with a larger and more diverse samples to minimize possible bias resulting from different organizational cultures and subcultures.

Thus, the proposed WSCM needs to be applied to a larger and more diverse sample of companies in different sectors, with the introduction of elements of segmentation, such as number of employees, gross revenues and geographic locations to increase the legitimacy of the tool.

Finally, the result of the application of the WSCM aids the development of intervention projects intended to align a company's WSC with the behavior expected from employees. The application of the WSCM leads to benefits for companies that have become aware of the importance of WSC, as it enables them to identify the degree of internalization of their WS practices, which effectively sustain a company's WSC.

The future research with a larger sample of companies, will pave the way for the WSCM to be valid and reliable in establishing with precision the level of WSC maturity in each organization.

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