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Food Safety Culture and Climate

An analysis of the Italian packaged confectionery raw material suppliers

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Abstract

Despite all the audits, training, and controls put in place in the Hazard Analysis and Critical Control Point (HACCP) and Food Safety Management Systems (FSMS), there are still numerous cases of foodborne illness around the world. This condition leads the research on food safety to change from a technology oriented FSMS to its human component, which is typically referred to as food safety climate.

Currently, there has been no in-depth food safety culture and climate research conducted in Italy from an industry perspective and especially from raw material suppliers' point of view.

For this reason, in this study, the food safety culture and climate in the Italian packaged confectionery raw material suppliers' industry was quantitatively assessed using a food safety climate self-assessment tool developed by De Boeck et al. (2015). The questionnaire evaluates the human dimensions of food safety climate such as leadership, communication, commitment, resources, and risk awareness through 28 indicator statements. A five-point Likert scale was used by the respondents to score the assertions. A higher score on the scale was intended to indicate a stronger food safety climate.

Firstly, the relationships between organizational traits and the food safety climate were evaluated. Next, exploratory factor analysis was used to investigate the factorial validity of the applied food safety climate assessment tool, and eventually the national culture influence on the food safety climate results was tested.

Based on the total valid employees' answers, the overall Italian packaged confectionery raw material suppliers' industry was found to have a good food safety climate, even comparing it to previous studies of other industries and countries.

For some organizational characteristics investigated, such as company size, production sectors, and food safety dedicated roles, significant correlations with the food safety climate could be proven.

Exploratory factor analysis revealed the existence of 2 underlying factors: factor 1 mainly dealing with 'leadership and communication related' indicators, factor 2 with 'resources and risk awareness related' indicators; the 'commitment related' indicators instead belonged to both the two factors.

Finally, some correlations between national culture parameters and food safety climate dimensions were found.

Introduction

The following study describes an analysis designed to quantitatively measure food safety perceptions of employees in the Italian packaged confectionery raw material supplier industry.

Problem formulation

Scientists and the food industry have recently focused an extensive amount of attention on evaluating the food safety culture within food companies (e.g., [1], [2], [3]), as consumers food poisoning and outbreaks continue to be reported and are a significant cause of human disease [4]. This has resulted in the introduction of terms like "food safety culture" and "food safety climate," which reflect a shift in the focus of several academics from a formal and technical Food Safety Management Systems approach to a more human approach to food safety [2] [5].

However, the conducted literature review revealed that there has been no in-depth food safety culture and climate research in Italy from an industry perspective and specifically from raw material suppliers' point of view.

Moreover, some studies [6] highlighted the need to cover the opinions of workers from all departments, to have a broader view of shared values, norms, and attitudes of food safety.

Finally, another important aspect that only few scholars [7] have already explored is the investigation related to the national culture influence on the food safety climate results, as they are context specific and can be influenced by peculiar characteristics of the sectors and countries.

For the aforementioned reasons, this research aims at answering the following questions:

- What is the level of food safety culture and climate for raw material suppliers in the Italian packaged confectionery sector?
- Are there significant correlations between the organizational traits of the respondents' companies and their perceptions of the organization's food safety culture?
- Are there significant correlations between organizational functions of the respondents and their perception of organisation's food safety culture?
- Can the National culture influence the food safety climate results?

Objective of the research

The present study evaluates the human aspects of food safety culture and climate in Italian packaged confectionery raw material suppliers, including leadership, communication, commitment, resources, and risk awareness. The results from each dimension's ratings contributes to identify the gaps in the organizations' food safety climate. The goal is to have this study used as a baseline for future research in the Italian market.

Thus, the research objectives of the study are to (1) assess the overall Italian food safety culture and climate, (2) evaluate possible statistical correlations between companies' organizational traits and the food safety climate results, (3) assess factor validity of the tool used in the analysis, and (4) appraise the influence of National culture on food safety climate results.

Method

Firstly, a literature review regarding the topics of food safety and specifically food safety culture and climate was carried out using two search engines, such as Pico and Google Scholars.

Through the literature study, a questionnaire developed by De Boeck et al. (2015) [1] was found and selected as the most suitable for the analysis. A contact person for each company involved in the analysis was reached via mail or LinkedIn and asked to circulate the questionnaire within the company, in order to collect multiple responses for each company and gather different opinions from the same environment. Each participant received the electronic link to the questionnaire and had to spend around 5 minutes to complete it.

After the collection of the responses, data processing was executed using IBM SPSS. Some statistical tests, such as Kruskal-Wallis H and Mann-Whitney U ones, and exploratory factor analysis were performed to respectively evaluate possible correlation between the different factors and assess factor validity of the tool. Finally, some hypotheses extracted from previous studies regarding the influence of National culture on food safety climate were tested.

Structure of the document

The present study is structured into four main chapters divided as follow.

In the first chapter an introduction of the main literature findings regarding food safety culture and climate is performed. The chapter begins by defining the origins of food safety and its campaigns and certifications. This is followed by defining organizational culture and especially food safety culture. Then, the definitions of food safety culture and climate, and the concepts and approaches related to them are explained. The chapter then progresses to talk about the impact of National culture on food safety climate and the presentation of the available tool to assess food safety climate.

The second chapter traces the materials and methods used in the analysis. Firstly, the structure of the Food Safety Climate questionnaire forwarded to respondents is defined. The chapter then progresses to talk about the respondents' sample: from the reasons and the importance of the selected sample to its effective structure.

The third chapter is devoted to the description and discussion of the results of the analysis. The chapter begins with a general discussion of the results, summarizing all the main data. This is followed by an analysis of the data with respect to various organizational traits, to evaluate if these can influence food safety climate results. The chapter continues with an exploratory factor analysis to assess factor validity and a final consideration of the influence of national culture (as assessed by Hofstede scores) on employees' perceptions of food safety culture and climate.

Finally, the last chapter traces the conclusions that aim to illustrate through salient points and main concepts the issues discussed in the paper, highlighting some limitations of the study conducted and offering some insights for future research.

1. Literature Review

1.1. Food Safety

Integrity in food is crucially dependent on food safety. From farm to fork, the whole supply chain's worth of food items' general quality and safety are referred to as the "food integrity" chain. It covers every facet of food production, as well as food-related ethical, legal, and societal concerns [8].

In the context of food supply chain, Elliot affirms that “food integrity can be seen as ensuring that food which is offered for sale or sold is not only safe and of the nature, substance and quality expected by the purchaser but also captures other aspects of food production, such as the way it has been sourced, procured and distributed and being honest about those elements to consumers” [9].

Food integrity can also be seen as a house supported by pillars such as Food Safety, Food Quality and Food Defence with at their base the fundamental mechanisms to improve the integrity of the food supply chain, identified as food assurance, traceability and technology systems and standards [8].

However, maintaining food integrity fundamentally involves ensuring food safety. Implementing efficient quality control systems, locating, and containing possible dangers in the food production process and preventing food contamination are all examples of food safety procedures.

Due to ongoing outbreaks of foodborne illness and erratic microbiological safety of the food products, food safety is a concern for governments, businesses, and regulators worldwide. At least 600 million cases of foodborne disease occur annually worldwide, or around 1 in 10 cases [10].

Regulators created regulations, such as the Safe Food for Canadians Act [11], the Food Safety Modernization Act [12], and the General Food Law [13], to lessen the overall burden. The food sector is also working together to lower the hazards to food safety [13]. The public now distrusts the food sector as well as authorities due to persistent and recent food safety breaches, which have occurred even in businesses in industrialized nations with well-established legal systems [14]. This is due to the fact that appropriate food hygiene is not necessarily the consequence of rules, since food handlers and

organizations may have an impact through proper implementation, dedication to and display of care for food safety [15].

According to EC N. 178/2002 [13], "safe food" is defined as food that is not harmful to health or unfit for human consumption. A food can become unhealthy by being subjected to any of the following processes or treatments: adding anything to it, using something as an ingredient in its preparation, abstracting (which means "taking away") any constituents from it, or any combination of these. If a food product is dangerous, the Regulation forbids its sale. If food has already been sold, it must be recalled from consumers or taken off the market [9]. In a nutshell, food safety can be interpreted as a discipline that describes the handling, preparation, and storage of food to prevent foodborne illness.

The minimum expected standard within which the food industry must operate is established by food legislation [16]. A trustworthy, legal framework serves as the foundation for the creation and execution of food safety management systems in the food industry [17]. Implementing standards may lower internal food safety hazards and promote exports of goods by increasing customer trust in food safety [18].

The main challenges of food safety include four major areas: Microbiological Safety, Chemical Safety, Personal Hygiene and Environmental Hygiene. The first area includes both viruses and bacteria: the former are responsible for the majority of foodborne illnesses while the latter concern foodborne infections leading to hospitalizations and deaths; the second one, however, focuses on pollutants like pesticide residues and non-food grade chemical additions like colorants and preservatives that are present in food; the third one, instead, focuses on routine tasks like hand washing and using washing facilities, which, if done incorrectly, represent significant hazards to both individual and societal health; the last category relates to the hygienic conditions in the area where food is processed and produced, if these circumstances are poorly handled, they may result in poor food storage, poor food transit and unsanitary food sales [19].

Also depending on Uçar, et al. (2016) [20], the main issue of food safety could be similarly classified into food hygiene, personal hygiene of food handlers and kitchen sanitation, the last one can be interpreted in general as workstation sanitation. So, the concepts are almost the same with the ones identified by Fung, Wang and Menon (2018) [19], simply food hygiene includes both Microbiological Safety and Chemical Safety.

1.1.1. Food Safety campaigns and certifications

A global campaign launched by the top food producers and retailers in the world is known as the Global Food Safety Initiative (GFSI) [21]. By taking into account the standards presently in use around the world, GFSI seeks to standardize international food safety standards and identify critical areas for food safety [22] [23].

Its origin was in 2000, when The Consumer Goods Forum was founded in Europe by major global retailers and food manufacturers. Currently, the GFSI mission is stated as "continuous improvement in food safety management systems to ensure confidence in the delivery of food to consumers".

The objectives of GFSI, defined by Wallace et al. (2014) [24], are:

- to promote convergence of food safety standards through the maintenance of a benchmarking process for (existing or new) food safety management schemes;
- to improve cost efficiency throughout the global supply chain through the common acceptance of GFSI standards by retailers from around the world;
- to provide a unique international stakeholder platform for networking, knowledge exchange and sharing of the best food safety practices and information.

GFSI's work in benchmarking and harmonization aims to foster mutual acceptance of GFSI-recognized certification programs across the industry with the ambition to enable a "once certified, accepted everywhere" approach.

To control and guarantee the safety of products in the food value chains, the GFSI technical committee established a benchmark that all standards had to meet in order to receive GFSI approval [21] [25].

The British Retail Consortium Global Standards (BRCGS), the Food Safety System Certification (FSSC) 22000, and the International Featured Standard (IFS) are a few of these benchmark standards.

British Retail Consortium Global Standard is the private-label certification standard created for the qualification of private-label producers in Anglo-Saxon mass retailing now adopted by all international markets. It provides a framework to manage product safety, integrity, legality and quality, and the operational controls for these criteria in the food and food ingredient manufacturing, processing and packing industry [26].

Food Safety System Certification scheme is the private international food certification standard, which incorporates the requirements of ISO 22000, together with the industry technical standard, ISO 22002, and certain GFSI requirements [21] [27] [28].

IFS is also a benchmarked standard for producers, wholesalers, distributors, agents, and brokers by the Global Food Safety Initiative (GFSI). It applies when products are "processed" or when there is a hazard for product contamination during primary packing. The Standard is important for all food manufacturers, especially for those producing private labels [29] [30].

No matter their size or complexity, all food makers must adhere to these criteria. These certifications support the FSMS's foundation and incorporate the Codex Alimentarius Commission's internationally recognized Hazard Analysis and Critical Control Point (HACCP) program [21] [31] [32]. The implementation of a food safety management system based on the worldwide Codex Alimentarius HACCP principles is required by current European law for food firms [33] [34].

The food industry's globalization has led to the development of an integrated Food Supply Chain Management conceptual model. The integrated FSCM system is essential for preserving the high standards of food safety and quality.

Griffith (2014) [35] defined an organization's food safety management systems (FSMS) as "all its documented procedures, practices, and operating procedures which influence food safety". These FSMS provide policies, protocols and guidelines on food safety to establish standard operating procedures to ensure acceptance with regulations [16].

The application of a few food safety management methods, such as Hazard Analysis and Critical Control Point (HACCP), Good Agricultural Practices (GAP), and Good Manufacturing Practices (GMP), can help achieve the fundamental needs of food safety and quality [36].

1.1.2. HACCP

HACCP stands for Hazard Analysis and Critical Control Points and it is a systematic approach to food safety that aims to identify and control potential hazards at every stage of the food production process. The HACCP system was developed in the 1960s by a team of scientists and engineers at Pillsbury Company in collaboration with the U.S. Army

Natick Laboratories and NASA. Since then, HACCP has become a widely recognized and accepted food safety management system around the world [24].

Hazard analysis (HA), the first part of HACCP, entails the company evaluating each stage of its processes to determine what possible hazards could exist and where they might occur. The possibility of the danger occurring, and the severity of the hazard will be taken into account while evaluating it in this component. 'Significant hazard' is a term used to describe a danger that is both likely to occur and may have undesirable consequences [24]. A critical control point (CCP), which is the second element of HACCP, is defined as "a step at which control can be applied and is essential to prevent or eliminate food safety hazard or reduce it to an acceptable level" [37].

Codex Alimentarius (2009) [37] has established the seven principles of HACCP:

- *Conduct a hazard analysis*: Identify and assess potential hazards in the food production process, including biological, chemical, and physical hazards.
- *Determine critical control points (CCPs):* Identify the points in the production process where hazards can be controlled or eliminated (CCPs).
- *Establish critical limits*: Set specific limits for each CCP that must be met in order to ensure food safety.
- *Establish monitoring procedures*: Develop procedures to monitor CCPs to ensure that critical limits are being met.
- *Establish corrective actions*: Develop procedures to take corrective action when critical limits are not met.
- *Establish verification procedures*: Develop procedures to verify that the HACCP system is working effectively.
- *Establish record-keeping and documentation procedures*: Keep records to document the HACCP system and its implementation.

1.1.3. GAP

Good agricultural practices (GAPs) are essential in setting a standard for crop harvesting and on-farm processing to guarantee that contamination of fresh produce is completely avoided.

Practically speaking, GAPs aid farmers in preventing contamination of their produce. GAPs are a useful approach to ensuring food safety. The GAPs are about being aware of potential risk areas for food safety and taking precautions before a product is released onto the market. The four main production and processing areas that GAPs concentrate on are soil, water, hands, and surfaces [36].

GAPs are designed to minimize risks to human health, the environment and the quality and safety of the food produced. They are typically based on a set of principles and guidelines established by regulatory agencies, industry associations, and other organizations. Some common features of GAPs defined by FAO (2016) [38] include:

- *Site selection and preparation*: selecting a suitable site for production and preparing the soil, water, and other inputs to ensure optimum growing conditions.
- *Crop management*: using appropriate practices for planting, fertilizing, irrigating, and controlling pests and diseases.
- *Harvesting and post-harvest handling*: using appropriate methods for harvesting, sorting, cleaning, packaging, and storing crops to ensure their quality and safety.
- *Training*: The farmers and workers shall be given sufficient training in the areas of responsibility relevant to GAP and records of training shall be kept
- *Record keeping and documentation*: maintaining records of production practices and product traceability to ensure transparency and accountability.

1.1.4. GMP

Jarvis (2014) [39] referred to the terms Good Manufacturing Practices (GMPs) as food manufacturers' practices and procedures which cover all aspects including food production, storage, handling and distribution to ensure food safety, hygiene, and quality [8]. GMPs apply to manufacturing process personnel, machinery, processes, as well as the environment and their key emphasis is on reducing the potential risks of any food production [36].

The four pillars of GMP are: (1) exclusion, (2) removal of unwanted and foreign matter, (3) inhibition and (4) destruction of unwanted microorganisms. The building and its surroundings, the workforce, cleaning and sanitization procedures, equipment and utensils, processes, controls, storage and distribution are the components that make up GMP. The GMP program's analysis and control of these factors aims to produce high-

quality meals due to decreased levels of degrading microorganisms, as well as foods that are safe from the perspective of public health, as GMP are one of the strategies to control foodborne infections [40].

The management of the PDCA (plan, do, check and act) cycle is the foundation of the ongoing method for enacting GMPs. Implementing GMP can be broken down into four parts based on the PDCA cycle: completing the initial diagnosis, developing the roadmap, resolving nonconformities and revaluating the corrective actions. Initial diagnosis and revaluation of corrective steps are typically performed through facility inspection utilizing a checklist based on the nation's GMP laws. Roadmaps can be created following an inspection, but the implementation of remedial actions frequently necessitates choosing which areas to focus on first, depending on the resources and efforts that the organization has available [41].

1.1.5. The need of focusing on Food Safety Culture and Climate

How there are still numerous cases of foodborne disease despite all the audits, training, and controls put in place in the HACCP and FSMS remains a mystery [42]. The fact is that too many external factors affect food safety [43]. Nayak & Taylor (2018) [44] go on to say that the company itself has to be motivated so that everyone is committed to preventing infections from unsafe food consumption. Even when no one is looking, responsible food workers must still perform this duty daily. That would demonstrate a strong culture of food safety [45].

Wallace, Sperber & Mortimore (2014) [24] also assert that HACCP is insufficient on its own to control foodborne illnesses. In addition to HACCP, Wallace, Sperber & Mortimore (2014) [24], Yiannas (2009) [5] and Nayak and Waterson (2017) [17] discuss the necessity of a food safety culture. Only in an organization with the proper balance of attitudes, values and beliefs will a HACCP strategy be effective. The workforce must be convinced of the value of HACCP [46].

Another limitation of HACCP regards the term ‘hazard analysis’ that not many trained people comprehend. The difficulty in identifying hazards can lead to wrong interpretation and faulty critical measure identification. Such faulty HACCP analyses lead to outbreaks [24].

The problem of consumer food poisoning and outbreaks, which was not resolved by the

creation and application of FSMS, caused several academics to shift their emphasis from a formal and technical FSMS approach to a more human approach to food safety, as evidenced by the introduction of concepts like food safety culture and food safety climate [2] [14] [5] [47]. According to Griffith, Livesey, and Clayton's (2010b) [48] food safety culture can be defined as "the aggregation of the prevailing, relatively constant, learned, shared attitudes, values, and beliefs contributing to the hygiene behaviors used within a particular food handling environment" and can be thought of as a particular type of organizational culture.

Food safety culture demands businesses to alter how things are done in the workplace and extends beyond the functional parts of Food Safety Management Systems and the more conventional approaches like sampling, testing, inspections, and auditing [32]. Also, it calls for cooperation, dedication, involvement, communication, accountability, perseverance and time. It could also call for a change in how people act because behavior might be connected to the dominant Food Safety culture [2]. Additionally, if improvements in food safety performance and a decrease in the global burden of foodborne illnesses are to be achieved, a shift may be required in personal characteristics (e.g., attitudes, values) and in the organizational culture (group values, attitudes, etc.), in addition to the FSMS and the technological system environment [32]. To achieve a good food safety performance, organizations therefore need to have a well-elaborated Food Safety Management System and a positive Food Safety culture in place [14] [1].

1.2. Organizational culture

Organizational culture can be described as the traits that make up an organization. These traits compose the collection of presumptions that the organization accepts. They are preserved by ongoing interactions between people or workers and manifest in the accepted attitudes and behaviors of personnel within the organization.

Martins and Terblanche (2003) [49] defined organizational culture as "a pattern of shared basic assumptions that a group learned 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". This definition emphasizes the importance of shared

assumptions and learning within a group, as well as the role of culture in problem-solving and achieving both external adaptation and internal integration. It also highlights the concept of culture as something that is taught to new members and is considered valid based on its effectiveness in addressing organizational challenges.

Symbols, behaviors, language, and the physical surroundings inside the organization all contribute to the expression and communication of organizational culture. It influences the organization's objectives and statements and bridges the gap between what is said and what is really done [49].

As employees learn what behaviors are appropriate and how duties should be carried out, the socialization process has an impact on the culture of an organization. By the process of socialization, norms are created, accepted, and then disseminated [49].

Four common cultural types can be often found in organizations according to Martins and Terblanche (2003) [49]: Clan culture, Adhocracy culture, Market culture and Hierarchy culture.

Clan culture is characterized by a family-like atmosphere and a focus on collaboration, teamwork, and employee development. It is often found in small companies or departments where employees work closely together. Adhocracy culture is instead characterized by innovation, creativity, and risk-taking and is often found in start-up companies or industries that are highly competitive and require constant innovation. Moreover, Market culture is characterized by a focus on results, competition, and achievement. This type of culture can be mainly found in sales-driven companies or industries where performance is closely monitored and rewarded. Finally, Hierarchy culture is categorized by a focus on rules, procedures, and efficiency, peculiar for large, bureaucratic organizations where strict hierarchies and formal systems are in place [49].

While these cultural types may exist in varying degrees within a single company or department, they represent distinct orientations toward work and are associated with different values, beliefs, and behaviors. Understanding the dominant culture within an organization can be helpful in identifying strengths and weaknesses and developing strategies for improving organizational performance [49].

In order to achieve organizational goals, organizational culture can either inspire employees to work to the best of their abilities or it might demoralize them, which would

have a detrimental effect on the organization's performance. Organizational culture has a greater impact on behavior than management directives. As a result, the dynamic aspect of the organization can be characterized and described using organizational culture. Certain organizational cultures are more resilient than others since they are an integral aspect of every organization [50].

A framework for comprehending organizational culture and the various sorts of cultures that can exist inside an organization is Handy's Model of Organizational Culture, developed by Handy (1993) [51]. Four major categories of organizational culture are identified by the model:

- *Power culture*: In a power culture, power and decision-making are concentrated in the hands of a small group of people or one individual. In tiny companies or those that demand a strong, centralized leadership, power cultures are frequently present.
- *Role culture*: In a role culture, individuals are arranged into well-defined and highly structured roles, and decisions are made in accordance with rules and procedures. In bureaucratic organizations like governmental institutions or big businesses, role cultures are common.
- *Task culture*: In a task culture, people are allowed a lot of autonomy to accomplish their goals and the emphasis is on getting the job done and addressing issues. Project-based businesses or those that demand a lot of creativity frequently have task cultures.
- *Person culture*: In a person culture, people are prioritized above the organization as a whole, and decisions are made with each person's best interests in mind rather than the company's overall goals. Human cultures are uncommon and are frequently observed in fields like academia or the arts.

These models can be helpful for characterizing organizational culture, but they can also be deceptive because an organization will often operate with multiple cultures at once. Due to external influences and structural changes within the organization, the dominant and mixture of cultures will shift [50].

Consequently, it's crucial to keep in mind that an organization's culture is made up of both subcultures and cultural models such as power, task, position, and person cultures. The goals and objectives of these subcultures are related to business, health, safety, and food safety. These subcultures will have an impact on the organization's financial, health, safety, and food safety performance as well as employee beliefs and behaviors.

Also shaping an organization's culture and having an impact on its overall success are managers' views, attitudes, and behaviors [52].

1.3. Food Safety Culture

The study of food safety is not new, however there have been questions raised about the historical dominance of a microbiological approach and the drawbacks of this [4]. A lot of research has investigated what food handlers know, feel, and act about food safety in response to calls for the increased adoption of a behavioral approach [4].

Focusing on this strategy has come under scrutiny more recently after it was discovered that some food handlers were not following recommended food hygiene procedures [53]. As a result, the idea of the pervasive, collective food safety culture within a firm has received more attention [35] [5] [53]. Several epidemic investigations have brought attention to the significance of food safety culture and more study is being done on the subject [17] [34] [35] [2] [48] [54] [55].

Food safety culture can be considered as a specific form of organizational culture and is embedded in Schein's (2004) [56] definition of organizational culture, "a pattern of shared basic assumptions that was learned by a group while solving its problems".

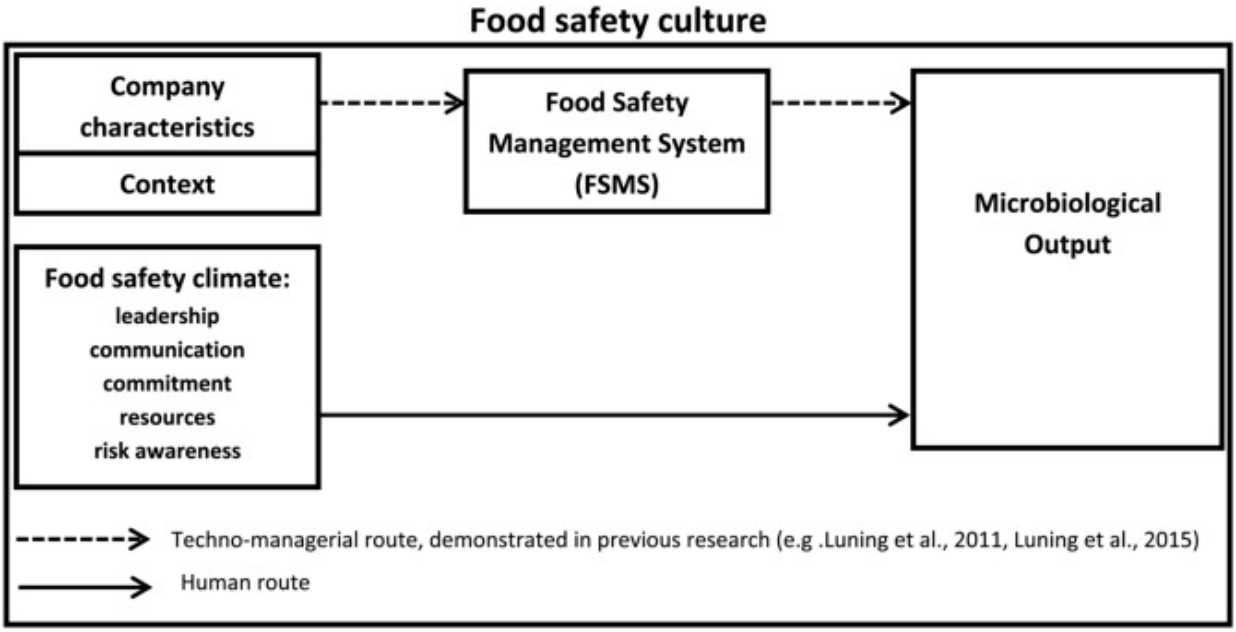
Moreover, food safety culture has been defined as "the aggregation of the prevailing, relatively constant, learned, shared attitudes, values, and beliefs contributing to the hygiene behaviors used within a particular food handling environment" [48].

This type of definition recognizes certain key elements including that: every food business will have a food safety culture whether it is known or (as is more usual) unknown; a culture can be positive; the food safety culture does belong to one person but is shared within a group; new employees pick up on this culture, and regardless of their personal views on food safety, they could adjust their behavior to conform to that of their colleagues and the company [35].

Food safety culture was also defined in De Boeck, Jacxsens, Bollaerts, and Vlerick's (2015) [1] conceptual model as the interaction between the implemented Food Safety Management Systems, which will be influenced by the available technology, company characteristics, and the context of the company (so-called "techno-managerial route"), and the perceived food safety climate by employees and management at all levels of a

company (so called 'human route'). Employees' (shared) perceptions of leadership, communication, dedication, resources, and risk knowledge about food safety and hygiene within their present workplace are referred to as the food safety climate, which is a component of the food safety culture (Figure 1) [1].

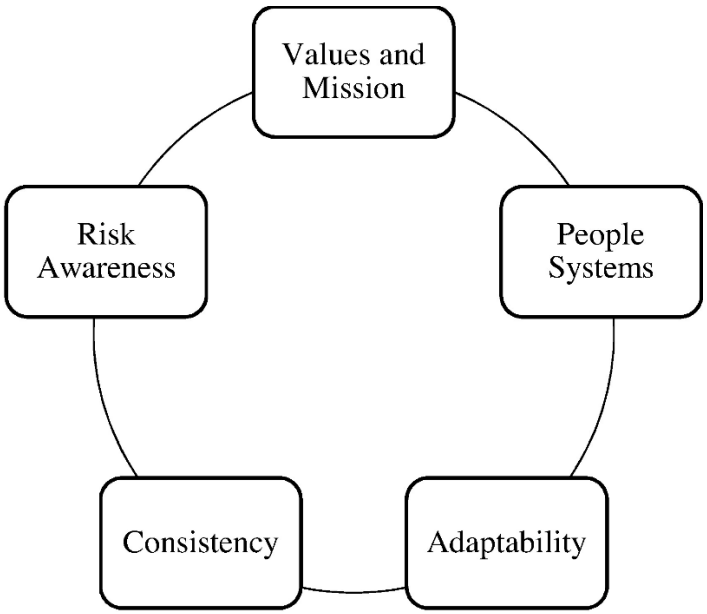
Figure 1. Food safety culture: conceptual model [1]



According to the definitions of organizational culture and food safety culture, cultures are learned and transmitted from generation to generation [2] [56]. They are dynamic and influenced by a variety of conditions and factors, and are built on widely held assumptions, values, and beliefs. Food producers can assess culture to gain a quick understanding of their strengths and shortcomings and decide what to do with their resources and how to proceed [3].

Jespersen, Griffiths, and Wallace (2017) [3] proposed a dimensional framework to food safety culture, composed by five dimensions (Figure 2):

Figure 2. Food safety culture - dimensional framework [54]



- *Risk awareness*: This dimension includes a shared understanding of potential food safety hazards and how to prevent them, as well as awareness of the consequences of food safety failures.
- *Value and mission*: This dimension includes a strong organizational commitment to food safety, as well as alignment of food safety goals with the broader organizational mission and values.
- *People systems*: This dimension includes the role of leadership in building a strong food safety culture, as well as the engagement and empowerment of employees in food safety practices.
- *Consistency*: This dimension includes the establishment and consistent implementation of food safety policies, procedures, and controls across all levels of the organization.
- *Adaptability*: This dimension includes the ability of the organization to adapt to changes in food safety requirements, emerging hazards, and new technologies.

1.3.1. The impact of Food Safety Culture on Food Safety

All food safety culture models acknowledge that an organization's food safety culture may have a positive or negative impact on food safety. There were three ways to categorize the kind of food safety culture that an organization had in the examined literature [57]:

- Griffith, Livesey and Clayton (2010a) [2] claim that all food enterprises have a safety culture, some of which are positive and some of which are negative. Businesses in the food industry with a positive food safety culture prioritize food safety, whereas those with a bad food safety culture prioritize sales and profits. Many often, owners of food businesses are unaware of how much more expensive product recall and outbreak control are than effectively developing and implementing food safety processes and fostering a strong food safety culture inside their food business [58].

  Ineffective management contributes to a negative food safety culture [59]. According to Griffith (2010) [59], management is divided into two components: systems used to assure food safety and organizational adherence to safety culture systems. Food safety is increased through a strong safety culture, which also benefits the brand's reputation [17] [60]. Thus, it is essential to educate every employee on the value of a strong food safety culture.

- Food safety culture is categorized as reactive, active, or proactive by Nyarugwe et al. (2018) [7].

  (1) Reactive food safety cultures are characterized by poor support, little to no consideration for the significance of food safety and safe practices, and actions conducted only in response to external stimuli; attitudes, values, and beliefs towards food safety behaviours are not created. (2) In an active Food safety culture, food and other safety procedures are only partially valued and supported; attitudes, values, and beliefs around food safety behaviours are formed but not shared. (3) High esteem and unwavering support for food safety and safe procedures are characteristics of a proactive FS-culture; attitudes, values, and beliefs regarding food safety behaviours are formed and shared.
- Food safety culture is characterized by its maturity, which is divided into five phases by Jespersen et al. (2016) [54]: (1) doubt, (2) respond to, (3) know about, (4) predict, and (5) internalize.

Each of these stages can be defined by a question or a statement: Questions like "Who screwed up?" and "Food safety - QA does that?" characterize Stage 1 of Doubt. Reacting to queries and scenarios like "How long would it take?" and "We are adept at fighting fires and reward it" are examples of Stage 2. Stage 3 is known and is characterized by phrases like "I know it's essential, but I can only address one issue at a time." Predict is the fourth stage, and lines like "Here we plan and execute with knowledge, data, and patience" are used to characterize it. Internalize is Stage 5, which is characterized by statements like "Food safety is an intrinsic element of our company".

1.4. Food Safety Climate and its determinants

Nevertheless, research on food safety has changed from a technologically centered FSMS to its human component, which is typically referred to as "food safety climate" [61].

Although in the literature for a long time there was no clear difference between food safety culture and food safety climate and for this reason they were used indiscriminately, recently some scholars have started to give a clear definition.

According to Sharman et al. (2020) [62], food safety climate can be defined as “a temporary construct existing at the individual level, relating to the perception and attitudes of individuals and how they influence others in an organization to adhere to the food safety management systems and practically apply these in their working environment”. Differentiating it from food safety culture defined more as a long-term construct related to beliefs, behaviors, and assumptions that impact food safety performance.

As already explained in the previous section, also in the De Boeck, Jacxsens, Bollaerts, and Vlerick's (2015) [1] conceptual model a clear differentiation has been theorized: food safety climate is a component of the food safety culture and is defined as “Employees' (shared) perceptions of leadership, communication, dedication, resources, and risk knowledge about food safety and hygiene within their present workplace”.

Food safety climate is determined by a range of factors, including leadership, communication, commitment, resources, and risk awareness [1]. Highlighting and understanding the factors that can impact food safety climate is important for

organizations to maintain a strong culture of food safety and ensure the safety and quality of their products.

1.4.1. Leadership

Strong leadership commitment to food safety is critical for building a positive food safety culture, and leaders should set clear expectations for food safety practices and provide resources and support for their implementation.

Better leaders make their organizations more productive, competitive, and responsive [2]. Also, the climate of an organization is determined from the top down [5]. Consequently, having strong management alone is not enough; strong leaders are also required.

Leaders need to show that hygiene and food safety are more essential than things like productivity and cost-cutting [48]. This idea ought to become part of the corporate culture. Also, if employees have personal hygiene and food safety ideas and values that are in line with those of the firm, they will be more motivated and perform better since they do not just see it as a duty but rather something they believe in [2].

It may be a sign of strong leadership ambition and a reflection of how important hygiene and FS are to the business when leaders strive for ongoing development in these areas [1].

Employees on the shop floor are frequently the first to spot infractions and to identify issues and opportunities since they are regularly exposed to cleanliness and food safety standards. As a result, it may be advantageous for managers to pay attention to staff members who make comments or suggestions about hygiene and food safety [1].

1.4.2. Communication

It is possible to learn a lot about a Food Safety culture of an organization by the manner in which a company shares FS concerns and communicates FS directives with personnel at all levels [61]. There are several ways available to do this crucial work in the current food business environment, including verbal, written, and visual communications, as

well as a range of media including signs, posters, leaflets, and brochures, company intranet sites, and even company-run television channels [5].

Leaders should communicate in a manner that is clear, simple to grasp, and appropriate for the recipient's educational background. This statement also implies that the appropriate terminology should be utilized, and that extra effort should be made to ensure that messages on hygiene and food safety are understood by staff members who do not share the same primary language [22].

Moreover, spreading hygiene and food safety information through a variety of media can boost efficacy [5]. The identification of crucial control points inside an organization through signage and messaging encouraging hand washing at washing facilities are a few such examples.

1.4.3. Commitment

According to De Boeck et al. (2015) [1], commitment refers to how managers and staff members express their commitment to and value for food safety. It entails allocating funds to assure the development and upkeep of a food safety culture, backing activities related to food safety, and displaying visible and proactive leadership in promoting and enforcing food safety principles. This factor represents the organization's willingness to invest in food safety and how seriously it is treated across the board.

Similar to this, Powell et al. (2011) [14] defined commitment as management's active engagement in promoting food safety and offering the required tools and training to guarantee it. In general, the term "commitment" in the context of food safety refers to the degree of commitment and support shown by management towards food safety inside the business.

1.4.4. Resources

De Boeck et al. (2015) [1] defined the food safety climate component resources as the availability of the necessary resources (e.g., time, money, equipment, personnel) to perform work according to food safety procedures and guidelines. It includes the adequacy of resources and the support provided by the organization for the implementation of food safety practices. The authors emphasized that inadequate

resources could lead to a negative food safety climate, as employees may perceive that food safety is not a priority for the organization.

Maintaining food safety procedures and preventing foodborne diseases require enough resources. A strong food safety atmosphere and improved food safety outcomes are more probable in organizations that prioritize and invest in resources for food safety. Organizations that do not devote enough resources to food safety, on the other hand, may find it difficult to uphold food safety procedures and are more likely to experience food safety problems [14] [1].

1.4.5. Risk awareness

The degree to which workers are aware of the possible hazards associated with food safety and the steps that must be taken to reduce those risks is described by De Boeck et al. (2015) [1] as the food safety climate component of risk awareness. It entails being aware of the potential risks at work and taking the necessary precautions to avoid them. This factor is crucial because it shows how well-informed and aware personnel are of the risks to food safety, as well as how well-equipped they are to see possible dangers and take the necessary precautions to avoid disasters.

Employees' overconfidence in hygiene and food safety concerns and their miscalculation of the food safety risks are both possible contributors to food safety difficulties. However, employees will be less likely to conduct themselves in a hygienic and food-safe manner if they believe that the leaders overstate and exaggerate the hazards pertaining to hygiene and food safety [2].

Hence, at the same time as employees must be vigilant and aware of potential issues and dangers linked to hygiene and food safety, leaders should have a realistic understanding of those issues and hazards [1].

1.5. National culture as impact factor of Food safety culture and climate

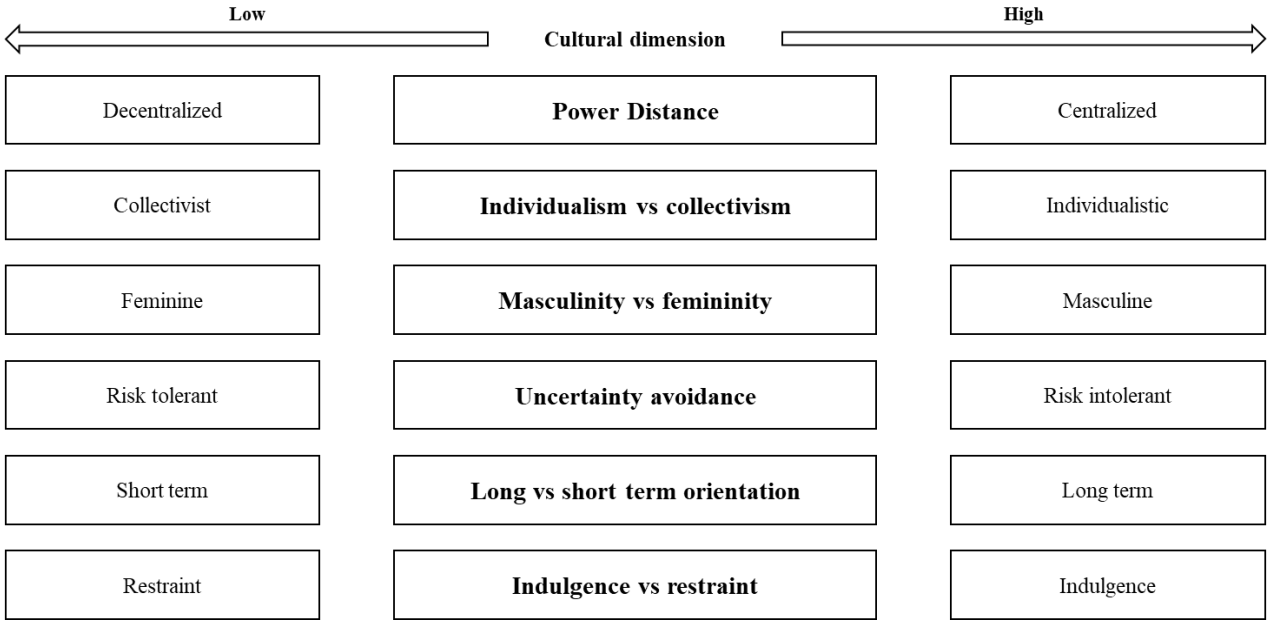
Another important factor that several scholars believe influences food safety culture and climate is national culture [22] [63] [64]. Although it cannot be classified as a determinant, it can influence and determine the work within a business environment.

Culture is defined at the national level as “collective programming of the mind that distinguishes the members of one group or category (nation) of people from others” [65].

National culture is recognized in existing research as a situational factor that affects how organizations function and perform [66].

Hofstede identified six cultural dimensions to analyze values that differ among nations [65] (*Figure 3*).

Figure 3. Hofstede's six cultural dimensions (adapted from [65])



Power distance, the first dimension, makes a distinction between low-power distance cultures, where decision-making is decentralized and employees expect to be consulted, and high-power distance cultures, where decision-making is centralized, and employees are hardly involved in it [65]. This component deals with the fact that not all people in civilizations are created equal; it expresses how the culture views these differences between people. Power distance is the degree to which members of institutions and organizations within a nation who are less powerful assume and accept that power is dispersed inequitably [67].

The second dimension focuses on individualism versus collectivism and makes a distinction between individualistic cultures, where people are expected to look out for their own interests and achievement is based on individual merit rather than teamwork,

and collectivistic cultures, where group interests take precedence over individuals' interests [65]. The degree of interdependence a society maintains among its members is the key problem this dimension attempts to solve. Whether or not individuals describe themselves in terms of "I" or "We" is relevant. People in individualist society are expected to take care of themselves and their immediate family. People in collective societies are members of "in groups" that provide for them in exchange for their allegiance [67].

The third component is masculinity versus femininity, where individuals in masculine cultures are forceful and hesitant to help others unless they receive recognition, whereas people in feminine cultures help others and place a higher importance on relationships and other people than on monetary achievement [65]. A high score (Masculine) on this dimension denotes a society that is motivated by competition, accomplishment, and success, with success being defined by the winner / best in field - a value system that begins in school and lasts throughout organizational life. If the dimension has a low score (Feminine), then quality of life and compassion for others are the dominating social ideals. Living a high-quality life is a sign of success in a feminine culture and standing out from the crowd is not admired. The core problem here is whether people are motivated by a desire to excel (masculine) or a love of what they do (feminine) [67].

In terms of uncertainty avoidance, people in societies with high levels of uncertainty avoidance are expressive and stay away from ambiguous circumstances, whereas those in societies with low levels of uncertainty avoidance are less expressive and feel safe [65]. The aspect of uncertainty avoidance is concerned with how a society responds to the reality that the future is always uncertain. The score on Uncertainty Avoidance reflects how much a culture's citizens feel frightened by ambiguous or unknowable circumstances and have developed ideas and structures to try to avoid them [67].

The fifth component is long versus short-term orientation, where long-term cultures emphasize perseverance, long-term goals, and future rewards, whereas short-term cultures concentrate on current problems [65]. This dimension shows how cultures prioritize these two existential aims differently and how each society must keep some ties to its own history while addressing the difficulties of the present and the future. Normative cultures, which rank poorly on this metric, favor upholding time-honored customs and conventions while being wary of societal change. On the other hand, high-

scoring cultures adopt a more practical approach: they promote thrift and efforts in contemporary education as a means of preparing for the future. [67].

The sixth dimension is indulgence versus restraint, where indulgent cultures are characterized by unrestrained satisfaction and restraint cultures are characterized by self-control that is constrained by societal standards [65]. Based on how they were raised, this dimension is described as the degree to which people attempt to regulate their impulses and inclinations. "Indulgence" and "Restraint" are terms for comparatively strong and poor control, respectively. Therefore, cultures might be categorized as indulgent or restrained [67].

Due to their comprehensiveness, applicability, acceptability, and convenience for evaluating the contribution of national culture to organizational and safety culture and safety performance, these dimensions have been widely employed (e.g., [66]). Moreover, this method offers country-specific numeric scores for each of their cultural dimensions allowing international comparison between cultures, also called comparative research [61].

Wallace (2009) [63], Taylor (2011) [22], and Nyarugwe et al. (2020) [64] made the suggestion that the dimensions could have an impact on the success of the FSMS and the organization's food safety culture from the standpoint of food safety. For instance, their studies revealed that employees seek individual acknowledgment for their efforts in individualistic cultures, but employees in collectivistic cultures want to fulfil food safety goals by working as a team. Wallace (2009) [63] proposed that employees in masculine cultures prioritize getting the work done while those in feminine cultures are more inclined to help one other to meet food safety regulations. Also, people "are more open of new ideas and will likely take on new tasks" in low uncertainty avoidance cultures, while organizations with long-term-oriented cultures place a strong emphasis on having comprehensive and well-established food safety policies/systems [63]. Organizations may offer transient solutions to food safety issues in short-term-focused societies [22].

Additionally, Nyarugwe et al. (2020) [64] claimed that individualism and power distance were positively and negatively connected with the degree of risk perception, meaning that lower power distance and higher individualism were associated with improved risk perceptions for food safety and hygiene and that in countries with high power distance scores, food handlers are not free to approach and communicate with their bosses.

1.6. Food safety Culture and Climate assessment tools and outcomes associated

The three first theoretical studies of Griffith ([59], [2], [48]) were the starting point for multiple study groups to define and create a number of techniques to evaluate the prevalent Food Safety culture in various food industries [16] [21] [22] [1] [3] [7] [68] [69].

The primary goals of the tools to assess food safety culture were to assist companies in understanding why staff members might or might not adhere to safe food handling procedures [22] [2]. Because of this, the instruments often polled employees at many organizational levels, including senior management, middle management, and food handlers. Additional techniques described in the literature include focus groups, third-party audits, data verifications, third-party audits of certain types of data, and staff behavior observations [57].

Almost all the studies that evaluated it used quantitative questionnaires as their primary method of evaluation [21]. Most of the questionnaires employed Likert-scale question types [21]. Because they are a quick technique to gather information and make it simple to gather data from many people, questionnaires were utilized in research involving both managers and food handlers. Even if they are helpful, surveys have drawbacks because they can show bias if respondents don't read the questions carefully or don't take the time to provide complete answers [21]. Furthermore, when questioned, food handlers could explain their procedures in an extremely biased manner [46]. Another drawback of questionnaire-based food safety culture research is that it primarily measures the outward manifestations (the artifacts) of culture rather than its underlying presumptions. On the other hand, by using a strong questionnaire design and conducting adequate pre- and pilot-testing, these constraints can be reduced [56]. Moreover, when the relative utility and validity of such models are assessed, surveys are useful for comparisons and correlation analysis, e.g., between organizations, food handlers, or sectors [56]. Additionally, questionnaires can be helpful in specific assessments of culture, such as determining whether certain aspects of culture are systematically related to certain aspects of performance, analyzing subculture differences, or educating employees about certain crucial aspects that management wants to focus on [56].

However, according to Zanin et al. (2021) [21], there is no agreement or accepted norm on the factors or dimensions to evaluate Food safety culture. Yet, the most often utilized factors/dimensions for evaluating Food safety culture are people, communication, commitment, leadership, FSMS, risk, and work environment [21].

The first empirical and methodological studies by De Boeck et al. (2015) [1], Ball et al. (2010) [68] and Ungku Fatimah et al. (2014) [69] evaluated Food Safety culture using a quantitative approach with questionnaires as their primary data collection tool. Instead, Griffith et al. (2017) [34] employed a qualitative approach based on semi-structured interviews.

According to Taylor et al. (2015) [70], conducting in-depth interviews with key employees inside a food production setting is particularly beneficial for learning about the organization's food safety culture.

Moreover, Jespersen and Wallace (2017) [71] introduced a mixed-methods strategy that included quantitative and qualitative techniques. Due to the intricacy of the phenomena, it is the suggested method for doing FS-culture study [55]. These methods necessitate a lot of time and resources, though. The generation of a series of survey questions that are simple, valuable and can achieve a degree of depth in a shorter amount of time, comparable to the interview technique, would be a speedier and more practical option [25]. Indeed, quantitative surveys using Likert scale questions were the major technique used to analyze Food Safety culture [21].

The most important quantitative tools developed in recent years are listed below:

- De Boeck et al. (2015) [1] developed a self-assessment tool to measure food safety climate in food processing companies. The tool consists of a questionnaire that includes 28 statements related to five different components of food safety climate, such as leadership, communication, commitment, resources, and risk awareness. The questionnaire is designed to be completed by employees at all levels of the organization, from management to frontline workers, and its aim is to identify how the company's climate concerning hygiene and food safety is perceived by their employees. Respondents are asked to rate the extent to which they agree or disagree with each statement on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The responses are used to calculate scores for each of the components, providing a quantitative measure of

the organization's food safety climate. The tool is intended to be used as a diagnostic tool to identify areas for improvement in the organization's food safety culture and to track progress over time. This tool has been used in several studies, starting from the one in which has been tested and validated [1], but also in some other subsequent studies [30] [61] [72].

- Ungku Fatimah et al. (2014) [69] also developed a self-assessment tool for food safety climate in the Malaysian food industry. The tool consists of 47 items grouped into nine dimensions: Leadership (5 items) – the extent to which leaders visibly demonstrate their commitment to food safety; 2) Communication (7 items) – the effectiveness with which management, supervisory personnel, and co-workers convey information and understanding about food safety; 3) Self-commitment (5 items) – attitudes and opinions held by employees on best practices for food safety; 4) Management system and style (5 items) – coordinated activities or policy and procedure to direct or control food safety; 5) Environment support (5 items) – the infrastructure's accessibility and quality in fostering a culture of food safety; 6) Teamwork (5 items) – teammates' assistance in implementing safe food handling procedures at work; 7) Accountability (5 items) – controls in place to ensure that expected results are realized; 8) Work pressure (5 items) – a variety of pressures related to food preparation and service that have an impact on safe food handling procedures; 9) Risk perception (5 items) – organizational risk awareness and risk judgments with reference to food safety.

  Each item is rated on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The tool has been used to assess food safety climate in various types of food establishments in Malaysia, including food manufacturing plants, food service establishments, and wet markets. The results of the assessment have been used to identify areas for improvement and to develop strategies to enhance food safety culture in these establishments.
- Ball et al. (2010) [68] created a Food Safety Climate tool to examine the major factors influencing meat processing plant employees to adhere to food safety protocols. The 65 questions of the tool, based on a 7-point Likert scale, measured five workplace factors: infrastructure, worker food safety behaviours, management commitment, work unit commitment, and training in food safety. The fundamental characteristics of the atmosphere surrounding food safety in

meat processing factories were discovered using factor and reliability analyses, conducted on SPSS 17. The findings of the extraction of fifteen factors with Eigenvalues larger than one revealed significant cross loading among the components. The fifteen components were subsequently divided by the authors into five higher order factors (i.e., factor that contain several sub-factors). The cross loadings were proposed as a possible indicator of factor interconnection.

Furthermore, moving to the connection between Food Safety Culture and the outcomes, only few empirical investigations specifically looked at it. The economic effect, the correlation between good microbiological hygiene and favourable food safety climate, the relationships between the food safety climate and employees' food safety behaviour and the connection between the environment's food safety climate and Listeria monocytogenes contamination were among the outcomes that were investigated. The majority of researchers used employee questionnaires to gauge an organization's Food Safety Culture and its connection to food safety results [57].

Jespersen et al. (2019) [73] found that positive changes in food safety culture maturity could lead to potential economic gains. They stated that as food firms increasingly understand the strategic value of their food safety culture, the need for a reliable and meaningful evaluation grows. So, the maturity scale defined by Jespersen et al. (2016) [54] was aligned to the levels of Crosby's Quality Management Maturity Grid [74] in order to estimate the proportion of the sales wasted through cost of poor quality and design interventions to improve food safety performance.

The cost of poor quality (COPQ) was calculated by Jespersen et al. (2019) [73] using the following percentage of sales per maturity stage [74] (*Figure 4*):

Figure 4. Maturity stages and cost of quality as percentage of sales [74]

Maturity stage	**1**	**2**	**3**	**4**	**5**
Percentage (%)	20	18	12	8	2.5

In their study, Jespersen et al. (2016) [54] analyzed 5 different companies and they found the firms spend $1.14 billion of sales on cost of poor quality yearly. They would

incur an additional $0.38 billion in sales if they all slipped back one maturity level, while an additional $0.43 billion in sales would be saved if they all moved up one stage. Thus, this study demonstrates the importance and the economic impact of the company's food safety culture.

De Boeck et al. (2016) showed that associated butcher shops are able to achieve good microbiological hygiene and safety status because they have both a well-developed food safety management system and a favorable food safety climate. While in the examined farm butcheries, the overall lower level of safety and sanitation is probably due to their lower food safety climate score in combination with a simpler food safety management system. This semi-quantitative case study showed that a good and steady microbiological output in food enterprises is likely to be caused by employees' perceptions of a positive food safety climate combined with a suitable food safety management system [75].

Instead, De Boeck et al. (2017) [30] looked at the phenomenon at the individual level, especially studying the relationship between the food safety climate and employees' food safety behavior. Therefore, the conceptual food safety culture model of De Boeck, Jacxsens, Bollaerts, and Vlerick (2015) [1] was expanded by introducing food safety behavior, knowledge, motivation, burnout, and job stress of the individual employees in the organization. They mainly found that employees' compliance, involvement and conduct with regard to food safety are both directly and indirectly connected to the food safety climate and food safety knowledge serves as a partial mediator in the relationship between the food safety climate and the behavior with regard to food safety [30].

The first investigation into the connection between the environment's food safety climate and Listeria monocytogenes contamination in retail deli settings has been conducted by Wu et al. (2020) [76] and offers guidance for effectively enhancing the environment's food safety climate, culture, and hygiene. In order to assess the relationships between the climate, culture and Listeria monocytogenes control for food safety, a forty-four-question poll on feeling of dedication, staff training and personal hygiene was conducted in 50 supermarket retail deli departments across six states in the United States. The results of the study confirmed the fundamental significance of value, commitment, and hygiene, which are closely related to food safety and Listeria monocytogenes prevalence and control. Indeed, the study found that a stronger food safety culture, particularly greater manager and employee commitment and better

perception of training program and infrastructure was significantly associated with lower Listeria monocytogenes contamination risk [76].

To conclude, De Boeck et al. (2015) [1] self-assessment tool has been identified as the most suitable tool for the present study, as it possesses a lean but comprehensive structure that will be well explained in the next chapter.

Although in later studies (e.g., [47]), the people- or human-oriented method using the food safety climate self-assessment tool has been combined with two managerial-technique-oriented methods, such as internal audits and verification of critical control point recording data as part of daily HACCP system monitoring, both of which assess FSMS performance, in this case it was not possible to receive audits or checkpoints from the different companies involved and only the evaluation of the human component will be pursued.

2. Materials and methods

2.1. Structure of the Food Safety Climate questionnaire

As anticipated in the previous chapter, the tool developed by De Boeck et al. (2015) [1] has been selected, among the possible tools, for the present study. It was found to be the most suitable as it is a comprehensive tool that gives the ability to compare several responses from different companies.

The tool was originally developed in two sections: the first related to organizational characteristics of the company and the second focused on food safety climate assessment.

In the case of the present study, the first part was redesigned to capture data useful for subsequent analysis, while the second part remained the same as in the paper of De Boeck et al. (2015) [1] because it had already been validated by experts and used in past studies ([30], [1], [75]). Therefore, the questionnaire was designed with 34 multiple-choice questions in total.

The first section of the survey consisted of six multiple-choice questions related to organizational characteristics of the food companies. General organizational characteristics which were deemed relevant are: function of the respondent, organizational size (number of full-time equivalents, FTE), production sector, which department is mainly in charge of food safety issues and food safety certifications acquired (*Table 1*). These kinds of characteristics have been defined as important according to the aim of the study to look not at the single company but instead at a bigger picture. The idea in fact is to analyse the perceptions according to the different organizational characteristics.

It is important to note that subsequently for the purposes of the analysis, the breakdown of companies by size (FTE) changed, grouping the seven initial categories into three clusters: 1-49 FTE, 50-249 FTE and more than 250 FTE.

Table 1. Introductory questions

	Introductory questions				
1	Function of the respondent				
	☐ R&D	☐ Sales	☐ Operations	☐ Quality	☐ Other

2	Production sector of the company								
	☐ Cereals	☐ Legume	☐ Milk	☐ Food Flavouring	☐ Dried fruits	☐ Sugar	☐ Honey	☐ Coffee	☐ Other
3	Total number of full-time equivalents (FTE) in the company								
	☐ 1-19	☐ 20-49	☐ 50-99	☐ 100-249	☐ 250-499	☐ 500-999	☐ > 1000		
4	Dedicated full-time Food Safety roles in the company								
	☐ Yes				☐ No				
5	Department mainly in charge of Food Safety in the company								
	☐ R&D		☐ Quality		☐ Operations		☐ Other		
6	Food Safety certifications acquired by the company								
	☐ FSSC 22000		☐ BRCGS Food Safety		☐ IFS Food		☐ Other		

The second part of the survey, which was based on research by De Boeck et al. (2015) [1], asked participants to score 28 indicators or statements on a five-point Likert scale (1–5: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree). The 28 indicators were divided into the following groups: 6 indications (L1-L6) belonged to the component "Leadership," 5 indicators (C1-C5) to the component "Communication," 6 indicators (E1-E6) to the component "Commitment," 6 indicators (M1-M6) to the component "Resources," and 5 indicators (R1-R5) to the component "Risk awareness" [1]. A higher score on the response scale (greater agreement with statements) coincides with a better perceived food safety climate in the organization since the indicators and answer scale were designed in this way.

As already stated in the previous chapters, De Boeck et al. (2015) [1] divided the 28 indicators into a range of factors, including leadership, communication, commitment, resources, and risk awareness.

The first factor is Leadership, because a strong leadership commitment to food safety is critical for building a positive food safety culture, and leaders should set clear expectations

for food safety practices and provide resources and support for their implementation. This factor is represented by six different statement which are presented below (*Table 2*).

Table 2. Leadership indicators [1]

	LEADERSHIP
L1	In my organization, the leaders set **clear objectives** concerning hygiene and food safety.
L2	In my organization, the leaders are clear about the **expectations** concerning hygiene and food safety **towards operators**.
L3	In my organization, the leaders are able to **motivate** their operators to work in a hygienic and food safe way.
L4	In my organization, the leaders **listen to operators**, if they have remarks or comments concerning hygiene and food safety.
L5	In my organization, hygiene and food safety issues are addressed **in a constructive and respectful way** by the leaders.
L6	In my organization, the leaders strive for a **continuous improvement** of hygiene and food safety.

The second factor, namely Communication, is composed by five statements (*Table 3*) and is considered as a fundamental component as it is possible to learn a lot about a food safety culture of an organization by the manner in which a company shares food safety concerns and communicates food safety directives with personnel at all levels [61].

Table 3. Communication indicators [1]

	COMMUNICATION
C1	In my organization, the **leaders communicate regularly** with the operators about hygiene and food safety.
C2	In my organization, the **leaders communicate in a clear way** with the operators about hygiene and food safety.

C3	In my organization, it is possible for the **operators to communicate** about hygiene and food safety **with the leaders**.
C4	In my organization, the importance of hygiene and food safety is **permanently present** by means of, for example, posters, signs and/or icons related to hygiene and food safety.
C5	I can **discuss** problems concerning hygiene and food safety **with colleagues** in my organization.

The third component, made up of 6 indicators (*Table 4*), concerns the commitment about food safety in the company. According to De Boeck et al. (2015) [1], commitment refers to how managers and staff members express their commitment to and value for food safety. Similarly, Powell et al. (2011) [14] defined commitment as management's active engagement in promoting food safety and offering the required tools and training to guarantee it.

Table 4. Commitment indicators [1]

	COMMITMENT
E1	In my organization, the leaders clearly consider hygiene and food safety to be of **great importance**.
E2	My colleagues are **convinced of the importance** of hygiene and food safety for the organization.
E3	In my organization, working in a hygienic and food safe way is **recognized and rewarded**.
E4	In my organization, the leaders **set a good example** concerning hygiene and food safety.
E5	In my organization, the leaders **act quickly** to correct problems/issues that affect hygiene and food safety.
E6	In my organization, operators are **actively involved** by the leaders in hygiene and food safety related matters.

The fourth factor, namely Resources, is composed by six statements (*Table 5*) and according to De Boeck et al. (2015) [1] can be synthetized as the availability of the necessary resources (e.g., time, money, equipment, personnel) to perform work according to food safety procedures and guidelines. It includes the adequacy of resources and the support provided by the organization for the implementation of food safety practices.

Table 5. Resources indicators [1]

	RESOURCES
M1	In my organization, operators get **sufficient time** to work in a hygienic and food safe way.
M2	In my organization, **sufficient staff** is available to follow up hygiene and food safety.
M3	In my organization, the **necessary infrastructure** (e.g., good workspace, good equipment…) is available to be able to work in a hygienic and food safe way.
M4	In my organization, **sufficient financial resources** are provided to support hygiene and food safety (e.g., lab analyses, external consultants, extra cleaning, purchase equipment…).
M5	In my organization, **sufficient education and training** related to hygiene and food safety is given.
M6	In my organization, **good procedures and instructions** concerning hygiene and food safety are in place.

The last factor is characterized by 5 components (*Table 6*) and is named Risk Awareness. It can be defined as the degree to which workers are aware of the possible hazards associated with food safety and the steps that must be taken to reduce those risks and entails being aware of the potential risks at work and taking the necessary precautions to avoid them [1].

Table 6. Risk Awareness indicators [1]

	RISK AWARENESS
R1	In my organization, the risks related to hygiene and food safety **are known**.
R2	In my organization, the risks related to hygiene and food safety **are under control**.
R3	My colleagues are **alert and attentive** to potential problems and risks related to hygiene and food safety.
R4	In my organization, the **leaders have a realistic picture** of the potential problems and risks related to hygiene and food safety.
R5	In my organization, the **operators have a realistic picture** of the potential problems and risks related to hygiene and food safety.

2.2. Sample

2.2.1. Italian packaged confectionery raw material suppliers

The industry of raw material suppliers for the production of packaged confectionery in Italy was selected as the sample to be assessed as it is an important sector within the country's food industry. This sector includes companies that provide a wide range of ingredients used in the production of sweets, such as milk, sugar, flours, flavors, colorings, and more.

The ingredients supplied by these companies are essential for creating high-quality and delicious sweets, both for the domestic and international markets. Italy is renowned for its culinary tradition and artisanal sweets, and the quality of the raw materials used is a crucial element in creating excellent products.

Raw material suppliers for the production of confectionery in Italy can be divided into various categories depending on the type of ingredient they provide. Some companies may specialize in the production and supply of high-quality milk, while others may focus on supplying refined sugar or special food flavoring for sweets.

These companies often work closely with confectionery manufacturers, providing them with the necessary raw materials for production. They may also offer consulting services and technical support to ensure the proper and safe use of ingredients.

In the confectionery raw material suppliers' industry, quality and food safety are of paramount importance. Companies must adhere to strict standards and regulations to ensure that the supplied raw materials are safe for human consumption and meet the required quality standards [26].

The companies of the Confectionery food industry must adopt an efficient supplier approval and control system to ensure that all potential risks associated with raw materials (including primary packaging), regarding safety, authenticity, legal compliance, and final product quality, are properly understood and managed [26]. This in fact is one of the main rationales behind the analysis carried out.

The companies must implement a documented supplier approval procedure to ensure that all suppliers of raw materials and primary packaging know how to manage the risk associated with the safety and quality of raw materials and adopt efficient traceability procedures. The approval procedure must be based on a risk assessment or a combination of the following elements [26]:

- A valid certification recognised by the Global Food Safety Initiative.
- An audit at the supplier's premises to assess food safety, traceability, HACCP compliance and Good Manufacturing Practices (GMP), carried out by an inspector with proven food safety expertise.

A documented process for the continuous verification of supplier performance, based on pre-defined performance and risk assessment criteria, must be in place, and the company must ensure that its raw material suppliers (including primary packaging) have an effective traceability system [26].

2.2.2. Structure of the sample

The sample of the current study was composed of employees of Italian Confectionery raw materials suppliers' industry. The companies involved belong to the following production sectors: cereals, food flavouring and essential oils, honey, milk, and sugars. Surveying began on 27th February 2023 and closed on 11th June 2023.

The sample of employees who participated were informed of the objectives of the study and made aware that the compilation was anonymous and that no sensitive data about the person or company would result in the analysis.

Firstly, a referent for each company has been contacted via mail or LinkedIn and finally the referent circled the email within the company, in order to collect multiple responses for each company and gather different opinions from the same environment. Each participant received the electronic link to the questionnaire and spent around 5 minutes to complete the questionnaire.

The tool could be filled out through a link to an online survey (Google Moduli) and was available in Italian and English. A short introduction was added to give some explanation about the research, and it was mentioned that surveys should be filled out by people involved in food safety topics. For this reason, the functions involved have been mainly Quality and Operations, but also some others, such as R&D, Sales, etc., as in small companies for instance there is not a specific function that deals with these issues.

In total, among the 36 companies contacted, only 14 should have answered. In fact, because of the anonymity of the questionnaire, the number could be greater, as 14 is the number of companies that also confirmed via mail their contribution.

However, 126 responses were totally collected, resulting in 124 valid responses. Two answers were disregarded in the analysis as the participants did not answer more than 50% of the questions, thus making it difficult to draw a complete picture of their opinions. Although the final figure is not an optimal representative sample of the raw material suppliers to the Italian Confectionery food industries, it may be viewed as an easy sample of the most forward-thinking businesses. In fact, the employees of the responding companies can be interpreted as the most proactive and the most involved in food safety activities. This was also noted by De Boeck et al. (2015) [1] in their research of the overall Belgian food processing sector, in which only 136 companies were surveyed for the study to compare the total food industry climate.

Furthermore, the collection was also complicated by the fact that the only reward available was the overall analysis report, which therefore might not be an attractive reward considering the interesting in the topics of the company.

Table 7 summarises the organizational characteristics of the sample. The largest proportion of respondents work in the quality (67%) and operations (19%) departments, while the others are divided into Sales, R&D and other minor functions. 48% of the respondents belong to the food flavouring sector, 30 % to the cereals chain and the remaining percentages to milk, honey, sugar, and others. Moreover, the largest proportion of the employees (58%) work in a medium size (FTE: 50-249) company, while 24% belong to big (FTE: > 250) and 18% to small companies (FTE: 1-19).

Table 7. Sample characteristics

Characteristic	**Category**	**N**	**Respondents**	**Percentage**
Department	Quality	124	83	67%
	Operations		24	19%
	Sales		10	8%
	R&D		2	2%
	Others		5	4%

Characteristic	Category	N	Respondents	Percentage
Production sector	Others	124	3	2%
	Food flavouring		59	48%
	Cereals		37	30%
	Milk		13	11%
	Honey		4	3%
	Sugar		8	6%
Characteristic	**Category**	**N**	**Respondents**	**Percentage**
FTE	1-49	124	22	18%
	50-249		72	58%
	> 250		30	24%

The total sample is biased in terms of company size, as the share of medium and large companies is quite high, even though most companies in Italy are small [77]. However, this bias was firstly due to the fact that medium and big companies were more willing to participate compared to small sized companies, even considering that by collecting more than one response per company, the larger the size of the company, the more likely it is that there are more people involved in food safety-related activities.

Moreover, the *Table 8* summarises the answers to the last three organizational questions. It is noted that 83% of the respondents indicated having specific roles dedicated to food safety. This suggests a significant commitment from the companies in ensuring the safety of food products through the allocation of specialized resources. Regarding the department mainly in charge of food safety in the company, 94% of the respondents indicated that the Quality department is primarily responsible for this function, followed by Legal & Compliance one (5%). Furthermore, regarding the food safety certifications acquired by the company, several certifications were mentioned by the respondents. The most common certification is Food Safety System Certification (FSSC), reported by 44% of the companies, followed by BRCGS for

Food Safety (21%) and IFS for (16%). Some companies have acquired more than one certification, indicating a commitment to meet multiple food safety standards. Additionally, there are also some companies that mentioned "Others" unspecified certifications. It is important to note that the total number changes because in some cases some respondents did not fill in the specific field.

Table 8. Additional sample characteristics

Characteristic	**Category**	**N**	**Respondents**	**Percentage**
Dedicated full-time Food Safety roles in the company	Yes	122	101	83%
	No		21	17%
Characteristic	**Category**	**N**	**Respondents**	**Percentage**
Department mainly in charge of Food Safety in the company	Quality	124	117	94%
	Operations		2	1%
	Legal & Compliance		6	5%
Characteristic	**Category**	**N**	**Respondents**	**Percentage**
Food Safety certifications acquired by the company	FSSC	121	53	44%
	BRCGS		25	21%
	IFS		19	16%
	BRCGS, FSSC, IFS		13	11%
	BRCGS, IFS		9	7%
	Others		2	1%

3. Results & Discussion

3.1. Data Analysis

As discussed in the earlier section, research was conducted using questionnaires which assessed the food safety climate of the Italian packaged confectionery raw material suppliers. The questionnaire was designed to survey the employees and was composed of 34 multiple-choice questions, with 28 indicator statements. The second part related to the statement was taken by De Boeck et al. (2015) [1] paper, where it was also tested and validated.

After all responses were collected, the data was analysed by calculating the total mean values to assess the overall food safety climate and then the mean values according to the different organizational traits to assess any possible correlations.

The following table (*Table 9*) gives the overall perception of the food safety climate. Mean overall food safety climate scores (mean calculated over the 28 indicators) and mean scores per component (mean calculated over the indications per component) were determined.

Starting with the leadership indicators, it can be said that response rates vary amongst leadership statements, with higher scores for L1, L2, L5, and L6, and a progressive decline for L3 and L4. The mean leadership ratings range from 4.11 to 4.38, showing that leadership in connection to food safety is typically seen favourably. Their standard deviations are quite small, which suggests that each leadership level's reactions are consistent.

The percentage of respondents with respect to communication statements varies depending on the efficacy and amount of engagement of the communication. The mean communication ratings range from 4.11 to 4.30, indicating a generally favourable impression of food safety communication methods.

It is possible to claim that the percentage of responses varies among commitment characteristics, representing various degrees of dedication and engagement, based on the commitment indicators and their accompanying statistics. Indicating a somewhat positive to very positive opinion of dedication to food safety, the mean commitment scores range from 3.90 to 4.44.

The percentage of responders varies among resource statements, reflecting changes in resource distribution and availability. Resources have mean scores ranging from 3.69 to 4.28, making them the indication with the lowest total score.

The number of replies for the risk awareness statements also shows varying degrees of knowledge and understanding of the dangers to food safety. The risk awareness average scores range from 3.90 to 4.32, suggesting a somewhat positive to positive impression of risk awareness.

Table 9. Overall results for Food Safety Climate indicator statements

		1		2		3		4		5		Mean	St. dev.	Median
Leadership	**L1**	2	2%	4	3%	8	6%	40	33%	69	56%	4.38	0.87	5
	L2	1	1%	6	5%	4	3%	49	40%	63	51%	4.36	0.83	5
	L3	1	1%	7	6%	11	9%	63	51%	41	33%	4.11	0.85	4
	L4	1	1%	7	6%	14	11%	44	36%	56	46%	4.20	0.92	4
	L5	1	1%	7	6%	6	5%	53	43%	56	45%	4.27	0.86	4
	L6	2	2%	6	5%	5	4%	49	39%	62	50%	4.31	0.89	4.5
Communication	**C1**	2	2%	4	3%	13	11%	63	51%	41	33%	4.11	0.84	4
	C2	2	2%	4	3%	13	11%	62	50%	42	34%	4.12	0.85	4
	C3	3	2%	6	5%	12	10%	49	39%	54	44%	4.17	0.96	4
	C4	3	2%	6	5%	9	7%	52	42%	54	44%	4.19	0.94	4
	C5	3	3%	5	4%	5	4%	50	40%	61	49%	4.30	0.91	4
Commitment	**E1**	2	2%	4	3%	5	4%	40	32%	73	59%	4.44	0.85	5
	E2	0	0%	7	6%	20	16%	44	35%	53	43%	4.15	0.89	4
	E3	1	1%	13	10%	22	18%	50	40%	38	31%	3.90	0.99	4
	E4	0	0%	11	9%	10	8%	55	44%	48	39%	4.13	0.90	4
	E5	1	1%	9	7%	16	13%	53	43%	44	36%	4.06	0.93	4
	E6	4	3%	10	8%	15	12%	54	44%	41	33%	3.95	1.03	4
Resources	**M1**	10	8%	7	6%	20	16%	62	50%	25	20%	3.69	1.11	4
	M2	8	6%	11	9%	22	18%	53	43%	30	24%	3.69	1.13	4
	M3	4	3%	7	6%	25	20%	46	38%	41	33%	3.92	1.03	4
	M4	5	4%	4	3%	21	17%	54	44%	39	32%	3.96	1.00	4
	M5	2	2%	5	4%	8	6%	54	44%	55	44%	4.25	0.87	4
	M6	2	2%	4	3%	9	7%	51	41%	57	47%	4.28	0.86	4
Risk Awareness	**R1**	1	1%	4	3%	11	9%	46	37%	62	50%	4.32	0.83	4.5
	R2	0	0%	6	5%	14	11%	51	41%	53	43%	4.22	0.83	4
	R3	2	2%	5	4%	22	18%	49	39%	46	37%	4.06	0.93	4
	R4	2	2%	5	4%	14	11%	55	44%	48	39%	4.15	0.89	4
	R5	2	2%	5	4%	27	22%	60	48%	30	24%	3.90	0.87	4
Total FS Climate		**2%**		**5%**		**11%**		**42%**		**40%**		**4.13**	**0.94**	**4**

Looking at the overall picture, the food safety climate in the responding Italian raw material suppliers can be considered good: 42% of the respondents agreed (4) and 40% totally agreed (5) to the statements, reaching an overall mean of 4.13 ± 0.94.

L1 ("In my organization, the leaders set clear objectives concerning hygiene and food safety"), L2 ("In my organization, the leaders are clear about the expectations concerning hygiene and food safety towards operators"), L6 ("In my organization, the leaders strive for a continuous improvement of hygiene and food safety"), E1 ("In my organization, the leaders clearly consider hygiene and food safety to be of great importance") and R1 ("In my organization, the risks related to hygiene and food safety are known") are the indicators that are better perceived by the respondents (all scores higher than 4.30), with E1 that set the highest score of 4.44. Almost all the highest scored indicators, except for R1, are related to the leaders, highlighting the great importance perceived by the respondents with respect to their leaders.

M1 ("In my organization, operators get sufficient time to work in a hygienic and food safe way") and M2 ("In my organization, sufficient staff is available to follow up hygiene and food safety") are instead the indicators worse perceived by the respondents with the score of 3.69. Although the values are not so low, what is easily found is that respondents have the perception that they do not have enough time and therefore not enough people to properly comply with food safety and hygiene regulations.

For what concerned the analysis, Likert scale data was considered as ordinal values and non-parametric statistical tests were used since data were not normally distributed. To verify the normality of the sample, the Shapiro-Wilk and Kolgomorov-Smirnov tests were performed, resulting in not normally distributed sample as suggested by the p-value < .001 for each food safety dimension (*Figure 5*).

Figure 5. Test of normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
L1	.314	116	<.001	.704	116	<.001
L2	.284	116	<.001	.717	116	<.001
L3	.301	116	<.001	.790	116	<.001
L4	.259	116	<.001	.793	116	<.001
L5	.271	116	<.001	.742	116	<.001
L6	.268	116	<.001	.717	116	<.001
C1	.293	116	<.001	.786	116	<.001
C2	.289	116	<.001	.786	116	<.001
C3	.269	116	<.001	.769	116	<.001
C4	.282	116	<.001	.758	116	<.001
C5	.271	116	<.001	.716	116	<.001
E1	.328	116	<.001	.670	116	<.001
E2	.246	116	<.001	.812	116	<.001
E3	.262	116	<.001	.846	116	<.001
E4	.278	116	<.001	.785	116	<.001
E5	.267	116	<.001	.817	116	<.001
E6	.290	116	<.001	.817	116	<.001
M1	.312	116	<.001	.815	116	<.001
M2	.280	116	<.001	.850	116	<.001
M3	.242	116	<.001	.840	116	<.001
M4	.276	116	<.001	.815	116	<.001
M5	.268	116	<.001	.745	116	<.001
M6	.263	116	<.001	.744	116	<.001
R1	.302	116	<.001	.749	116	<.001
R2	.265	116	<.001	.782	116	<.001
R3	.238	116	<.001	.824	116	<.001
R4	.268	116	<.001	.787	116	<.001
R5	.265	116	<.001	.852	116	<.001

a. Lilliefors Significance Correction

The Kruskal-Wallis H test was carried out to compare statements between more than two groups, such as size of company, food production sector, function of the respondent. For the analysis that was classified as significant or had to compare statements between only 2 groups, the Mann-Whitney U test was performed. The level of statistical significance was set at 0.05 and statistical processing was performed using SPSS Statistics.

It was already noted in the US by Ungku et al. (2014) [69] and in the Central and Eastern Europe by Tomasevic et al. (2020) [61] that operational company characteristics like company size, food production characteristics (product riskiness) and FSMS employed could influence FS-culture. The aim of the study was also to explore if the same can be concluded for the food suppliers operating in Italy and their perception of Food Safety climate components and their indicators.

3.1.1. Company size

The *Table 10* provides data on the means of different factors related to the organizational climate for food safety, categorized by the number of full-time equivalent (FTE) employees. The data is divided into three categories based on the number of FTE employees: 1-49, 50-249, and > 250. This categorization allows for a comparison of the organizational climate across different sizes of organizations.

For organizations with 1-49 FTE employees, the mean scores range from 3.23 to 3.65. This suggests a moderate to somewhat positive perception of leadership, communication, commitment, resources, and risk awareness in the context of food safety.

In organizations with 50-249 FTE employees, instead, the mean scores range from 3.99 to 4.31. This indicates a generally positive perception across all factors, reflecting a stronger organizational climate for food safety compared to smaller organizations.

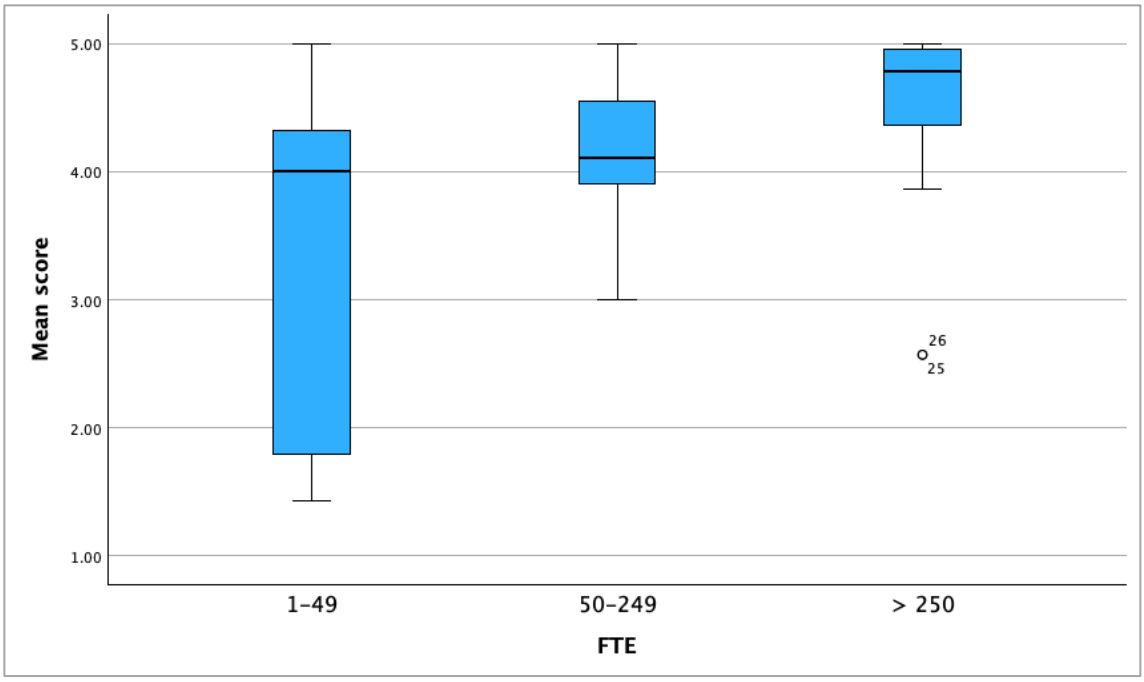
In organizations with > 250 FTE employees, the mean scores range from 4.44 to 4.65. These higher mean scores suggest a significantly positive perception of all factors, indicating a robust and well-established food safety climate within larger organizations.

Table 10. Results by company size

FTE	No. of responses	L	C	E	M	R	Total means	Total medians
1-49	22	3.65	3.61	3.55	3.23	3.51	**3.51**	**4**
50-249	72	4.31	4.22	4.11	3.99	4.13	**4.15**	**4**
> 250	30	4.65	4.51	4.50	4.44	4.59	**4.54**	**5**

In addition, a graphic view of the different scores by company size was carried through the use of the boxplots (*Figure 6*).

Figure 6. Boxplots: mean scores by company size



These results suggest that as the size of the organization increases, there is generally a more positive perception of the organizational climate for food safety. Larger organizations tend to exhibit higher mean scores across all factors, indicating a potentially stronger focus on food safety management practices and a more developed infrastructure for ensuring food safety.

According to a number of studies, small food enterprises have a substantially harder time implementing a Food Safety Management Systems [78]. In smaller businesses, the people in control are juggling numerous tasks at once and managing food safety may be difficult due to a lack of highly knowledgeable or technically competent staff [75]. Tomasevic et al. (2020) [61] also found that small food businesses in Central and Eastern Europe had a considerably lower Food Safety knowledge score (3.94) compared to medium-sized businesses (4.16) and large businesses (4.31). The findings of the current study are in concurrence with the before mentioned conclusions because large companies provided higher scores (4.54) compared to medium (4.15) and small sized (3.51) companies.

Hence, to validate the previous statements, some statistical analyses were developed. Firstly, as already explained in the previous section, Kruskal-Wallis H test was carried out to compare the statements between the three groups, highlighting a p-value ≤ .002 for all the dimensions (*Figure 7*).

Figure 7. Kruskal-Wallis H test: Company size

Test Statistics[a,b]

	L	C	E	M	R
Kruskal-Wallis H	21.952	12.817	15.024	21.594	20.657
df	2	2	2	2	2
Asymp. Sig.	<.001	.002	<.001	<.001	<.001

a. Kruskal Wallis Test

At this point, as this test showed a significant difference but without stating between which groups, further pairwise analyses were needed. The following figures show the Mann-Whitney U test performed for each couple of groups (*Figure 8, Figure 9,* and *Figure 10*).

Figure 8. Mann-Whitney U test: Medium vs Large size companies

Test Statistics[a]

	L	C	E	M	R
Mann-Whitney U	534.000	650.500	641.000	556.000	553.500
Wilcoxon W	3162.000	3278.500	3269.000	3184.000	3181.500
Z	-4.053	-3.180	-3.247	-3.869	-3.905
Asymp. Sig. (2-tailed)	<.001	.001	.001	<.001	<.001

Figure 9. Mann-Whitney U test: Small vs Large size companies

Test Statistics[a]

	L	C	E	M	R
Mann-Whitney U	125.500	182.000	151.000	127.500	126.500
Wilcoxon W	378.500	435.000	404.000	380.500	379.500
Z	-3.869	-2.767	-3.354	-3.792	-3.835
Asymp. Sig. (2-tailed)	<.001	.006	<.001	<.001	<.001

Figure 10. Mann-Whitney U test: Small vs Medium size companies

Test Statistics[a]

	L	C	E	M	R
Mann-Whitney U	592.000	639.000	625.000	550.500	606.500
Wilcoxon W	845.000	892.000	878.000	803.500	859.500
Z	-1.795	-1.379	-1.496	-2.164	-1.668
Asymp. Sig. (2-tailed)	.073	.168	.135	.030	.095

As previously hypothesised, large companies provided significantly higher scores (4.54) compared to medium (4.15) and small sized (3.51) companies, in fact the p-value of the Mann-Whitney U test was lower than 0.006 for all the indicators (*Figure 8* and *9*).

Moreover, moving towards the comparison between medium size companies and small size ones, only for the Resources (M) dimension the test was significant (p = .03), in fact the average score of the former was 3.99 compared to 3.23 of the latter (*Figure 10*).

The current findings confirmed the results of Tomasevic et al. (2020) [61], in which overall the small companies received lower scores than medium and big ones, even if this hypothesis was not verified for all the dimensions separately (Communication (C) and Resources (M) did not highlight significant differences with respect to company size). Instead, the findings are contradictory with respect to the ones of De Boeck et al. (2018) [72] observed in Belgium, where no significant correlations compared to company size were found.

3.1.2. Organizational functions

The *Table 11* provides data on the means of different factors related to food safety climate, categorized by different respondent functional areas within the organization. The data is segmented into different functional areas, including Quality, Sales, Operations, Research and Development (R&D), and Others.

With 83 responses, the Quality department has high mean scores ranging from 3.97 to 4.29 across all factors. This indicates a generally positive perception of leadership, communication, commitment, resources, and risk awareness within the Quality department in relation to food safety.

The Sales department, with 24 responses, has mean scores ranging from 3.95 to 4.22, suggesting a positive perception of the organizational climate for food safety, particularly in terms of communication and risk awareness.

The Operations department, with 10 responses, scores from 3.68 to 4.28. While the scores are relatively lower compared to other departments, they still indicate a moderately positive perception of leadership, commitment, and risk awareness within Operations.

The R&D department, with only 2 responses, has high mean scores ranging from 4.17 to 4.50, highlighting a strongly positive perception of leadership, communication, commitment, and resources within the R&D department in relation to food safety.

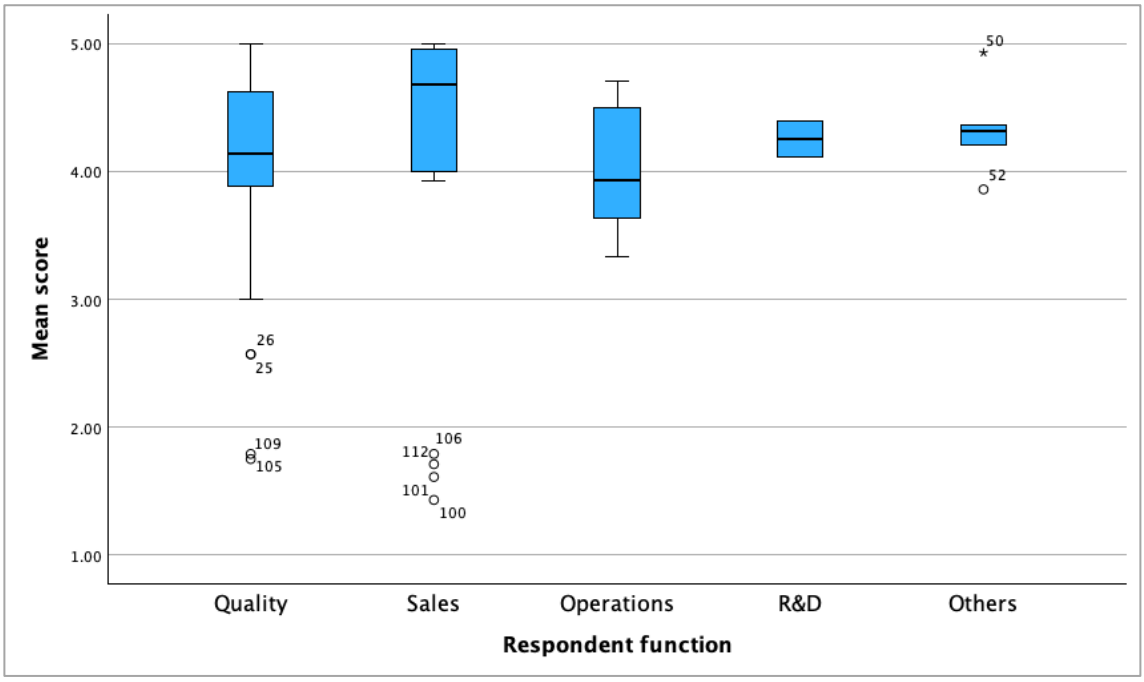
The "Others" category, representing miscellaneous or unspecified functional areas with 5 responses, has consistently high mean scores ranging from 4.13 to 4.50. This indicates a positive perception of all factors related to food safety within these departments.

Table 11. Results by respondent organizational function

Function	No. of responses	L	C	E	M	R	Total means	Total medians
Quality	83	4.29	4.20	4.08	3.97	4.11	**4.13**	**4**
Sales	24	4.20	4.05	4.22	3.95	4.21	**4.13**	**5**
Operations	10	4.14	4.28	3.98	3.68	4.00	**4.01**	**4**
R&D	2	4.50	4.30	4.17	4.33	3.90	**4.25**	**4**
Others	5	4.50	4.32	4.13	4.30	4.44	**4.34**	**4**

In addition, a graphic view of the different scores by organizational function was carried through the use of the boxplots (*Figure 11*).

Figure 11. Boxplots: mean scores by respondent organizational function



These results suggest that different functional areas within the organization may have varying perceptions of the organizational climate for food safety. The Quality department generally shows high mean scores, indicating a strong focus on food safety practices. However, other departments such as Sales, Operations, R&D, and Others also demonstrate positive perceptions of food safety-related factors, highlighting a holistic approach to food safety management across the organization.

Moreover, it was possible to state that all the organizational functions are "on the same wavelength" since no meaningful perceptual differences were observed for individual Food Safety Climate indicators with respect to the functions ($p > .05$ for the Kruskal-Wallis test, see *Figure 12*). The means in fact ranged between 4.01 and 4.34.

Figure 12. Kruskal-Wallis H test: organizational functions

Test Statistics[a,b]

	L	C	E	M	R
Kruskal–Wallis H	2.537	.984	5.197	4.569	7.943
df	4	4	4	4	4
Asymp. Sig.	.638	.912	.268	.334	.094

3.1.3. Production sectors

The *Table 12* provides data on the means of different factors related to the ffod safety climate within the production sector. The data is segmented into various product categories, including Food Flavouring, Cereals, Milk, Honey, Sugar, and Others.

With 59 responses, the largest share, the Food Flavouring category demonstrates high mean scores ranging from 4.13 to 4.39 across all factors. This indicates a generally positive perception of leadership, communication, commitment, resources, and risk awareness within the food flavouring segment.

The Cereals category, with 37 responses, shows mean scores ranging from 3.86 to 4.17, suggesting moderately positive perception of leadership, communication, commitment, resources, and risk awareness within the cereals segment of the production sector.

Milk category, with 13 responses, has mean scores ranging from 3.37 to 3.79. These scores, the lowest among all the categories, indicate however a somewhat positive perception of the indicators.

The Honey category, with 4 responses, demonstrates mean scores ranging from 3.58 to 4.40, suggesting a mixed perception of different factors, with relatively higher scores for commitment and risk awareness within the honey segment.

Sugar category, with 8 responses, shows exceptionally high mean scores ranging from 4.19 to 4.81. This indicates a strongly positive perception of leadership, communication, commitment, resources, and risk awareness within the sugar segment of the production sector.

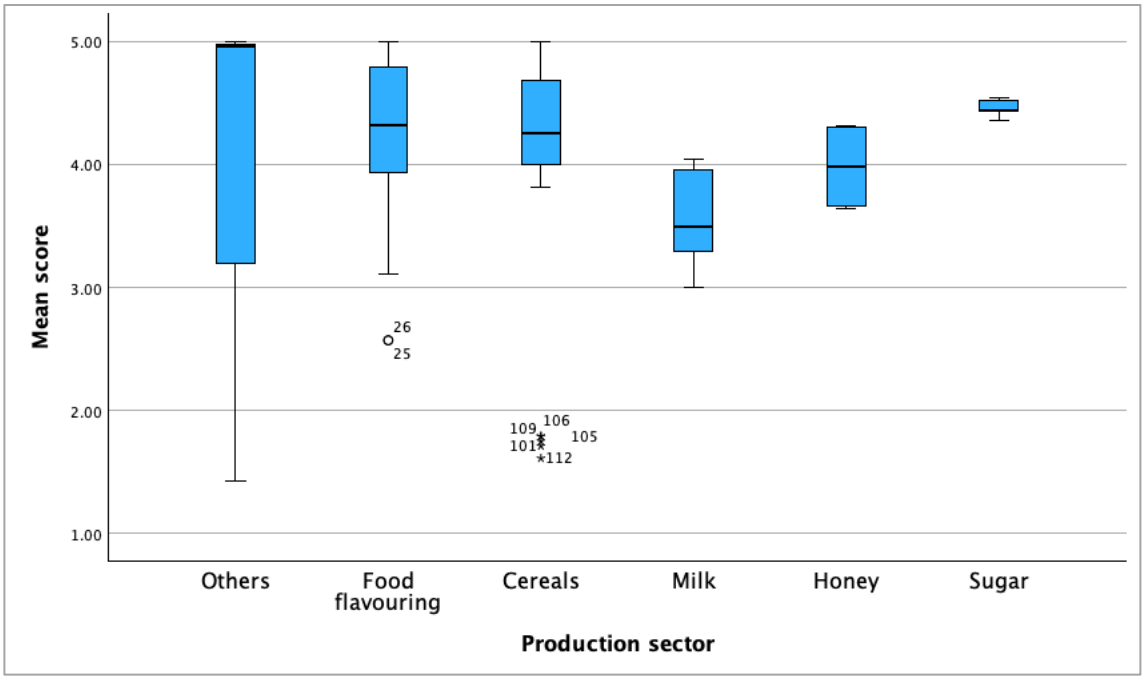
"Others" category, with 3 responses, shows mean scores ranging from 3.67 to 3.94 across different factors. This suggests a moderately positive perception of leadership, commitment, and risk awareness within this segment of the production sector.

Table 12. Results by production sector

Production sector	No. of responses	L	C	E	M	R	Total means	Total medians
Others	3	3.94	3.73	3.89	3.67	3.73	**3.80**	**5**
Food flavouring	59	4.39	4.32	4.25	4.13	4.27	**4.27**	**4**
Cereals	37	4.17	4.13	4.07	3.86	4.08	**4.06**	**4**
Milk	13	3.79	3.65	3.37	3.56	3.63	**3.60**	**4**
Honey	4	4.29	4.40	3.96	3.58	3.70	**3.98**	**4**
Sugar	8	4.81	4.33	4.48	4.19	4.48	**4.46**	**4**

In addition, a graphic view of the different scores by production sector was carried through the use of the boxplots (*Figure 13*).

Figure 13. Boxplots: mean scores by production sector



Hence, some statistical analyses were developed to verify possible significant difference between the groups. Because the minimum sample size for the Kruskal-Wallis H test is 5, Honey and «Other» sectors were not included in the analysis.

Firstly, as already explained in the previous section, Kruskal-Wallis H test was carried out to compare the statements between the four groups, highlighting a p-value ≤ .004 for Leadership, Communication, Commitment and Risk Awareness dimensions (*Figure 14*).

Figure 14. Kruskal-Wallis H test: production sectors

Test Statistics[a,b]

	L	C	E	M	R
Kruskal–Wallis H	19.143	19.656	19.665	4.895	13.087
df	3	3	3	3	3
Asymp. Sig.	<.001	<.001	<.001	.180	.004

At this point, looking at the mean ranks (*Figure 15*), that are the averages of the ranks for all observations within each sample, it was possible to state that Food Flavouring (#2), Cereals (#3) and Sugar (#6) had a similar and significantly higher rank for each indicator with respect to Milk (#4).

Figure 15. Mean ranks: production sectors

Ranks

	Chain	N	Mean Rank
L	2	59	63.20
	3	37	59.61
	4	13	23.73
	6	8	82.50
	Total	117	
C	2	59	63.79
	3	37	64.92
	4	13	20.15
	6	8	59.44
	Total	117	
E	2	59	64.06
	3	37	61.46
	4	13	20.62
	6	8	72.69
	Total	117	
M	2	59	63.41
	3	37	57.36
	4	13	41.04
	6	8	63.25
	Total	117	
R	2	59	62.83
	3	37	60.81
	4	13	28.15
	6	8	72.50
	Total	117	

Therefore, Mann-Whitney U test was performed directly on the two different groups, the first one composed by Food Flavouring, Cereals and Sugar sectors and the second one by Milk companies (*Figure 16*).

Figure 16. Mann-Whitney U test: production sectors

Test Statistics[a]

	L	C	E	M	R
Mann–Whitney U	217.500	171.000	177.000	448.000	275.000
Wilcoxon W	308.500	262.000	268.000	539.000	366.000
Z	-4.011	-4.414	-4.351	-1.986	-3.506
Asymp. Sig. (2–tailed)	<.001	<.001	<.001	.047	<.001

Finally, from the analysis, even if it is in contradiction with the findings of De Boeck et al. (2018) in Belgium, where it was stated that no meaningful perceptual differences were observed with respect to the sectors, it was easy verifiable that companies belonging to the milk production sector provided significant lower scores (3.60) with respect the ones

belonging to food flavouring (4.27), cereals (4.06) and sugar (4.46) sectors. In fact, the p-value was lower than .05 for all the indicators (see *Figure 16*).

3.1.4. Presence of specific roles dedicated to Food Safety

The data in the *Table 13* categorizes the responses into two groups based on the presence of Food Safety dedicated roles inside the companies. The "Yes" group consists of answers related to companies with Food Safety dedicated roles, while the "No" group comprises companies without such roles.

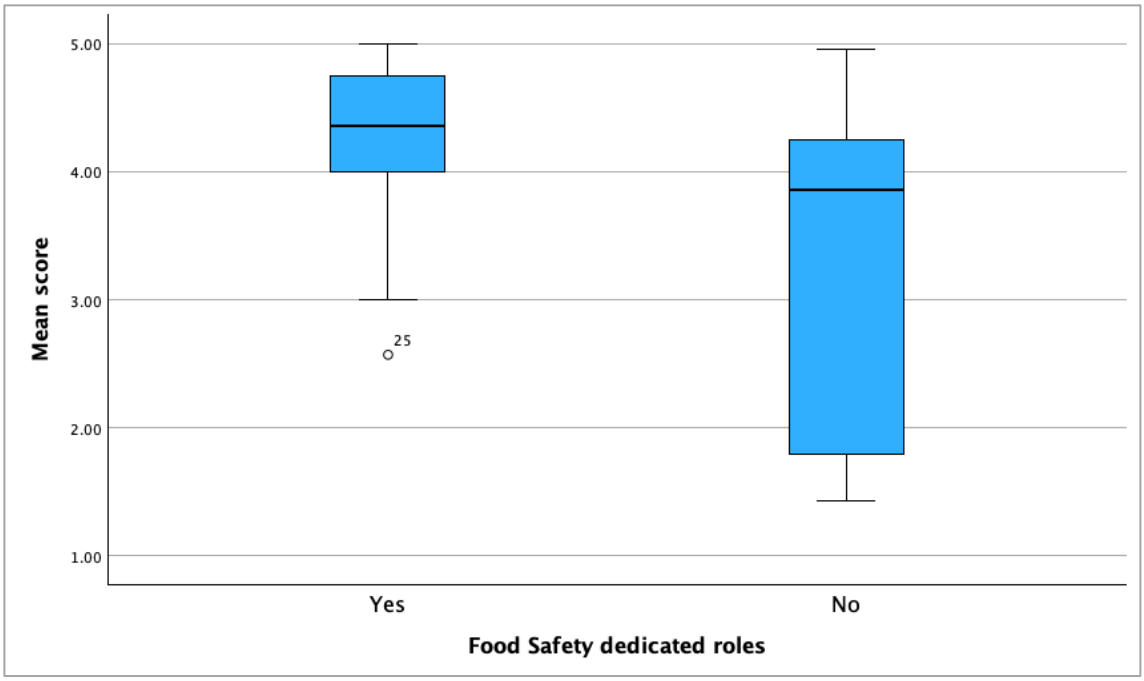
The first group, with 101 responses, demonstrates high mean scores ranging from 4.15 to 4.46 and median scores of 4 across all factors. This suggests a strong positive perception of leadership, communication, commitment, resources, and risk awareness among employees in companies with Food Safety dedicated roles. The second group, with 21 responses, shows lower mean scores ranging from 3.12 to 3.44 and a median score of 4 across all factors. This indicates a comparatively less positive perception of the Food Safety dimensions.

Table 13. Results by presence of Food Safety dedicated roles

FS dedicated roles	No. of responses	L	C	E	M	R	Total means	Total medians
Yes	101	4.46	4.35	4.27	4.15	4.29	**4.30**	**4**
No	21	3.44	3.37	3.33	3.12	3.32	**3.31**	**4**

In addition, a graphic view of the different scores by the presence of Food Safety dedicated roles was carried through the use of the boxplots (*Figure 17*).

Figure 17. Boxplots: mean scores by presence of Food Safety dedicated roles



These results suggest that employees in companies with Food Safety dedicated roles have a significantly more positive perception of the organizational climate for food safety compared to employees in companies without such roles, highlighting the importance of having dedicated roles and specialized expertise in managing and promoting food safety within the organization.

The significant difference between the two groups was also emphasised by p-value equal or lower than .001 of the Mann-Whitney U tests performed for each Food Safety Climate dimension (see the results in the *Figure 18*).

Figure 18. Mann-Whitney U test: Food Safety dedicated roles

Test Statistics[a]

	L	C	E	M	R
Mann-Whitney U	527.000	592.500	559.000	537.000	489.500
Wilcoxon W	758.000	823.500	790.000	768.000	720.500
Z	-3.650	-3.200	-3.420	-3.565	-3.904
Asymp. Sig. (2-tailed)	<.001	.001	<.001	<.001	<.001

Finally, organizations without Food Safety dedicated roles may need to focus on enhancing their food safety practices and cultivating a more positive climate by implementing measures such as training, awareness programs, and allocating appropriate resources, as the lowest scoring dimension was the one related to Resources (M). By understanding these differences,

organizations can develop targeted strategies to improve food safety practices and create a stronger organizational culture of food safety awareness and responsibility.

3.1.5. Organizational function mainly involved in Food Safety topics

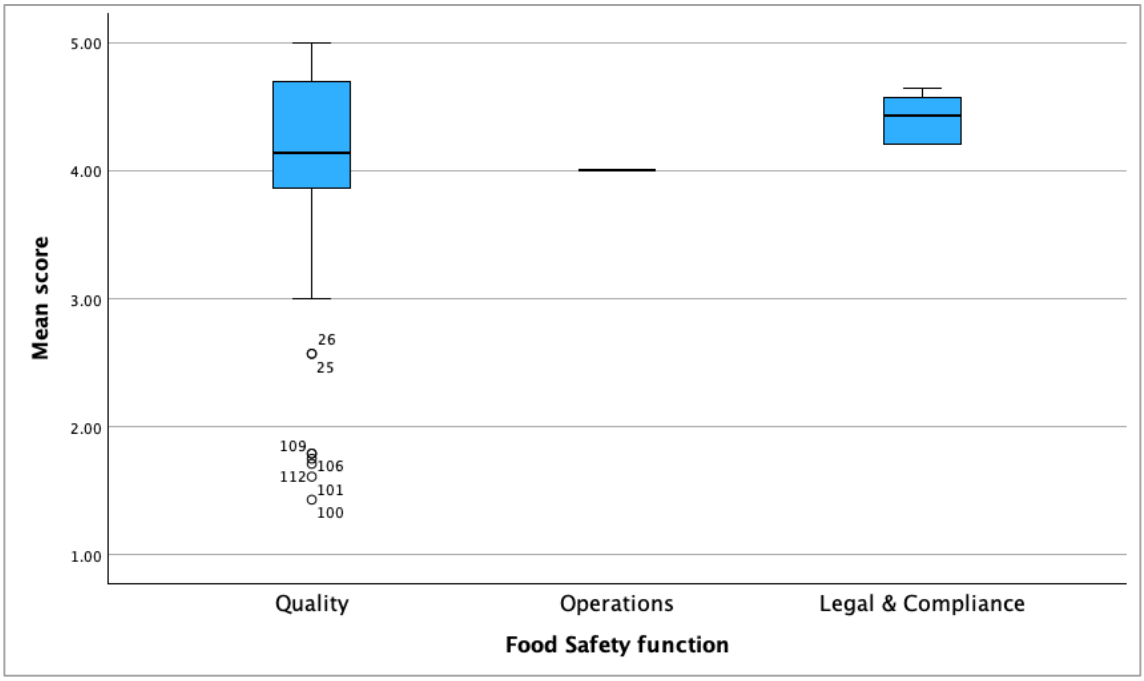
Table 14 provides data on the company function that mainly deals with food safety issues. It was evident that in almost all companies, the function that deals with these issues is Quality, which with 117 responses scored 4.11 as mean and 4 as median. Furthermore, the second most common function dealing with food safety is Legal & Compliance one, with 6 responses and the highest mean of 4.42. While only one company was also individuated where the corporate function most involved in food safety issues is Operations.

Table 14. Results by functions involved in Food Safety topics

Functions involved in FS topics	No. of responses	L	C	E	M	R	Total means	Total medians
Quality	117	4.25	4.17	4.10	3.95	4.11	**4.11**	**4**
Operations	1	4.00	4.00	4.00	4.00	4.00	**4.00**	**4**
Legal & Compliance	6	4.72	4.37	4.22	4.28	4.50	**4.42**	**4**

In addition, a graphic view of the different scores by the functions involved in Food Safety topics was carried through the use of the boxplots (*Figure 19*).

Figure 19. Boxplots: mean scores by functions involved in Food Safety topics



To verify any possible significant differences, the Mann-Whitney U test was carried between the Quality and Legal & Compliance function, as Operations only presented one response and for this reason could not be included in the analysis. However, no meaningful perceptual differences were observed ($p > .05$), as reported in the *Figure 20*.

Figure 20. Mann-Whitney U test: functions involved in Food Safety topics

Test Statistics[a]

	L	C	E	M	R
Mann-Whitney U	245.000	335.000	347.500	288.000	258.000
Wilcoxon W	7148.000	7238.000	368.500	7191.000	7161.000
Z	-1.255	-.189	-.041	-.743	-1.101
Asymp. Sig. (2-tailed)	.209	.850	.967	.458	.271

3.2. Exploratory factor analysis

As already performed in previous studies [72], the underlying factor structure of the 28 indicators of the food safety climate questionnaire developed by De Boeck et al. (2015) was subjected to an exploratory factor analysis to investigate its factorial validity.

Firstly, two tests were performed to assess the suitability of the data: The Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity. The former is a statistical measure to determine

how suited data is for factor analysis. The test measures sampling adequacy for each variable in the model and the complete model. The statistic is a measure of the proportion of variance among variables that might be common variance. The higher the proportion, the higher the KMO-value, the more suited the data is to factor analysis. In general, KMO values between 0.8 and 1 indicate the sampling is adequate. KMO values less than 0.6 indicate the sampling is not adequate and that remedial action should be taken. In contrast, others set this cutoff value at 0.5 [72]. Bartlett's Test of Sphericity checks whether the correlation coefficients are all 0. The test computes the probability that the correlation matrix has significant correlations among at least some of the variables in a dataset, a prerequisite for factor analysis to work [72].

The Kaiser-Meyer-Olkin (KMO) test, with a value of 0.96, and Bartlett's Test of Sphericity, which was highly significant ($p < .001$), confirmed the suitability of the data before factor analysis (*Figure 21*).

Figure 21. KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		.964
Bartlett's Test of Sphericity	Approx. Chi–Square	4243.999
	df	378
	Sig.	<.001

Two factors with eigenvalues greater than 1 were found through the exploratory factor analysis. Factor 1 explained 72.7% of the data's variation, while factor 2 explained 4.2%, for a total explained variance of 76.9% (*Figure 22*). Eigenvalues were 20.37 for factor 1 and 1.18 for factor 2. The scree plot (*Figure 23*) led to similar findings. These discoveries contrasted with what was found in the study of De Boeck et al. (2018) [72], in which four factors with eigenvalues greater than 1 were found.

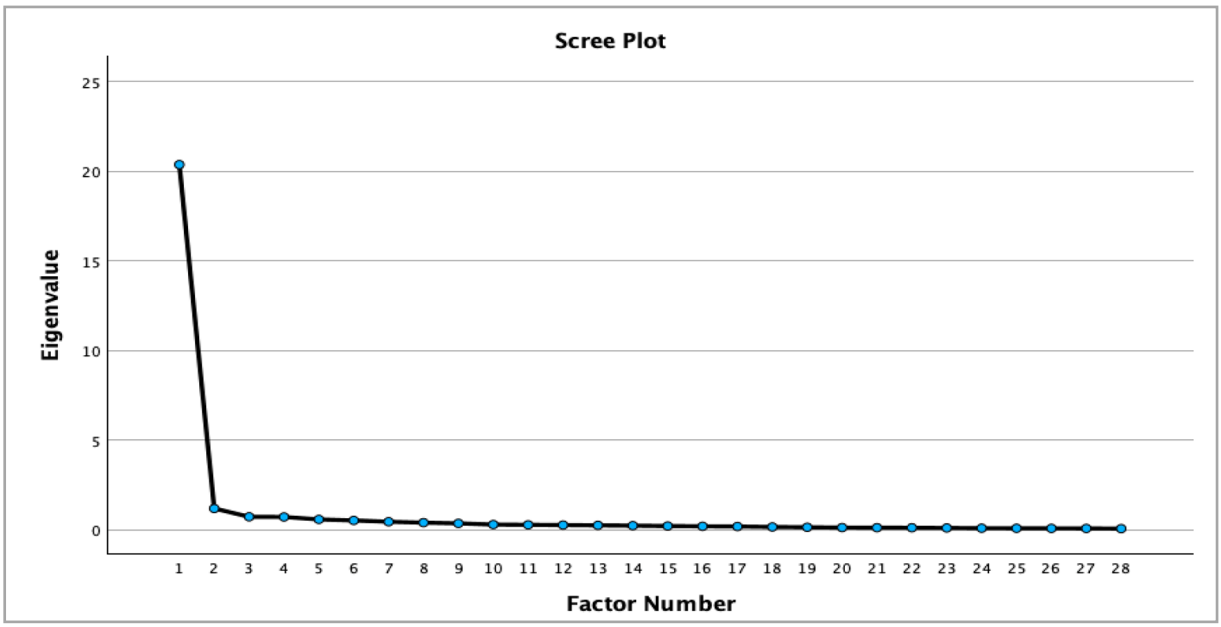
Figure 22. Total variance explained

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20.365	72.733	72.733	20.121	71.862	71.862	11.020	39.359	39.359
2	1.177	4.202	76.935	.935	3.340	75.203	10.036	35.844	75.203
3	.712	2.544	79.479						
4	.703	2.510	81.989						
5	.567	2.024	84.013						
6	.507	1.812	85.826						
7	.436	1.556	87.381						
8	.386	1.378	88.759						
9	.346	1.234	89.993						
10	.280	.999	90.992						
11	.263	.940	91.933						
12	.251	.897	92.830						
13	.235	.839	93.668						
14	.218	.780	94.448						
15	.197	.704	95.152						
16	.182	.649	95.801						
17	.170	.607	96.408						
18	.144	.515	96.923						
19	.128	.456	97.379						
20	.110	.394	97.772						
21	.104	.373	98.145						
22	.101	.361	98.506						
23	.089	.318	98.825						
24	.076	.271	99.096						
25	.072	.255	99.351						
26	.066	.236	99.588						
27	.063	.226	99.813						
28	.052	.187	100.000						

Extraction Method: Principal Axis Factoring.

Figure 23. Exploratory factor analysis: Scree plot



Finally, *Figure 24* gives the pattern matrix with Varimax and Kaiser Normalization, showing that factor 1 is a mix of 'leadership and communication related' indicators, factor 2 a mix of 'resources and risk awareness related' indicators; instead, the commitment related' dimensions are perfectly broken down into the two factors.

Figure 24. Exploratory factor analysis: Rotated components matrix

Rotated Component Matrix[a]

	Component	
	1	2
L1	**.767**	.429
L2	**.740**	.506
L3	.547	**.710**
L4	**.770**	.438
L5	**.758**	.534
L6	**.793**	.456
C1	**.632**	.550
C2	**.656**	.593
C3	**.786**	.356
C4	**.748**	.311
C5	**.795**	.382
E1	**.835**	.423
E2	.540	**.625**
E3	.376	**.747**
E4	**.713**	.516
E5	**.711**	.521
E6	.568	**.668**
M1	.386	**.817**
M2	.334	**.846**
M3	.379	**.789**
M4	.447	**.737**
M5	**.615**	.595
M6	**.647**	.585
R1	.451	**.744**
R2	.575	**.671**
R3	.500	**.703**
R4	.626	**.631**
R5	.426	**.737**

Specifically, the *Figure 24* shows that Leadership (L1-L6) and Communication (C1-C5) dimensions are all loading on factor 1, except for L3 ('In my organization, the leaders are able to motivate their employees to work in a hygienic and food safe way'), which is loading on factor 2. All indicators dealing with Resources (M1-M6) and Risk awareness (R1-R5) are loading on factor 2, except for M5 ("In my organization, sufficient education and training related to hygiene and food safety is given") and M6 ("In my organization, good procedures

and instructions concerning hygiene and food safety are in place"). Indicators E1-E6 (component Commitment) are more spread over all 2 factors: E1, E4 and E5 to factor 1, and E2, E3 and E6 to factor 2.

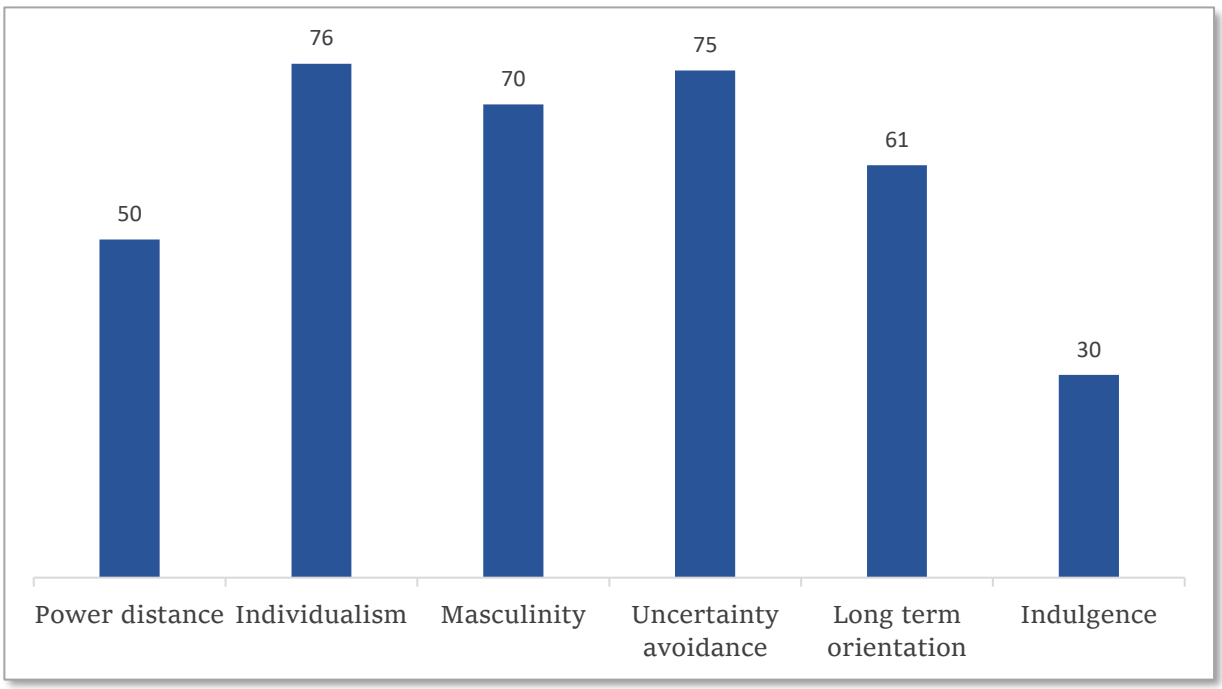
The astounding finding that factor 1 accounts for the majority of variation (72.7%) in the data set and refers content-wise to "leadership and communication related factors", probably reflects the importance of leadership and communication issues in the respondents' mindsets and perceptions when asked about the culture of food safety in their food processing organization.

3.3. National culture impact on Food Safety Climate

As reported in the previous chapters, one aspect that emerged from the literature review that needs be better explored is the influence of national culture on food safety climate. Some scholars have found several relationships between these two components, and the purpose of this study is to verify if these are confirmed in the Italian confectionery raw material suppliers' industry.

Firstly, an overview of the Hofstede's score related to Italian National culture is reported in the *Figure 25*.

Figure 25. Hofstede's scores: Italian National culture



The score of 50 in power distance dimension suggests a moderate acceptance of hierarchical structures and authority in Italian society. With a score of 76 in the second indicator, Italian culture leans towards individualistic values, emphasizing personal achievements and self-interest. Scoring 70 in Masculinity factor, Italian culture exhibits a relatively high degree of masculinity, valuing assertiveness, ambition, and success. The high score (75) of uncertainty avoidance indicates a strong preference for rules, structure, and avoiding ambiguity in Italian society. Scoring 61, Italian culture reflects a moderate focus on long-term planning and traditions while balancing some short-term considerations. Finally, with a score of 30 in indulgence indicator, Italian culture tends to be more restrained and places importance on fulfilling social obligations rather than pursuing personal desires.

Moreover, the *Table 15* shows the average results for each Food Safety climate dimension, which will be useful in the next sections.

Table 15. Average scores of Food Safety climate dimensions

	Leadership	**Communication**	**Commitment**	**Resources**	**Risk Awareness**	**Overall**
Avg. score	4.27	4.18	4.10	3.96	4.13	**4.13**

Hereafter, the *Table 16* highlights which factors of the national culture affect the different dimensions of the food safety climate according to some hypotheses highlighted in the next chapters (the symbol ↑ highlights positive correlation, while ↓ negative one).

Table 16. Relationships between national culture elements and Food Safety climate dimensions

	Power distance	Individualism	Masculinity	Uncertainty avoidance	Long-term orientation	Indulgence
Leadership	↓					
Communication	↓					
Commitment			↓			
Resources				↑	↑	
Risk awareness	↓	↑		↑	↓	

3.3.1. Leadership

The impact of power distance on leadership behaviours and styles has already been studied. Leaders from national cultures with higher power distance indices typically adopt a more directive leadership style, whilst those from national cultures with lower power distance indices typically adopt a participative leadership style [79].

The two are frequently perceived as having diametrically opposed leadership philosophies: directive leadership is more authoritarian and top-down, whereas participatory leadership is more collaborative and non-hierarchical. It was discovered that both participative leadership and directive leadership had beneficial benefits on company culture, but that employees were less adaptive under directive leadership. Along these lines, it was discovered that participative leadership had the opposite effect of directive leadership, which enhanced team productivity but lowered team creativity [80].

Finally, it was argued that participative leadership leads to a greater involvement of the employees by the leader, resulting in high score in the leadership indicators [61]. This theory was established in the analysis of the food safety climate in Central and Eastern Europe by Tomasevic et al. (2020) [61], although this was confirmed by only one country of that

geographical area (Hungary with low power distance score (45) and high Leadership score (4.5)).

Italy scored 50 in the power distance indicator, indicating a preference for decentralized authority and decision-making as well as equality. Younger people tend to prefer teamwork and an open management style, and they generally reject formal control and supervision [67].

Because of the medium-low power distance score of Italy, it is possible to assert that the hypothesis developed by Tomasevic et al. (2020) can be confirmed, in fact the leadership dimension reached 4.27, the highest overall score. Hence, leaders are more likely to embrace a participative and inclusive leadership style. They encourage employee involvement, empowerment, and decision-making autonomy, which fosters a sense of ownership and responsibility among employees. This participatory approach enhances employee engagement and commitment, leading to better performance and productivity.

3.3.2. Communication

For the communication dimension, it was asserted that in nations with high power distance scores, food handlers are already prohibited from approaching and speaking with their employers [81]. Additionally, evidence suggests that Food Safety information exchange is more prevalent in nations with low power distance scores [63]. On the other hand, in a recent study carried out in Eastern and Central European countries [61], some countries reached the highest score in communication indicator even if their power distance score was close to 90, contradicting previous findings.

Therefore, although there are no unambiguous findings, in the current study, Italian employees with a medium-low power distance culture (50) obtained good and above the average (4.18 vs 4.13) overall results in the communication indicators, confirming the hypothesis that in lower power distance culture the employees are free to approach and communicate with their bosses. The low score in fact leads to a minimization of the hierarchical gaps between individuals, allowing for more direct and informal communication between people of different positions or ranks. This encourages individuals to freely express their thoughts, ideas, and opinions without fear of retribution or judgment.

3.3.3. Commitment

In national cultures where masculinity predominates, decision-making is more centralized [81], whereas femininity cultures are more likely to reach Food Safety goals through teamwork and consensus decision-making [63]

A high score in Masculinity dimension denotes a society that is motivated by competition, accomplishment, and success, with success being defined by the winner. If the dimension has a low score (Feminine), then quality of life and compassion for others are the dominating social ideals. Living a high-quality life is a sign of success in a feminine culture and standing out from the crowd is not admired. The core problem here is whether people are motivated by a desire to excel (masculine) or a love of what they do (feminine) [67]. Finally, it was found that in a mostly feminine environment, the employees are actively involved by leaders in hygiene and Food Safety decision making and this results in higher score in commitment indicators [61].

At 70 Italy is a Masculine society, highly success oriented and driven [67]. Therefore, it is surprising that in the current investigation, Italy, that belongs to a more masculine national culture (70), agreed (4.11) that their employees are actively involved by leaders in hygiene and FS decision making. In fact, it contradicts what was previously theorized by the scholars.

3.3.4. Resources

It is expected that uncertainty avoiding national cultures will have a strong preference towards written food safety procedures and instructions [82]. At the same time, it was anticipated that also national cultures that place a significant emphasis on the long term would favour comprehensive and established food safety regulations and processes [63].

The aspect of uncertainty avoidance is concerned with how a society responds to the reality that the future is always uncertain. The score on Uncertainty Avoidance reflects how much a culture's citizens feel frightened by ambiguous or unknowable circumstances and have developed ideas and structures to try to avoid them [67].

Instead, the long-term component, however, explains how each society must preserve certain ties to its history while addressing issues of the present and the future, and how each civilization prioritizes these two existential aims differently [67].

Italy scored highly on uncertainty avoidance (75), indicating that the people there do not generally feel at ease in unclear circumstances. High Uncertainty Avoidance in the workplace leads to extensive, meticulous planning. For Italians, the low Uncertainty Avoidance approach, where the planning procedure can be adaptable to changing environmental conditions, can be quite stressful [67]. On the other hand, Italy's high score of 61 on this factor demonstrates the pragmatic nature of Italian culture. People in pragmatic civilizations hold the view that situation, context, and time all play a significant role in determining what is true.

Hence, it is possible to argue that the Italian Uncertainty Avoidance and Long-term culture was the reason why Italian employees strongly agreed (4.28) to the M6 indicator ("In my organization, good procedures and instructions concerning hygiene and food safety are in place"), the one directly related to the preference towards written food safety procedures and instructions.

3.3.5. Risk awareness

In the recent investigation of Nyarugwe et al. (2020) [81], the authors concluded that generally Food Safety and hygiene risks awareness could have some correlations with National Culture dimensions. Specifically, it could be negatively correlated with high power distance and long-term orientation national cultures, and positively correlated with highly individualist and uncertainty avoidance culture.

As already anticipated in the previous sections, with a score of 50 in the power distance dimension, Italy's society appears to accept hierarchical systems and authority to a moderate extent. Italian society has a great propensity for norms, structure, and avoiding ambiguity, as seen by the high score (75) on the uncertainty avoidance scale. Moreover, Italian culture received a score of 61, indicating a moderate emphasis on traditions and long-term planning while juggling some short-term concerns.

In contrast, the dimension regarding individualism in Italy has not yet been explored in depth. As suggested by the high score (76), Italy is an Individualist culture, "me" centred, in fact, for Italians having their own personal ideas and objectives in life is very motivating and the route to happiness is through personal fulfilment [67].

The initial hypothesis is complex since it involves several cultural dimensions at the same time and therefore it is not easy to find a culture that can embody all these values. However, given

the good perception of Italian employees regarding risk awareness (4.13), it can be asserted that it may depend on some of the factors mentioned above.

Indeed, in individualistic cultures, such as the Italian one, individuals tend to have a higher sense of personal responsibility and autonomy. This can lead to a greater awareness of risks as individuals take more ownership of their actions and decisions, making them more vigilant and cautious in identifying potential risks and taking necessary precautions [83].

Moreover, Italian culture with a high level of uncertainty avoidance exhibits a strong preference for rules, structure, and predictability. This can contribute to a heightened awareness of risks, as individuals and organizations strive to minimize uncertainty and mitigate potential hazards. The focus on avoiding ambiguity and maintaining stability can lead to a greater emphasis on risk assessment and risk management practices [82].

Finally, being Italian culture a quite low power distance one, employees inside the companies are empowered, involved, and feel encouraged to participate in the decision-making process and it can be beneficial to increase the risk awareness perception of them [84].

The only assumption that could not be confirmed is the one regarding long term orientation, as it had been stated to be negatively correlated with risk awareness, and in the present study this was not evinced.

4. Conclusions

Through the use of the revised questionnaire by De Boeck et al. (2015) [1], the study managed to outline the food safety climate of Italian packaged confectionery raw material suppliers.

Based on the perceptions of 124 respondents, food safety climate could be considered good in the responding Italian packaged confectionery raw material suppliers' companies. In fact, looking at the overall picture, 42% of the respondents agreed (4) and 40% totally agreed (5) to the Food Safety statements, reaching an overall average score of 4.13 and a standard deviation of 0.94.

Whether compared with the results of previous studies such as that of De Boeck et al. (2018) [72], where the final result of the food processing companies in Belgium was 3.92, and also that of Tomasevic et al. (2020) [61], where the food safety climate in Central and Eastern European countries was found to be 4.18, it can be stated that the Italian market had a good overall perception of food safety topics.

The research identified the strongest and weakest components of the organisation's food safety climate.

L1 ("In my organization, the leaders set clear objectives concerning hygiene and food safety"), L2 ("In my organization, the leaders are clear about the expectations concerning hygiene and food safety towards operators"), L6 ("In my organization, the leaders strive for a continuous improvement of hygiene and food safety"), E1 ("In my organization, the leaders clearly consider hygiene and food safety to be of great importance") and R1 ("In my organization, the risks related to hygiene and food safety are known") are the indicators that are better perceived by the respondents (all scores higher than 4.30), with E1 that set the highest score of 4.44. It can be easily observed that most of the indicators with higher perceptions refer to the leaders' behaviour. This can be interpreted as great care by leaders in conveying the right values and making their employees aware of possible risks related to Food Safety issues. In the literature, in fact it has extensively highlighted the value of leadership in creating a strong and supportive environment for food safety. Employee engagement and motivation are increased when good leaders let their team members know where the company is going and why [2].

On the other hand, M1 ("In my organization, operators get sufficient time to work in a hygienic and food safe way") and M2 ("In my organization, sufficient staff is available to follow up hygiene and food safety") are the indicators worse perceived by the respondents, with a score

of 3.69. Although the values are not so low, what is found is that respondents believe that the organization does not offer a lot of support (financially, practically, psychologically, or emotionally) for hygiene and food safety-related concerns. According to Griffith et al. (2010) [2], this perception might result in less incentive to operate in a sanitary and food-safe manner. Additionally, if workers are under pressure due to a lack of staff, this may result in lower-quality final goods.

Furthermore, the results were statistically analysed using the Kruskal-Wallis H and Mann-Whitney U tests and some correlations between organizational traits and food safety results were found.

Large companies, with more than 250 FTE, were found to have significantly higher scores in all the food safety indicators than medium (50-249 FTE) and small sized (1-49 FTE) companies ($p < .001$). Instead, medium size companies provided significantly higher score than smaller size ones only for the Resources (M) dimension ($p = .03$). These findings confirmed the significant correlation between company sizes and food safety climate results found by Tomasevic et al. (2020) [61]. The correlation can be justified by the fact that tackling food safety issues is much more challenging for smaller food companies, mainly due to a lack of resources, including personnel, finances, and expertise [78].

On the other hand, companies belonging to the milk production sector have provided significant lower scores compared to the ones belonging to food flavoring, cereals, and sugar sectors ($p < .05$ for all the Food Safety dimensions), contrasting the findings of De Boeck et al. (2018) [72] in Belgium, where no meaningful perceptual differences were observed with respect to the sectors. This may point to a low perception of food safety in the milk sector and therefore could lead to a future analysis to enlarge the sample for this sector and possibly justify this result.

The last significant correlation was found between the presence of food safety dedicated roles and food safety results. In fact, companies with food safety dedicated roles provided meaningfully higher scores in comparison with the companies lacking them ($p < .001$). Although this is an outcome that could have been predicted, it was the first time that this kind of organizational trait was taken into consideration so it could be also further analyzed in future studies to confirm the observation.

Based on the data, for the other organizational characteristics investigated (such as organizational function of the respondent and main organizational function involved in food safety topics), no significant correlations with the food safety climate could be proven.

Exploratory factor analysis revealed the existence of 2 underlying factors: factor 1 mainly dealing with 'leadership and communication related' indicators, and factor 2 with 'resources and risk awareness related' indicators; instead, the 'commitment related' indicators belonged to both two factors. The unexpected discovery that factor 1 accounts for most of the variation (72.7%) in the data set, probably reflects the significance of leadership and communication issues in respondents' mindsets and perceptions when asked about the culture of food safety in their food processing organization.

The extracted factor solution hardly mirrored the five dimensions (leadership, communication, commitment, resources, and risk awareness) as they were specified in the De Boeck et al. (2015) [1] tool for assessing the food safety climate. The findings imply that for certain organizational stakeholders, the food safety climate may be represented by less than five aspects.

Regarding the study of the influence of national culture on food safety dimensions, some previous hypotheses of correlations were verified. The dimensions of leadership and communication were negatively related to power distance; long-term orientation and uncertainty avoidance showed a direct correlation with written food safety procedures and instructions; finally, risk awareness appeared inversely related to power distance and long-term orientation and positively to individualism and uncertainty avoidance. Important to state is that these findings were found by means of a qualitative analysis based on a sample of Italian companies only and therefore it was not possible to compare results for different values of national culture. However, several insights were taken from the study by Tomasevic et al. (2020) [61] on companies from Central and Eastern Europe and several comparisons were made with their results.

4.1. Limits and future studies

One limitation of the study is related to the total number of responses and the number of companies involved. In fact, a huge amount of time would have been required to explore a more representative sample of the industry, also in relation to the low response rate. Moreover, among the contacted companies, only 39% gave their contributions. Therefore, the author of the present work is aware that this does not constitute an optimal representative sample of raw material suppliers to the Italian confectionery food industries but could be however considered as a starting point for future studies.

Secondly, it was not possible to gather results per company but only by organizational traits, due to the anonymity of the questionnaire. This therefore did not allow us to make evaluations for individual companies interviewed.

Thirdly, important to consider in interpretation of the results is the fact that through the food safety climate self-assessment tool, 'perceptions' are measured and so, this research does not assess the effectiveness or performance of the techno-managerial route such the organisation's HACCP system or CCP failures. Hence, the recommendation for future studies is to focus on the effect of the food safety climate on the effective food safety performances in Italian suppliers' companies.

Finally, the last limitation of this study is that all Food Safety climate indicators were measured evenly important in the assessment. In the future, researchers could evaluate to give a weight to the indicators with respect to their importance found in previous studies.

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