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OOD SAFETY CULTURE MATURITY INDEX [FSCMI]: PRESENTATION AND VALIDATION

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Objective: The literature on Food Safety Culture (FSC) has evolved in the conceptual dimension, but remains incipient regarding the creation of measurement instruments and quantitative evaluation. To fill this gap, this article presents a model that identifies the Food Safety Culture Maturity Index (FSCMI) and validates this instrument.

Methodology: The proposed model of the Food Safety Culture Maturity Index (FSCMI) has nine dimensions that encompass the main constructs of the FSC. For the semantic validation of the model, 15 workshops and 30 interviews were conducted, and to validate the model, research was conducted with participants from two companies in the Food and Beverage sector. For the face validity, specialists were invited to evaluate the consistency of the constructs. The statistical procedure of exploratory factorial analysis (EFA) was used to reduce the set of variables to a smaller number of factors in order to characterize the attribute dimensions of the evaluated object.

Originality: The importance of FSC is based on the organizational literature that identifies the limitations of technical approaches in the production of safety food. A mature culture that clearly translates the meaning of security value favors the understanding of the rules of the game and the internalization of expected behaviors, reducing the need for control and supervision. In addition, a validated FSC evaluation model is presented.

Main results: The results of the face validity correlations varied between 79% and 84%, and presented a consensus in most of the constructs. Cronbach's alpha values ranged from 0.695 to 0.844, showing satisfactory internal consistency. The results point to seven factors that explain 70.61% of the data variance: Leadership, Risk Perception, Management System, Communication, Commitment, Pressure at Work and Teamwork. On the other hand, the statistical analyses did not support the variance of two factors identified in the literature: Infrastructure and Responsibility. The instrument was found to be valid, robust and relevant for the advancement of FS analysis and for the FSC measurement of an organization. However, new tests are required for its generalization, with a seven-point interval scale that captures all the variability of the participants' perceptions of the study, and larger and more diverse samples that minimize possible bias due to differences in organizational cultures and subcultures.

Theoretical Contributions:

The theoretical foundation of the FSCMI, based on its dimensions, indicators and variables, offers us a robust tool to analyze an organization's FSC maturity. For the methodological improvement of the model, we suggest changing the FSCMI to a seven-point scale and future research with stratified samples that allow the evaluation of diverse cultural contexts.

Keywords: Organizational culture. Safety culture. Food safety culture. Maturity in food safety culture.

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ÍNDICE DE MATURIDADE DA CULTURA DE SEGURANÇA DE ALIMENTOS [IMCSA]: APRESENTAÇÃO E VALIDAÇÃO

Objetivo do Trabalho: A literatura sobre Cultura de Segurança de Alimentos (CSA) tem evoluído na dimensão conceitual, mas ainda é incipiente no que diz respeito a criação de instrumentos de mensuração e avaliação quantitativa. Para preencher esta lacuna, este artigo apresenta um modelo que apresenta o Índice de Maturidade da Cultura de Segurança de Alimentos (IMCSA), e faz uma validação do instrumento.

Metodologia: O modelo proposto do Índice de Maturidade da Cultura de Segurança de Alimentos (IMCSA) possui nove dimensões que englobam os principais construtos da CSA. Para a validação semântica do modelo foram realizados 15 *workshops* e 30 entrevistas; e para a validação do modelo foi realizada uma pesquisa com participantes de duas empresas do setor de Alimentos & Bebidas. Para a validação de face, foram convidados especialistas que avaliaram a consistência dos construtos. Foi utilizado o procedimento estatístico de análise fatorial exploratória (AFE) com o intuito de reduzir o conjunto de variáveis a um número menor de fatores, para caracterizar as dimensões de atributo do objeto avaliado.

Originalidade: A importância da CSA se fundamenta na literatura organizacional que identifica as limitações das abordagens técnicas na produção de alimentos seguros. Uma cultura madura que traduz claramente o significado do valor segurança, favorece o entendimento das regras do jogo e a internalização de comportamentos esperados, diminuindo as necessidades de controle e supervisão. Além disso, se apresenta um modelo de avaliação da CSA validado.

Principais Resultados: Os resultados das correlações da validação de face variaram entre 79% e 84%, tendo apresentado consenso na maioria dos construtos. Os valores de Alfa de Cronbach variaram entre 0,695 e 0,844, evidenciando consistência interna satisfatória. Os resultados apontam para sete fatores que explicam 70,61% da variância dos dados: Liderança, Percepção de Risco, Sistema Gerencial, Comunicação, Comprometimento, Pressão no Trabalho e Trabalho em Equipe. Por outro lado, as análises estatísticas não suportaram a variância de dois fatores identificados na literatura: Infraestrutura e Responsabilidade. Constatou-se que o instrumento é válido, robusto e relevante para o avanço da análise da SA e para a mensuração CSA de uma organização; mas que demanda novos testes para sua generalização, com uma escala intervalar de sete pontos que capte toda a variabilidade de percepções dos participantes da pesquisa, e amostras maiores e mais diversificadas que minimizem os possíveis vieses decorrentes das diferenças das culturas organizacionais e subculturas.

Contribuições Teóricas: A fundamentação teórica do IMCSA que embasou suas dimensões, indicadores e variáveis, nos oferece uma ferramenta robusta para a análise da maturidade da CSA de uma organização. Para aprimoramento metodológico do modelo sugerimos: a mudança do IMCSA para uma escala de sete pontos e pesquisas futuras com amostras estratificadas que permitam avaliar contextos culturais diversificados.

Palavras-chave: Cultura Organizacional. Cultura de Segurança. Cultura de Segurança de Alimentos. Maturidade em Segurança de Alimentos.

ÍNDICE DE MADUREZ DE LA CULTURA DE SEGURIDAD DE ALIMENTOS [IMCSA]: PRESENTACIÓN Y VALIDACIÓN

Objetivo del trabajo: La literatura sobre Cultura de Seguridad de Alimentos (CSA) ha evolucionado en la dimensión conceptual, pero aún es incipiente en lo que se refiere a la creación de instrumentos de medición y evaluación cuantitativa. Para rellenar esta laguna, este artículo presenta un modelo que identifica el Índice de Maturidad de la Cultura de Seguridad de Alimentos (IMCSA), y hace una validación de este instrumento.

Metodología: El modelo propuesto del Índice de Madurez de la Cultura de Seguridad de Alimentos (IMCSA) tiene nueve dimensiones que engloban los principales constructos de la CSA. Para la validación semántica del modelo se realizaron 15 talleres y 30 entrevistas; y para la validación del modelo se realizó una encuesta con participantes de dos empresas del sector de Alimentos y Bebidas. Para la validación de cara, fueron invitados especialistas que evaluaron la consistencia de los constructos. Se utilizó el procedimiento estadístico de análisis

factorial exploratorio (AFE) con el fin de reducir el conjunto de variables a un número menor de factores, para caracterizar las dimensiones de atributo del objeto evaluado.

Originalidad: La importancia exponencial del CSA se basa en la literatura organizacional que identifica las limitaciones de los enfoques técnicos en la producción de alimentos seguros. Una cultura madura que traduce claramente el significado de valor de seguridad, favorece la comprensión de las reglas del juego y la internalización de los comportamientos esperados, reduciendo la necesidad de control y supervisión. Además, se presenta un modelo de evaluación de la CSA validado.

Principales resultados: Los resultados de las correlaciones de la validación de cara variaron entre el 79% y el 84%, habiendo presentado consenso en la mayoría de los constructos. Los valores de Alfa de Cronbach variaron entre 0,695 y 0,844, evidenciando consistencia interna satisfactoria. Los resultados apuntan a siete factores que explican el 70,61% de la varianza de los datos: Liderazgo, Percepción de Riesgo, Sistema Gerencial, Comunicación, Compromiso, Presión en el Trabajo y Trabajo en equipo. Por otro lado, los análisis estadísticos no soportaron la varianza de dos factores identificados en la literatura: Infraestructura y Responsabilidad. Se constató que el instrumento es válido, robusto y relevante para el avance del análisis de la SA y para la medición CSA de una organización; pero que demanda nuevas pruebas para su generalización, con una escala de siete puntos que capte toda la variabilidad de percepciones de los participantes de la investigación, y muestras más grandes y más diversificadas que minimicen los posibles sesgos resultantes de las diferencias de las culturas organizacionales y subculturas.

Contribuciones teóricas: La fundamentación teórica del IMCSA que basó sus dimensiones, indicadores y variables, nos ofrece una herramienta robusta para el análisis de la madurez de la CSA de una organización. Para el perfeccionamiento metodológico del modelo sugerimos: el cambio del IMCSA a una escala de siete puntos e investigaciones futuras con muestras estratificadas que permitan evaluar contextos culturales diversificados.

Palabras-claves: Cultura Organizacional. Cultura de Seguridad. Cultura de Seguridad de Alimentos. Madurez En Seguridad de Alimentos.

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; Ball *et al.*, 2010; Brannon *et al.*, 2009).

These two SC approaches are reflected in studies on Food Safety (FS), in which we identified parallel managerial practices that hinder the integration of Food Science and Behavioral Sciences (Yiannas, 2009).

In this sense, in the last two decades, some researchers have found that FS problems are often not only associated with technical issues (Sneed & Henroid, 2007; Sneed *et al.*, 2004; Taylor, 2011). Studies have demonstrated that even employees with technical knowledge of FS 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 (Arendt & Sneed, 2008; Griffith *et al.*, 2010; Abidin *et al.*, 2014; Yiannas, 2009; Arendt *et al.*, 2011; Ellis *et al.*, 2010; 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 FSC (Jespersen, 2017; Griffith *et al.*, 2010; Taylor, 2011; Yiannas, 2009). As stated at the Global Food Safety Conference in 2017, “Food safety culture is not just about changing behavior - it’s about sustaining it. To sustain behavioral change, indicators, metrics, consequences and accountability must be built into food safety systems” (Global Food Safety Conference, Executive Summary, 2017, p. 17).

To bridge this gap, this article proposes a quantitative instrument to measure Food safety Culture (FSC), the Food Safety Culture Maturity Index (FSCMI). 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 two factories in the Food and Beverage sector located in the north and south of Brazil.

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), Food Safety (FS) and Food Safety Culture (FSC). In the third part, the methodology of the work is presented, describing the FSCMI, its validation and application at the two factories in question. In the fourth part, the results of the empirical research are presented and analyzed. In the fifth section, the limitations of the FSCMI are discussed. In the last section, the final considerations regarding the benefits of applying the FSCMI to companies in the food and beverage sector are given, along with suggestions for future research in the field.

Theoretical Framework

Organizational Culture (OC)

In the history of the concept of organizational culture (OC), three distinct periods can be identified (Barbosa, 2010).

1. In the nineteen 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.

2. In the nineteen 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. In the nineteen eighties, 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.

3. In the mid nineteen nineties, OC came to be understood and studied as an intangible asset of firms and was associated with the role of leadership (Schein, 1992). 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” (Schein, 1992, p. 13).

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 (CS)

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). 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 (Furnham & Gunter, 1993; Johnson & Scholes, 1999). They argue that basic assumptions are reflected in the policies, structures, monitoring systems and organizational management (Thompson & Luthans, 1990). They use the concepts of Social Cognitive Theory to explain SC (Cooper, 2000), creating equivalence for the three-level model (Schein, 1992).

Finally, two others 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.



Figure 1: OC model of Schein (1992) applied to SC

Source: The authors

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

Food Safety Culture (FSC)

The theoretical framework shows that FSC seeks to adapt the concepts of OC and SC to FS practices (Lee *et al.*, 2012). It is a specific concept of OC that represents how a company uses FS (Yiannas, 2009). An important definition of FSC illustrates this relationship and values that contribute to the proposed hygiene behaviors used when handling food (Griffith *et al.*, 2010).

With the premise that FS problems are partially caused by behavioral issues, in current approaches to FSC an attempt is made to reduce the risk of diseases transmitted through food, integrating safety management systems with the values, beliefs and behaviors of the workforce (Griffith *et al.*, 2010).

Instead of focusing on creating a larger or better system, this can easily be achieved by strengthening FSC (Yiannas, 2009). Companies can opt to create a FSC when the shared beliefs, attitudes and values regarding food safety behavior become the responsibility of all members.

Therefore, we have four common themes when it comes to defining FSC in the organizational literature: (i) the identification of beliefs shared by all company

members; (ii) the importance of the leadership and the contribution of employees at all organizational levels to create a positive food safety culture; (iii) the impact of FSC on organizational performance and performance at work; and (iv) communication and training as fundamental instruments for defining, maintaining and internalizing FSC.

Studies and SC and FSC Measurement Models

SC studies have been conducted in different fields of knowledge, including organizational psychology (Wallace & Chen, 2006; Zohar, 1980, 2000), 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 & Phillips, 2004; Zohar & Luria, 2003), construction (Probst *et al.*, 2008), 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, 2007; 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, there is a general consensus with regard to the tools for measuring SC. 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. In this sense, in Table 1 we list the main instruments for measuring SC that have been developed since the nineteen eighties.

Authors	SC Measurement Tools
Zohar (1980)	Multilevel Safety Climate Scale
Cox & Cox (1991)	Cox & Cox Questionnaire
Diaz & Cabrera (1997)	Safety Climate Questionnaire
Clark (2000)	Clarke's Model of Safety Culture
Mearns, Flin, Gordon & Fleming (2001)	OffShore Safety Questionnaire
Singer, Gaba, Geppert, Sinaiko, Howard & Park (2003)	Stanford Tool
Silva, Lima & Conceição (2004)	Organizational and Safety Climate Inventory
Fang, Chen & Louisa (2006)	Safety Climate Questionnaire
Parker, Lawrie & Hudson (2006)	Development Levels for Safety Culture Maturity
Nielsen & Mikkelsen (2007)	Danish Safety Culture Questionnaire
Chen & Li (2010)	Hospital Survey on Patient Safety Culture

Table 1: SC Measurement Tools

Source: Prepared by the authors

Most of the tools in Table 1 served as a basis for constructing instruments applied to Workplace Safety Culture (WSC) and Food Safety Culture (FSC).

In the academic literature, several authors have sought to conduct pioneer studies of FSC, as follows:

1. Yiannas (2009), with a wide range of knowledge on the retail food sector, claimed that FS is synonymous with behavior and that a strong organizational FS culture is a direct reflection of the importance of FS to company leaders. The author identified some fundamental elements for building a robust FSC: (i) the role of the leadership in creating a FS vision; (ii) the employees' trust in FS as a non-negotiable value; (iii) the support of middle management; and (iv) the sharing of responsibilities, knowledge and information at all levels.

2. Griffith *et al.* (2010) identified a method for measuring FSC using six FS indicators considered as cultural factors (management systems, leadership, communication, commitment, environment, and risk perception) and which contribute to FSC performance.

3. Ball *et al.* (2010) constructed and validated an instrument for the qualitative measurement of behaviors in FS, with five dimensions: commitment of the management and production, training in FSC, infrastructure and FS-oriented behavior. This tool was applied to a meat plant in Ontario, proving that managerial commitment determines FS behavior.

4. Powell *et al.* (2011) analyzed three cases of companies seeking to create a strong FSC and concluded that all of them developed daily practices to reduce risk and openly and transparently informed their stakeholders of all their activities.

5. Taylor (2011) demonstrated how the FSC concept could be operationalized in practice through the validation of her model of Food Safety Culture Excellence with four categories (knowledge, attitude, psychological factors and behavioral and external factors) and sixteen dimensions. Her work emphasizes the importance of cultural auditing to develop safe food production.

6. Neal *et al.* (2012) identified the factors and behaviors that constitute FSC by applying a questionnaire with 38 items to a group of 103 employees in the food business. They concluded that the most important factors for developing a FSC are managerial commitment and employee behavior with regard to producing safe food.

7. Abidin *et al.* (2014) tested a scale for measuring the FSC of employees who served food in a hospital and in a school. A survey was conducted with 582 participants and validated six factors important to FSC: managerial support and cooperation of employees, commitment, communication, pressure in the workplace, risk perception and infrastructure.

8. Jespersen *et al.* (2016) developed a FS maturity model that evaluates through questionnaires the perceptions of perceived value for FS, the role of people and processes, and the technology, infrastructure and equipment. The model was applied to a Canadian company in the food sector, and 219 employees (21.3% of the sample) provided evidence that the organization was placed between maturity levels 2 and 3.

9. Manning (2018) presented the first article to emphasize the importance of measuring FSC in the tourism and accommodation sector, adapting the

measurement tools of the sector to support the practices of managers and scholars in the field.

10. Nyarugwe *et al.* (2018) identified four key elements (microbial safety performance, actual behavior, enabling conditions and employee characteristics) for evaluating FSC at reactive, active

or proactive levels in three small, medium-sized and large organizations in Zimbabwe.

The academic literature has included diverse models that have aided the measurement of FSC (Table 2).

Author	Model	Factors
Griffith <i>et al.</i> (2010)	The assessment of Food Safety Culture	(i) Systems, styles and processes, (ii) transformational leadership, objectives, vision and purposes, (iii) communication, complaints, intentions, feedback, (iv) commitment, rewards, clear roles, employee empowerment, job satisfaction, (v) tangible environmental factors, complacency, standards of excellence, consistency and perceived organizational support, (vi) risk perception, tolerated risk behaviors.
Ball <i>et al.</i> (2010)	Food Safety Climate tool	(i) Commitment of management and employees, (ii) training in food safety, (iii) infrastructure, (iv) employee behavior with regard to food safety.
Taylor (2011)	A new theoretical framework for Food Safety Culture	(i) Knowledge factors: raising awareness, food safety knowledge, technical experience, qualification, (ii) attitude and psychological factors: agreement, risk awareness, self-efficiency, expectations regarding results, reinforcement, motivation, perceived superiority, national cultural values, (iii) behavioral factors: organizational culture, monitoring, involvement, communication, reward and punishment systems, resources, competencies, language skills, (iv) external factors: government legislation and regulatory agencies of the sector and industry, consumers, suppliers, audits and inspections.
Wright <i>et al.</i> (2012)	The UK FSA toolkit	Defines eight FSC elements: leadership, role of the owner, competence, employee engagement, communication, attitudes and priorities, risk perception, knowledge of and trust in the FS management systems.
Neal <i>et al.</i> (2012)	Food Safety Climate Tool	(i) Managerial commitment, (ii) employee behavior with regard to the production of safe food.
Fatimah <i>et al.</i> (2014)	Food safety measurement scale	(i) Leadership, (ii) communication, (iii) commitment, (iv) management system and style, (v) environmental support, (vi) teamwork, (vii) auditing and accountability, (viii) pressure at work, (ix) risk perception.
Jespersen <i>et al.</i> (2016)	The food safety desirability response scale (FSDRS)	The scale has 18 statements for evaluation: (i) positive behavior towards FS, (ii) management of organizational image (iii) denial of behavior and errors concerning food safety issues.
Nyarugwe <i>et al.</i> (2018)	Food safety culture assessment	Data collected using (a) questionnaires with five elements: (i) microbial safety performance; (ii) actual behavior; (iii) enabling conditions; (iv) employee characteristics: attitudes, knowledge and risk perception; (b) eight FS stories submitted to an evaluation of FS behavior and a checklist with document analysis of installations and equipment.

Table 2: FSC Measurement Models

Source: Prepared by the authors

Methodology

In this third part, the methodology of the work, the FSCMI, is described and validated (face validity, semantic and exploratory factor analysis). Its application at two factories in the food sector is also described.

Food Safety Culture Maturity Index (FSCMI)

The proposed model of the Food Safety Culture Maturity Index (FSCMI) is founded on recent

studies of SC and FSC (Clarke, 2010; Ricci *et al.*, 2016; Liao *et al.*, 2014; Nielsen, 2014; Neal *et al.*, 2000, 2012). Its theoretical premises are that: (i) FSC affects safety behavior; (ii) employee commitment and support from the leadership regarding safety issues affect safety outcomes; (iii) individual attitudes to safety influence safety 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 food 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 FSCMI model has nine dimensions, as described in Table 3. They encompass the main aspects of FSC. The dimensions, indicators and variables used to compose the FSCMI can be identified in the SC and FSC models in the organizational literature and are summarized in Table 4. Even so, the construct of the FSCMI is completely original and guarantees the distinctiveness of the tool.

Dimension	Concept
Pressure at Work	Represents excessive demands for results that negatively affect FS practices. Limited time to comply with standard procedures.
Infrastructure	Assesses the availability of resources such as accessible and adequate installations, equipment, supplies and high quality training in food safety.
Management System	Aims to provide systems for the management of activities, policies and procedures to identify critical control points for the execution of FS practices, with regular and thorough inspections to gauge employees' compliance in their activities. .
Risk Perception	Assesses risk awareness in decisions regarding FS. Degree of conscientiousness and responsibility in situations of risk. Awareness of causes of accidents and ways to prevent them.
Responsibility	Evaluates the role of the owner in care over FS. Emphasizes the importance of FS, taking disciplinary measures to maintain procedures. Promoting a vision of responsibility for each person in choosing safer practices.
Leadership	Evaluates the vision and role of leadership in commitment to FS and to what extent it is respected, with an example and model to follow in practices and actions.
Teamwork	Assesses the degree of collaboration and mutual respect among employees to ensure FS. 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 FS between managers and employees. Employees are encouraged to speak freely about any subject that might affect FS.
Commitment	Assesses the use of positive and negative reinforcement tools for employees engaged in, and committed to, FS behaviors and improving FS outcomes. Clear criteria of rewards and punishment. Pride in producing safe products.

Table 3: Meaning of the FSCMI Dimensions

Source: Prepared by 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 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 FS in a company.

Dimension	Indicators	Variables	Authors
Pressure at Work	Volume of activities	My volume of tasks does not interfere with my ability to follow FS rules and procedures.	Singer <i>et al.</i> (2003); Mearns <i>et al.</i> (2001); Clarke (2010); Chen & Li (2010); Diaz & Cabrera (1997); Flin (2007); Pragle <i>et al.</i> (2007);
	Pressure from the manager	I have enough time to follow my manager's orientations on FS, even in times of great demand.	

	Pressure over deadlines	I manage to follow the FS norms and procedures because my manager sets clear priorities and deadlines for my activities.	Guldenmund (2000); Abidin <i>et al.</i> (2014).
	Dimensioning of professionals	The number of professionals in my sector is adequate for handling FS activities.	
Infrastructure	Quality	In my work sector, the quality of the clothes, hand-washing locations, anterooms and processing areas is adequate for FS practices.	Griffith <i>et al.</i> (2010); Singer <i>et al.</i> (2003); Fang <i>et al.</i> (2006); Clarke (2010); Silva <i>et al.</i> (2004); Chen & Li (2010); Lee (1998); Abidin <i>et al.</i> (2014); Ball <i>et al.</i> (2010); Taylor (2011).
	Processes	In my work sector, processes are executed in a way that reduces FS risks.	
	Training	FS training is compulsory for all employees in my sector.	
	Equipment	In my sector, the equipment, tools and general resources that aid adequate behavior to ensure FS are always available.	
Management System	Role of management systems	In my sector, we have objectives, goals that help us to improve conformity and reduce FS risks.	Griffith <i>et al.</i> (2010); Mearns <i>et al.</i> (2001); Diaz & Cabrera (1997);
	Metrics	The FS indicators reinforce desired behavior in my sector and motivate all my colleagues.	Pragle <i>et al.</i> (2007) Abidin <i>et al.</i> (2014).
	Metrics	The FS indicators help to identify new or safer ways of carrying out a particular task in the production of beverages.	
	Feedback	I receive feedback from my immediate superior when I do not seek to align my behavior with the FS indicators.	
Risk Perception	Behavior	In my sector, we take no risks, no matter how small, that might affect FS.	Griffith <i>et al.</i> (2010); Neal <i>et al.</i> (2012); Fang <i>et al.</i> (2006); Chen & Li (2010); Diaz & Cabrera (1997);
	Haste and Self-confidence	My colleagues in the sector do not perform their tasks in a hurry to avoid risks with FS.	Lee (1998); Flin (2007);
	Negligence and improvisation	My colleagues in the sector are not negligent in their activities to avoid risks with FS for the company.	Guldenmund (2000); Gordon & Kirwan (2005);
	Lack of insistence	My colleagues in the sector do not improvise in their activities to avoid risks of food safety in the company.	Abidin <i>et al.</i> (2014); Taylor (2011).
Responsibility	Role of the owner	My colleagues in the sector perform the role of owner in their care over FS and promote a vision of responsibility of each when choosing safer practices.	Griffith <i>et al.</i> (2010).
	Discipline	My manager complies with all his responsibilities related to FS.	
	Discipline	My manager promotes a vision of responsibility for every colleague in my sector when choosing safer practices.	
	Shared responsibility	My manager constantly emphasizes that FS is interdependent, i.e., all my colleagues have shared responsibilities to guarantee safe products.	
Leadership	Vision	The company leadership has a clear vision regarding the importance of FS practices.	Griffith <i>et al.</i> (2010); Fang <i>et al.</i> (2006); Clarke (2010); Yiannas (2009); Whiting & Bennett (2003);
	Vision	The company leadership inspires me regarding the importance of FS practices.	Flin (2007);
	Model	The company leadership provides good examples of the behavior expected to ensure FS.	
	Trust		

		The company leadership views FS as a non-negotiable value.	Guldenmund (2000); Chen & Li (2010); Abidin <i>et al.</i> (2014).
Teamwork	Collaboration	My colleagues in my sector are always helpful and support me to guarantee FS.	Griffith <i>et al.</i> (2010); Singer <i>et al.</i> (2003); Neal <i>et al.</i> (2012); Fang <i>et al.</i> (2006); Clarke (2010); Yiannas (2009); Chen & Li (2010); Diaz & Cabrera (1997); Lee (1998); Abidin <i>et al.</i> (2014).
	Collaboration	My colleagues in my sector encourage cooperative behavior for successful FS.	
	Proactivity	When unsafe behavior needs to be adjusted, my colleagues in the sector guide me based on the FS norms and procedures.	
	Trust and mutual respect	I trust and respect my colleagues and know that they make a maximum effort to ensure FS in the company.	
Communication	Quality	My manager provides me with adequate information and guidelines at the right moment regarding FS norms and procedures.	Griffith <i>et al.</i> (2010); Singer <i>et al.</i> (2003); Clarke (2010); Yiannas (2009); Whiting & Bennett (2003); Fleming (1999); Chen & Li (2010); Abidin <i>et al.</i> (2014); Taylor (2011).
	Content	I can speak freely with my manager about any subject that affects FS at the company.	
	Openness	I have an open dialogue with my manager about any subject related to FS.	
	Dialogue	My manager often makes time available for communication on issues related to food safety with all the employees in my sector.	

Table 4: Dimensions, Indicators and Variables of the FSCMI

Source: Prepared by the authors

Semantic Validation of the FSCMI

To validate the content of the dimensions, 15 workshops and 30 interviews were held with participants from different hierarchical levels of diverse organizations in the food and beverage sector. The workshops and individual interviews were intended to obtain real-life stories on FS that illustrated day-to-day work. After a brief reflection on the meaning of each of the nine dimensions during the workshops, each group, with five participants, had 20 minutes to tell a story of something that strengthened the FS 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 FS 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 FS at the organizations, thus facilitating the participants'

responses. During the workshops, we also conducted a semantic assessment (pre-test) of the FSCMI, i.e., to ensure that the affirmatives proposed in the FSCMI 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 FSCMI was reliable. However, it was necessary to calibrate some affirmatives to reduce the tendency towards automated responses.

Face Validity of the FSCMI

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 six 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 79% and 84%, 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 FSCMI: Exploratory Factor Analysis

To validate the FSCMI, 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:

1. Sample size: Hair Jr. *et al.* (1998) state that EFA should not be used in a sample with fewer than 50 units.

2. 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.

3. 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).

4. KMO: The Kaiser-Meyer-Olkin (KMO) measurement of sample adequacy is a test that compares the magnitudes of the correlation coefficients observed with the magnitudes of the partial correlation coefficients. Low values of the statistic, $KMO < 0.5$, indicate that the correlations between pairs of variables cannot be explained by other variables. Otherwise, the factor analysis is appropriate.

5. 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 ($r=0$)). If so, the test statistic assumes low values. This indicates that a correlation between the variables is unlikely.

6. 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. For this study, Principal Component Analysis was applied.

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

8. Eigenvalue: Represents total variance explained for each factor. Studies recommend an eigenvalue higher than 1 (Williams *et al.*, 2010).

9. Rotation Test: Rotation maximizes the high loads of items and minimizes low loads of items, thus producing a more interpretable and simplified solution. Orthogonal Varimax rotation is the most commonly used rotation technique in factor analysis (Williams *et al.*, 2010) and produces uncorrelated factor structures.

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). 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.

3.5 Survey

The exploratory and descriptive research that objectified the analysis of the relationship between the variables of the construct model (Snow; Thomas, 1994) of the FSCMI was conducted in a field of knowledge that has been studied little and has yet to be given a structured systematization

(Jespersen *et al.*, 2017). The questionnaire was applied to the FSCMI sample in person.

Sample and Data Collection

The sample was chosen at random and composed of employees from different levels of the operational area of two factories in the food and beverage sector. The factories were located in Brazil, one in the north and one in the south. The sample selection followed the study of Fey and 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 FSCMI.

The data were collected from groups of up to 50 people an hour, who were invited to the auditorium of each factory by the researchers. There they were

given instructions on how to complete the questionnaire. The questionnaires were completed anonymously and placed in a closed urn to ensure the confidentiality of the sample. The questionnaire was made up of 36 questions to be answered using a five-point Likert scale (1 = I totally disagree to 5 = I totally agree), prepared based on the nine dimensions and their four indicators, as shown in Table 4.

Analysis of the Results of the Application of the FSCMI

For the survey, the entire operational workforce of the two factories was invited to participate. A total of 395 (67% response rate) completed questionnaires were collected at the two factories (Table 5).

These responses came from all the areas of the company (bottling, manufacturing, logistics, maintenance, operations, quality).

Class	N	Percentage
Time with the Company		
• Less than 1 year	45	11%
• 1-5 years	115	29%
• 6- 10 years	129	33%
• 11-15 years	47	12%
• 16-20 years	16	4%
• Over 20 years	43	11%
Age		
• 20-25	64	16%
• 26-35	177	45%
• 36-45	98	25%
• 46-55	44	11%
• Over 55	12	3%
Gender		
• Female	78	20%
• Male	317	80%
Schooling		
• Elementary education	25	6%
• High school education (with diploma)	246	63%
• Higher education (degree)	107	27%
• Graduate degree/MBA (complete)	17	4%
Hierarchy Level		
• Manager	32	8%
• Non-manager	363	92%

Table 5 - Sample Profile

Source: Field Research

The sample is predominantly made up of professionals who have been with the company for up to ten years (73%), are between 26 and 45 years old (70%), are male (80%), have an education level

up to high school (69%), and work at the operating level (92%). This profile portrays manufacturing companies and enables FSC to be researched as perceived by operating employees.

The Exploratory Factor Analysis began by verifying the adequacy of the sample for the technique. The result of the Anti-image Correlation Matrix showed that 100% of the correlation of coefficients had an MSA higher than 0.63, indicating that the inter-correlations of the 24 variables were strong, based on the Measure of Sampling Adequacy (Noursis, 1994). The most conclusive tests, KMO (0.800) and Bartlett's Test of Sphericity ($\chi^2= 2,313.967$, 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 orthogonal rotation using the Varimax method.

In the initial theoretical and empirical model, it was assumed that the FSCMI was explained with nine dimensions (communication, commitment, infrastructure, pressure at work, risk perception, management system, leadership, teamwork and responsibility). The EFA reduced the 36 variables to 24 variables, distributed in 7 factors named: "Leadership" (Factor 1); "Risk Perception" (Factor 2); "Management System" (Factor 3); "Communication" (Factor 4); "Commitment" (Factor 5); "Pressure at Work" (Factor 6); and "Teamwork" (Factor 7). All the variables presented communalities between 0.599 and 0.826, showing that at least 70.61% 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 0.695 and 0.844 (Table 6). These results have satisfactory internal consistency.

	Denomination of factor	Qty. of variables	Eigenvalue	Variance Explained	Cronbach's Alpha
Factor 1	Leadership	4	7.475	31.072	0.844
Factor 2	Risk Perception	4	2.062	8.593	0.820
Factor 3	Management System	4	1.961	8.172	0.805
Factor 4	Communication	4	1.706	7.110	0.727
Factor 5	Commitment	3	1.468	6.115	0.730
Factor 6	Pressure at Work	3	1.242	5.174	0.761
Factor 7	Teamwork	2	1.052	4.382	0.695
Total		24	16.966	70.618	

Table 6 - Denomination of the factors, eigenvalues, variance explained and Cronbach's Alpha

Source: Prepared by the authors

The first factor, "Leadership" (Table 7) explained 12.8% of the variance and captured aspects such as: (i) clear vision of the leadership regarding the importance of FS practices; (ii) the leadership is considered an inspiring force, thus; (iii) the leadership's behaviors are considered examples and models that inspire its followers; and (iv) the leaders consider FS as a non-negotiable value. No variable was lost. All the loadings had a result between 0.567 and 0.829 and communalities over 0.654.

This factor showed the importance of the role of the leadership in strengthening FSC and applying practices focused on FS. Thus, it strengthened the role of the leadership and put into perspective the

need for its participation in daily organizational practices and responsibility in the process of sustaining the FSC.

According to Griffith *et al.* (2010), when the leadership is not considered a model in the practice of FS, it is not open to hearing and accepting suggestions from employees to ensure FS (even if they might have a negative impact on the company's outcomes), or it is active in supporting only the concept of FSC. In other words, they agree that it is important, but its practices are not internalized. The employees perform these tasks most of the time because they must, not because it is what they want. In more mature FSC, the leadership constantly communicates that FS is a

non-negotiable value for all. It clearly communicates what is expected from each employee with regard to FS practices. It plays a fundamental role in creating a FS vision, with clear

goals and shared purposes, and clearly explains the “whys” of desired behaviors (Fatimah *et al.* 2014; Fang *et al.* 2006; Yiannas, 2009).

	Variable	Factor Load	h ²
V1	Clear vision of the leadership regarding the importance of FS practices.	7.457	0.785
V2	Leadership as a source of inspiration for FS.	2.062	0.776
V3	Leadership shows good examples of FS behavior.	1.961	0.709
V4	Leadership believes FS is a non-negotiable value.	1.706	0.654

Table 7 - Leadership Factor
Source: Prepared by the authors

The second factor, “Risk Perception” (Table 8) explained 12.4% of the variance and captured aspects such as: (i) the impossibility of employees taking risks; (ii) working hastily; (iii) being negligent; and (iv) improvising in their activities, avoiding risks that would affect the FS of the company. No variables were lost. All the loadings had a result between 0.664 and 0.827 and communalities higher than 0.630. This factor included variables that encompass unacceptable behaviors during daily activities. The practice of any one of the variables weakens practices that focus on food safety. The interpretation of this factor suggests a possibility of unacceptable practices in the everyday production practices the

factory, as well as external factors that influence correct practices. These results are consistent with those found in the work of Nyarugwe *et al.* (2018), in which the authors claim that in organizations where employees clearly perceive FS risks, we observe more adequate behavior and incentives for safe practices.

In more mature FSC, employees have all the necessary knowledge of the risks associated with FS, precarious conditions and practices that put FS at risk are unacceptable (Powell *et al.*, 2011), and the risks that affect FS are always assessed by supervisors/coordinators to prevent deviations (Neal *et al.* 2012).

	Variable	Factor Load	h ²
V5	Possibility of taking any risk that affects FS.	1.468	0.630
V6	Possibility of performing tasks with haste that affects FS.	1.242	0.826
V7	Possibility of being negligent in activities that affect FS.	1.052	0.775
V8	Possibility of improvisation in tasks that would affect FS.	0.864	0.703

Table 8 - Risk Perception Factor
Source: Field Research

The third factor, “Management System” (Table 9) explained 10.8% of the variance and captured aspects such as: (i) the existence of objectives and goals that help to improve conformity and reduce FS risks; (ii) FS indicators that strengthen desired behaviors, help to identify new or safer ways of performing activities; and (iii) feedback is provided by managers when behavior is not in keeping with FS indicators. This factor also showed no loss of variables. All the loadings had a result between 0.551 and 0.890 and communalities over 0.609. This factor contains variables that seek to evaluate FS performance in a preventive way so that actions to handle problems that might impact FS can be anticipated. The preventive indicators open up the possibility for dialogue and a task force that seeks continuous improvement of FS processes.

In immature FSC, FS is mainly driven by obedience of rules and regulations and is seen as a responsibility of the technical area (Mearns *et al.*, 2001).

When employees understand and share the meaning and value of management systems and organizational goals and indicators, this increases commitment, alignment and voluntary participation in complying with safety rules and regulations (Diaz & Cabrera, 1997; Abidin *et al.*, 2014). In mature FSC, clear and achievable objectives and targets improve FS performance, increase conformity, reduce the risk of diseases transmitted through food and generate trust in FS management systems (Lee *et al.*, 2012; Wright *et al.*, 2012).

	Variable	Factor Load	h ²
V9	Existence of objectives and goals that help to improve conformity and reduce FS risks.	0.813	0.609
V10	Existence of indicators that reinforce desired FS behaviors.	0.648	0.818
V11	Indicators that help to identify new or safer ways of performing a certain task involving FS.	0.589	0.750
V12	Provision of feedback from the manager when the behaviors presented in the FS indicators are not in alignment.	0.563	0.663

Table 9 – Management System Factor

Source: Prepared by the authors

The fourth factor, “Communication” (Table 10) explained 10.4% of the variance and captured aspects such as: (i) the importance of the manager providing adequate information and guidelines on FS norms and procedures; (ii) the existence of dialogue and the possibility of speaking openly with the manager regarding any issue that affects FS; (iii) immediate action to stop production and make necessary corrections when a FS risk is detected; and (iv) a feeling of pride among employees regarding excellence in FS practices. This factor, too, did not present any loss of variable. All the loadings had a result between 0.618 and 0.758 and communalities over 0.599. This factor contains variables that seek to assess communication to promote FS at all levels and

allows for necessary adjustments, promoting pride among employees. In studies on FSC, we also found similar results. Authors such as Taylor (2011) and Griffith *et al.* (2010) emphasized that, irrespective of gender or how long participants have been at the firm, all of them show that understanding information, bilateral communication and opportunities for dialogue raise awareness of the reasons for emphasizing certain behaviors and punishing others. To the authors, factors such as little internal communication regarding FS (posters, banners and internet) in all areas of the factory or supervisors that do not make time to communicate issues related to FS practices to employees can have very negative consequences on the internalization of a FSC.

	Variable	Factor Load	h ²
V13	The manager provides adequate information and guidelines regarding FS norms and procedures.	2.055	0.602
V14	It is possible to speak freely with the manager on any subject that affects FS.	1.829	0.668
V15	It is possible to have an open dialogue with the manager on any subject related to FS.	1.737	0.599
V16	The manager makes time available for communicating issues regarding FS practices.	1.536	0.601

Table 10 – Communication Factor

Source: Prepared by the authors

The fifth factor, “Commitment” (Table 11) explained 8.9% of the variance and captured aspects such as: (i) employees understanding the reasons for having to follow FS practices consistently; (ii) feeling proud to practice FS with excellence; and (iii) doubts regarding FS risks leading to an immediate halt in production and taking corrective actions. This factor did not load one of the variables (Employees understand the reasons for having to follow FS practices). The variables had loadings between 0.606 and 0.856 and communalities starting at 0.606. This factor

contains variables that seek to evaluate the commitment of employees and the company, as halting production and corrective actions affect performance and lead to lower production. In a mature FSC, employees are proud to work for the company, there is interaction between company employees, sharing of thoughts and management committed to ensuring safe behavior (Ball *et al.*, 2010). In reactive FSC, safe behaviors are often imposed and monitored by the management with little involvement from employees (Mearns, 2001; Singer *et al.*, 2003).

	Variable	Factor Load	h ²
V17	Employees understand the reasons for having to follow FS practices consistently.	1.337	0.752
V18	Employees are proud to practice FS with excellence.	1.536	0.773
V19	Doubts regarding FS risk could mean halting production and taking corrective actions.	1.276	0.606

Table 11 – Commitment Factor

Source: Field Research

The sixth factor, “Pressure at Work” (Table 12) explained 8.0% of the variance and captured aspects such as: (i) the volume of activities does not affect the ability to follow FS norms and procedures; (ii) there is sufficient time to follow the orientations of the manager regarding FS, even at times of great demand; and (iii) the number of professionals is adequate for conducting FS activities. This factor too did not load one of the variables (Employees follow the FS norms and activities due to the clarity of my activities). The variables had a loading between 0.510 and 0.888 and communalities from 0.676. This factor contains variables that seek to evaluate the

difficulties that lead to pressure at work, hindering employees from doing their best in terms of FS.

Barriers were also perceived in the FS practices of employees at restaurants resulting from behavior affected by pressure at work, lack of an adequate infrastructure, lack of encouragement from the leadership and training based on memorization (Pragle *et al.*, 2007).

In immature FSC, there are many activities and considerable pressure for results, no concern over what happens and demands for productivity are given priority (Clarke, 2010; Chen & Li, 2010; Flin, 2007)

	Variable	Factor Load	h ²
V20	The volume of activities does not affect the ability to follow FS norms and procedures.	0.991	0.805
V21	There is sufficient time to follow the orientations of the manager regarding FS, even at times of great demand.	0.943	0.676
V22	The number of professionals is adequate for conducting FS activities	0.779	0.745

Table 12 – Pressure at Work Factor

Source: Field Research

The seventh factor, “Teamwork” (Table 13) explained 7.2% of the variance and captured aspects such as: (i) the volume of activities does not affect the ability to follow FS rules and procedures; (ii) there is sufficient time to follow the orientations of the manager regarding FS, even during times of great demand; and (iii) the number of professionals is adequate for conducting FS activities. This factor lost two variables in the factor loading (‘Colleagues encourage cooperative behavior for successful FS’ and ‘Colleagues provide guidance when there is a need to correct behavior, based on FS norms and procedures’). In this factor, as in the Pressure at Work factor, two variables that sought to evaluate norms and procedures did not have the necessary loading.

Collaboration and mutual respect between employees are fundamental for guaranteeing FS (Yiannas, 2009; Chen & Li, 2010).

These notions were reinforced in the study of Abidin *et al.* (2014), who found that FSC was shaped by interpersonal attributes and the ability to work with other people, requiring the encouragement of teamwork. As norms and rules serve as the basis for employees to perform their tasks, the non-loading of the variables leaves a gap in the model. Furthermore, as there is no explanation in the literature regarding a possible reason for the low significance on norms and procedures, this information warrants further investigation.

	Variable	Factor Load	h ²
V23	Colleagues always collaborate with each other to guarantee FS.	0.626	0.751
V24	Colleagues respect and trust each other and make a maximum effort to guarantee FS.	0.615	0.672

Table 13 – Teamwork Factor

Source: Field Research.

Finally, two dimensions did not have any variables with sufficient factor loading: Infrastructure and Responsibility. As the content of the variables of these dimensions are not present in the other variables, their non-loading represents a reduction in the original model. The Responsibility dimension was suggested by only one author (Griffith *et al.*, 2010), which may justify it not loading. Some authors included the responsibility dimension in the risk perception dimension (Yiannas, 2009), and others may not have identified variables related to responsibility and for this reason did not include these indicators in their studies.

On the other hand, the Infrastructure dimension was identified by a number of authors (Singer *et al.*, 2003; Fanha *et al.*, 2006; Clarke, 2010; Silva *et al.*, 2004; Chen & Li, 2010; Lee, 1998; Abidin *et al.*, 2014; Ball *et al.*, 2010; Taylor, 2011) as relevant and, therefore, it was included in the FSCMI model. It was not possible to identify an academically founded reason to justify the non-loading of the variables of the Infrastructure dimension; nor was it possible to draw comparisons with the validation of another model, as none of the models available in the literature was validated.

The methodological analysis of the case suggests a limitation in the sampling procedure. In other words, as the samples used for the application of the FSCMI were collected from only two factories located at either geographical extreme of the country, the traits of national culture and specific attributes of the subcultures distorted the results (Hofstede, 1991; Jespersen *et al.*, 2017).

As one of the main goals of this study was to test the FSCMI model to evaluate FSC, 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 original model of the FSCMI. This shows that the original FSCMI model was developed with stable and valid measures of FSC.

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).

Another possible limitation of the study may be related to the accuracy of the responses obtained using the five-point Likert scale in the research tool to evaluate the perception of the participants. A detailed analysis of the profile of the responses pointed to an error in terms of a tendency to opt for responses in the middle of the scale. This occurs when the respondent, due to fear or insecurity, tends to avoid minimum and maximum scores and shies away from giving responses with very low values so as not to do the company a disservice or very high scores in order to avoid overrating the company.

The use of a seven-point scale would improve the quality, providing a higher number of options for responses and reducing errors resulting from the participants' tendency to opt for responses in the middle of the scale (Fotopoulos *et al.*, 2009). The subjectivity involved in the evaluation of organizational culture requires participants to make complex decisions, which may not be restricted to a five-point Likert scale. Thus, a greater variability of responses affords respondents a wider range when it comes to describing their own opinions regarding the FSC of the company where they work. Seven-point scales have already been used in FS research and shown satisfactory statistical properties (Prescott *et al.*, 2002).

Only further studies can determine the conclusive stability of the FSCMI, bearing in mind the academic support of diverse authors regarding the importance of certain dimensions, such as Infrastructure.

For future studies and research, it is important to consider samples diversified by region in multicultural countries with large geographic dimensions. Likewise, it would be interesting to test a seven-point scale to avoid the tendency to opt for responses in the middle of the scale.

Conclusion

The FSCMI model meets the basic requisites of a valid measurement of FSC. 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 FSC.

This study shows that the FSCMI is an important instrument in advancing the measurement of FSC in companies in the Food and

Beverage sector. The theoretical premises of its dimensions, indicators and variables that influence FSC provide robust support for the identification of the FSCMI. The results point to seven factors that explained 70.61% of the variance of the data: Leadership, Risk Perception, Management System, Communication, Commitment, Pressure at Work and Teamwork. On the other hand, the statistical analyses did not support the variance of two factors identified in the literature: Infrastructure and Responsibility. The fact that the loadings occurred with seven of the nine selected dimensions indicates that the FSCMI model is very robust. However, it requires further testing for its generalization, with a seven-point scale that captures the complete variability of the perceptions of the participants in the survey, as well as larger and more diverse samples to minimize possible bias resulting from different organizational cultures and subcultures.

Thus, the proposed FSCMI model needs to be applied to a larger and more diverse sample of companies in the food and beverage sector, with the introduction of elements of segmentation, such

as number of employees, gross revenues and geographic locations to increase the legitimacy of the tool.

As the academic literature and companies in the food and beverages sector have valued and recognized the strategic importance of FSC as a competitive advantage, a reliable and valid assessment model becomes increasingly important.

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

The proposed alterations to the questionnaire, aligned with the statistical validations of the FSCMI and future research with a larger sample of companies, will pave the way for the FSCMI to be valid and reliable in establishing with precision the level of FSC maturity in each organization.

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