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*Just Culture Maturity Assessment Tool and Its Application
in Medium-Sized Food Company in Poland*

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Abstract

Theoretical background: Ensuring food safety requires the development of an appropriate food safety culture, including its important subculture – just culture (JC). JC is a fair, proportional, and transparent way in which individuals are held accountable for errors. JC in the food sector is an element of food safe-

ty culture and is one in which all employees within a food company are encouraged to provide and feel comfortable providing food safety-related information. It is an atmosphere of trust in which food handlers are convinced they will be treated fairly based on their actions rather than the outcome of those actions, in the case of positive, as well as negative food safety. No approach for the food sector for measuring this phenomenon is seen in the literature.

Purpose of the article: The article aims to present a proposal for a tool for assessing just culture in a food company and to discuss the results of empirical validation of this tool in a selected organization.

Research methods: A literature review was conducted to identify tools for measuring JC in different industries. The primary research method was a case study, including a documentation analysis, based on the READ approach. The just culture maturity assessment tool (JCMAT) used by the company was statistically verified. To interpret the results, the so-called Enlighten 4C Food Safety Culture model was applied.

Main findings: The JCMAT has proven to be a reliable tool for exploring JC maturity. A set of dimensions were proposed to constitute JC. The surveyed organization has reached the “awakening” maturity level. Socio-demographic characteristics did not have a major impact on respondents’ opinions about the JCMAT statements.

Introduction

Despite the efforts of different food safety agencies food safety incidents (FSI) are a problem affecting different groups of consumers (Soon et al., 2020). The World Health Organization statistics indicating various sources of food hazards are not optimistic (*Estimating the Burden...*, 2021). Among the 4,607 Rapid Alert System for Food and Feed (RASFF) notifications transmitted in 2021, 4,102 concerned food, 236 feed, and 269 food contact material. In comparison with 2020, increases of 19.6% and 3.5% in the number of original notifications were registered for food and feed respectively (*2021 Annual Report*, 2022, p. 11). Data of this type calls into question the implementation of basic hygiene principles in a food company and the effectiveness of the official supervision in this area. At the same time, first researchers began to signal the importance of the phenomenon known as just culture (JC), arguing that its absence may limit the proper recognition of the causes of inappropriate hygienic behavior at the level of a given food facility (Wiśniewska, 2022). JC in the food sector is

an element of food safety culture and is one in which all employees within a food company are encouraged to provide and feel comfortable providing food safety-related information. It is an atmosphere of trust in which food handlers are convinced they will be treated fairly based on their actions rather than the outcome of those actions, in the case of positive, as well as negative food safety. (Wiśniewska, 2022)

In turn, food safety culture can be understood as “shared values, beliefs and norms that affect the mindset and behavior toward food safety in, across and throughout an organization” (GFSI, 2018). According to Gogalniceanu et al. (2021), JC is a fair, proportional, and transparent way in which individuals are held accountable for errors. In our case, we should mean the errors made by food operators, but also those that are inherent in the food safety system. More so, as history and practice show, accidents

are often preceded by incidents and/or by predictable foreseeable failures in systems and safety deficiencies (Rodrigues & de Almeida Fachada, 2021). In general, a food incident is “any event where, based on the information available, there are concerns about actual or suspected threats to the safety or quality of food that could require intervention to protect consumers’ interests” (*Principles for Preventing...*, 2007).

JC is not a new phenomenon. Its importance over the years has been appreciated, among others in aviation, maritime, as well as in healthcare (e.g. Malone & Darcy, 2019; Arce & Baumler, 2021; Wiśniewska et al., 2022). In general, JC is seen as a part of the safety culture (SC), which gained importance mainly due to the Chernobyl nuclear disaster (1986), and then events such as the Herald of Free Enterprise disaster (1987), a fire at King’s Cross London Underground train station (1987), the Piper Alpha incident in the UK North Sea (1988) (Graveling, 2022; Hopcraft et al., 2023). In parallel, the need to develop tools to measure safety culture, therefore, became evident, which is fully in line with Lord Kelvin’s rule: “If you cannot measure it, you cannot improve it” (Wischmeyer, 2021). Over the years, many tools of this type for different sectors have already been proposed (e.g. Kalteh et al., 2020; Tappura et al., 2022; Otitolaiye et al., 2022; Ayob et al., 2022). In particular, a lot of specific tools have been developed in healthcare (Churruca et al., 2021). When it comes to the food industry and the measurement of food safety culture, the pioneering researchers are Griffith et al. (2010). Since then, nearly 50 publications devoted to measuring the culture of food safety have been written, and their extensive review is included in the work by Zanin et al. (2021). Recent works include, for example, the articles by Spagnoli et al. (2022) and Onojakpor et al. (2022). Nevertheless, not much work is noticed on JC assessment, as the authors will write about in the next chapter of this publication. The food industry is particularly affected by this gap. For this reason, the article aims to present a proposal for a tool for assessing just culture in a food company and to discuss the results of empirical validation of this tool in a selected organization. To our knowledge, this is the first article about measuring JC in a food company, which proves its originality. The following chapter presents the literature review for the development of the JC assessment tool in a food company. The considerations in this chapter were used to propose four research questions. The next chapters are addressed methodological assumptions and cover the research results and their discussion. The final chapters contain the limitations of the conducted research, possible implications for science and practice, further possible research directions, and conclusions.

Just culture assessment – literature review and research questions development

As mentioned, JC’s approach was developed based on knowledge about the safety culture, which is described as follows: “The product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that deter-

mine the commitment to, and the style and proficiency of, an organization's health and safety management" (Churruca et al., 2021). It was James Reason (1997) who first fully developed the foundations of a JC in his book, entitled *Managing the Risks of Organizational Accidents*. According to Reason (1997, pp. 191–222), JC is "a collective understanding of where the line should be drawn between blameless and blameworthy actions". David Marx (2001, p. 1), a specialist who has played an important role in promoting JC in healthcare, convinces:

On one side of the coin, it [just culture] is about creating a reporting environment where staff can raise their hand when they have seen a risk or made a mistake. On the other side of the coin, it is about having a well-established system of accountability. A just culture must recognize that while we as humans are fallible, we do have control of our behavioral choices.

The same author proposed an important classification of situations that are related to or might give rise to, an error: human errors (unintentional errors, lapses, omissions); negligent conduct (when employees, not being aware of certain risks, neglect some procedures, requirements); reckless conduct (e.g. conscious disregard of a visible, significant risk); and intentional rule violations (e.g. when employees consciously and intentionally grossly neglect food safety procedures). The above confirms how crucial the human factor is in a situation of uncertainty and/or danger (Wiechetek & Mędrek, 2022).

JC aims to respond to anxiety about blame-free approaches on the one hand, and a concern about people's willingness to keep reporting safety-related issues on the other. JC is situated between a culture of blame and no blame, with the blame culture focusing on finding and punishing the guilty person, and not blaming – on disregarding the fact that the error has occurred. JC sets out the conditions that legitimize a managerial intervention in the sanction or restoration of individuals in the organization (Dekker & Breakey, 2016). Without proper recognition of the nature of the mistake made, it is not an easy task. However, according to the old rule, prevention is better than cure. Hence, an important role should be assigned to the assessment of an atmosphere conducive to reporting errors. As the *Cambridge Dictionary* indicates an assessment is "the act of judging or deciding the amount, value, quality, or importance of something, or the judgment or decision that is made" (www1). The phenomenon of JC assessment is not yet common in the food industry, nor is it just culture. Nevertheless, when writing about JC, as well as preparing to measure it, researchers can benefit from the experience of other industries, including publications presenting specific tools for this purpose. The more so because according to the author's knowledge, only one article by Wiśniewska (2022) has been published so far on the importance of just culture in the food industry. The author describes, inter alia, the meaning of just culture, its genesis, essence, and connection with cultures such as food safety culture, reporting culture, informed culture, flexible culture, and learning culture. Next, she presents the so-called "Swiss cheese" model, illustrating the spread of hazards in the event of inadequate protection in the food safety system.

Da Cunha et al. (2022) by extending Wiśniewska’s (2022) view propose and discuss the use of multiple layers of defense to prevent foodborne illness in restaurants.

The fact that there is a short list of articles on measuring just culture confirms the literature review in this area. The results of searching the scientific databases available to the authors from the level of the home university repository (phrases: “just culture + assessment”; “just culture + evaluation”; “just culture + measurement”; years: 1997–2022; databases: Ebsco, Emerald, Science Direct, SAGE, Scopus, Springer, Taylor & Francis, Web of Science) are not impressive. 1997 was used as the starting year, as that was the year when Reason’s (1997) first publication on JC came out. In our research full-text publications in English were considered, which gave 34 studies. The search was limited to peer-reviewed papers, yielding 19 publications. After removing duplicates and unrelated articles (e.g. short comments), 13 papers were selected for further review. After reviewing all final papers included in the study were prepared for analysis by a pre-determined checklist, which included the names of the authors, year of publication, authors’ country of origin, the area of application, and the type of assessment tool used with applied dimensions. The results are presented in Table 1.

Table 1. JC assessment tools used by different researchers

Author/s (year of publication)	Country of origin (first author)	Application	Assessment tool / JC dimensions / scale
von Thaden and Hoppes (2005)	USA	Healthcare	Just Culture Survey (JCS) Tool; 4 dimensions: Reporting Systems, Response and Feedback, Accountability, Basic Safety; 7-point Likert scale questionnaire; 20 items.
von Thaden et al. (2006)	USA	Healthcare	See above
Barger et al. (2011)	USA	Healthcare	Part 1 – Patient Safety Officer Assessment of Just Culture Principles Based on Document Review; 13 questions about organizational policies, adverse event investigations, and human resources actions; Part 2 – Survey of Hospital Leaders; 20 questions about critical behavioral markers, such as system design, coaching, reporting, responses to human error, responses to reckless behavior, severity bias, equity, and transparency; Answers – Yes, No; Questions weight – 1, 2, and 3 points.
Petschonek et al. (2013)	USA	Healthcare	Just Culture Assessment Tool (JCAT); 6 dimensions: Feedback and Communication, Openness of Communication, Balance, Quality of event reporting process, Continuous Improvement, Trust; 27 items; 7-point Likert scale (1 – „Strongly disagree”, 7 – „Strongly agree”).
Walker et al. (2020)	USA	Healthcare	Just Culture Assessment Tool for Nursing Education (JCAT-NE) based on Petschonek et al. (2013).
El Gazar et al. (2020)	Egypt	Healthcare	Arabic version of the Just Culture Assessment Tool developed by Petschonek et al. (2013).
Walker et al. (2020)	USA	Healthcare	Just Culture Assessment Tool for Nursing Education (JCAT-NE) based on Petschonek et al. (2013).
Mahmoudi et al. (2021)	Iran	Petrochemical industry	Just Culture Assessment Tool (JCAT) developed by Petschonek et al. (2013).

Author/s (year of publication)	Country of origin (first author)	Application	Assessment tool / JC dimensions / scale
Rodrigues and de Almeida Fachada (2021)	Portugal	Air force	Just Culture Assessment Tool inspired by Petschonek et al. (2013); 6 dimensions: Balance, Trust, Openness of Communication, Quality of event reporting process, Feedback and Communication about events, Overall goals of continuous improvement; 27 items; 5-point Likert scale (1 – <i>strongly disagree</i> , 5 – <i>strongly agree</i>).
Kim and Yu (2021)	Korea	Healthcare	The Korean Just Culture Assessment Tool (K-JCAT) inspired by Petschonek et al. (2013); 24-item questionnaire; 6 dimensions: Organizational Trust, Information Sharing, Reasonable Reporting System, Acceptance of Opinions, Organizational Balance, Organizational Integration; 5-point Likert scale (1 – <i>strongly disagree</i> , 5 – <i>strongly agree</i>).
Yoon and Lee (2022)	Korea	Healthcare	Just Culture Assessment Tool (JCAT) based on Petchonek et al. (2013); 5-point Likert scale (1 – <i>strongly disagree</i> , 5 – <i>strongly agree</i>).
Wiśniewska et al. (2022)	Poland	Healthcare	Just culture maturity questionnaire (JCMQ) inspired by von Thaden and Hoppes (2005), Barger et al. (2011), and Petschonek et al. (2013). 24 items; 4 dimensions: General Rules, Reporting, Responsibility, Reaction; 5-point Likert scale (1 – <i>strongly disagree</i> , 5 – <i>strongly agree</i>); to assess the level of just culture maturity, a maturity grid developed by Ph. Crosby was used.
Hays and Kruse (2022)	USA	Healthcare	Just Culture Assessment Tool for Nursing Education (JCAT-NE) based on Walker et al. (2020), therefore, based on Petschonek et al. (2013).

Source: Authors' own study.

While following the development of works on JC assessment, it is noted that there were von Thaden and Hoppes (2005) and von Thaden et al. (2005; 2006), who for the first time developed a method for measuring just culture in a hospital work environment. However, as can be seen, the approach developed by Petschonek et al. (2013) plays a very important role in the conducted studies and was used in nine of the analyzed works. The dominance of healthcare works is also clear, which is consistent with the observation made by Wiśniewska (2022) when talking about publications on JC as such. It can also be noted that in all cases, the statements contained in the various assessment tools were assigned to different dimensions. The number of dimensions depends on the number of statements and varies between four and six in the identified works. The most popular, the JCAT includes both positively and negatively worded questions (items, statements), and the negative scores were reversed to obtain a higher score. Higher scores on all items reflect a positive view of the organization's just culture (Mahmoudi et al., 2021).

Given this experience and the work done in other industries, we pose the following research questions:

Q1: Can the assessment questionnaire prepared by the organization under study be considered a reliable tool for determining JC maturity?

Q2: What JC dimensions can be proposed within the measurement tool used by the organization?

A review of the identified work also highlighted the nature of the statements (items) constructing each dimension. From an analysis of their content, it is clear the attitude and behavior of the company's leaders lie behind the success of JC implementation in the organization. Almost every one of the statements, regardless of dimension, is based directly or indirectly on the attitude or conditions created by the management. This understanding of the role of superiors is fully in line with how these roles are perceived by, for example, quality management classics such as Juran and Deming. The first authority believed that it is managers and supervisors who must take the greatest responsibility for any action taken in the organization to achieve the planned goal (Juran et al., 1999, pp. 5.67–5.68). In contrast, the next classicist expressed the importance of superiors in his famous 14 Points for Management (Deming, 2012, pp. 38–39). According to Petschonek et al. (2013), JC should be championed by the leaders and then adopted by all staff members. The authors add that careful application of JC concepts should result in fair treatment of employees that generates a sense of trust. This trust should facilitate an atmosphere of open safety communication. All the more so because confidence does not come out of nowhere, but rather must be built in a conscious manner (Bylok, 2022). Mahmoudi et al. (2021) additionally mention the quality of leadership showing in their research that the quality of leadership was the most important predictor of just culture. Yiannas (2009), one of the first authors dealing with food safety culture, makes a distinction between leadership and management and notes that leadership is more about influencing people, whilst management is about control and creating predictable results. Regardless, however, the support of superiors and their creation of an appropriate, friendly working climate has an important place in the context of a food safety culture. This was confirmed by a review study carried out by Zanin et al. (2021), who claim that leadership and proper management are the critical factors commonly connected to the success or failure of an FS culture because leading managers are usually the spreaders of beliefs, values, and thoughts, which shape a group to deal with everyday troubles. As Griffith et al. (2010) confirm, in a just culture employees should not experience reprisal from their superiors or other negative outcomes, and any errors/mistakes can be used positively to prevent future problems. Therefore, an undesirable phenomenon, indicative of a lack of proper error reporting conditions conducive to JC, is anxiety and fear of reprisals (Griffith et al., 2010; Wawersik & Palaganas, 2022). According to von Thaden and Hoppes (2005), a workplace devoted to JC creates a friendly environment wherein members of an organization can openly discuss errors without the fear of negative repercussions. As Walker et al. (2020) convince, within JC, employees can admit to their mistakes without fear of punishment. Only then errors are examined to identify all possible contributing factors, and both individual and system processes are implemented to prevent future errors from occurring. The importance of a supportive environment, devoid of the

fear of revealing mistakes, was also highlighted, e.g. by Petschonek et al. (2013), Walker et al. (2020), Mahmoudi et al. (2021) or Wiśniewska et al. (2022).

With these considerations in mind, we asked the following research question:

Q3: The most important role in implementing just culture is played by the friendly environment created by superiors.

In addition, various researchers listed in Table 1 (von Thaden & Hoppes, 2005; von Thaden et al., 2006; Petschonek et al., 2013; Walker et al., 2020; Mahmoudi et al., 2021; Kim & Yu, 2021; Yoon & Lee, 2022; Hays & Kruse, 2022) assumed that respondents' answers towards JC statements can be influenced by different socio-demographic characteristics. Hence, also in our case, we propose the last research question:

Q4: The socio-demographic characteristics have a significant impact on employees' opinions towards JC statements.

Research methods

The research was based on the case study (CS) method, which is very popular in different disciplines, including social sciences, among the academics interested in qualitative research (Khan et al., 2022). Among the methods supporting CS might be documentation analysis. In our case, we analyzed materials provided by a quality representative of the organization (QR), and these were questionnaires of a survey conducted by a company among food handlers. Document analysis was consistent with the approach READ – (R) ready your materials, (E) extract data, (A) analyze data, and (D) distill your findings (Dalglish et al., 2020). Approval for the use of the documents was given by the company's management.

The case study involved a vegetable industry company (VIC) located in the north of Poland. VIC is one of the most important in this industry in Poland, also in terms of the amount of raw material processed. VIC has many certificates confirming its system approach to management, and the following can be indicated here: FSSC 22000 – The Food Safety System Certification 22000 (FSSC 22000) covering standards such as ISO 22000, ISO 9001, ISO/TS 22003, and technical specifications for sector-specific pre-requisite programs such as ISO/TS 22002-1; ISO 14001, which specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance; ISO 45001, which specifies requirements for occupational health and safety (OH&S) management system to enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance. In addition, VIC has Kosher and Halal certificates for its main product lines. It employs 64 people directly related to the manufacturing process (food handlers).

The questionnaire (JCMAT) used in the VIC, which we analyzed further, consisted of two parts. The first part allowed the collection of demographic data. The

second one consisted of 17 items equipped with a 5-point Likert scale (1 – *strongly disagree*, 5 – *strongly agree*). The JCMAT included positively and negatively worded items (marked as R) (see Table 2).

Table 2. JCMAT statements, the original version

Statements		Scale
S1	Superiors always share information with us about food safety incidents when they occur at our company	1 2 3 4 5
S2	Usually, we know nothing about the food safety incidents in our company (R)	1 2 3 4 5
S3	We are informed on an ongoing basis about the decisions related to the occurrence of food safety incidents	1 2 3 4 5
S4	Staff feel secure discussing food safety incidents with superiors (R)	1 2 3 4 5
S5	Superiors take seriously any suggestions made by the staff regarding food safety incidents	1 2 3 4 5
S6	Employees are usually blamed if any food safety incident occurs (R)	1 2 3 4 5
S7	When food safety incident occurs, employees fear disciplinary actions (R)	1 2 3 4 5
S8	The food safety incidents reporting system is used by employees as a basis for gossiping (R)	1 2 3 4 5
S9	Employees discourage each other from reporting food safety incidents (R)	1 2 3 4 5
S10	I follow food safety procedures because I'm afraid of being caught (R)	1 2 3 4 5
S11	I follow security procedures because others do	1 2 3 4 5
S12	I follow food safety procedures because I know there is a corresponding reward (bonus, praise, etc.) (R)	1 2 3 4 5
S13	I follow food safety procedures as I can see my superior is doing the same	1 2 3 4 5
S14	We do not report food safety incidents because we fear reprimands or other negative consequences (R)	1 2 3 4 5
S15	We don't talk about food safety incidents because we don't trust each other (R)	1 2 3 4 5
S16	We do not feel secure when someone informed our superiors about the existence of a food safety incident (R)	1 2 3 4 5
S17	When food safety incident occurs, we tend to feel fear and stress (R)	1 2 3 4 5

Source: Company's documentation.

Cronbach's alpha statistics were calculated to assess the scale reliability. A scale is considered reliable if Cronbach's alpha coefficient is ≥ 0.700 . To explain the variability of the intergroup of respondents' answers descriptive statistics and analysis of variance were used. To simplify and identify the new dimensions of just culture, a factor analysis was performed using the principal components method and Varimax rotation with Kaiser normalization. Statistical analyses were performed using IBM SPSS Statistics. 27.

After statistical analysis and verification of the questionnaire, a way of interpreting the results was proposed to the organization to determine the maturity of JC in the company. According to the dictionary, maturity can be defined as a "full development or perfected condition" (www3). It can be also "the level and state at which an organization can achieve its objectives" (Skrzypek, 2013, p. 11). To assess the level at which the company achieved its objectives in terms of FS incident reporting we were inspired by two approaches: a quality management maturity grid developed by Crosby (1979) and Enlighten 4C Food Safety Culture model (www2). By combining and modifying them, we have created a new tool for interpreting the results (see Table 3).

Table 3. JC levels

Level	Rating	Action level toward JC
I. Uncertainty	1.0–1.8	There is little or no evidence of reporting food safety incidents. “We do not know if we have all the information on food safety incidents”.
II. Awakening	1.9–2.7	Some efforts have been made within the organization to create a user-friendly FS incident reporting system. “We realized we need FS incident reporting”.
III. Enlightenment	2.8–3.5	Our organization has a formal food safety incident reporting system in place and our management encourages ongoing reporting of incidents. “We are prepared to analyze and resolve potential food safety incidents”.
IV. Wisdom	3.6–4.1	We have implemented and are correcting the effectiveness of our FS incidents reporting system. “We learn from experience and lessons from the results of FS incident reporting”.
V. Certainty	4.2–5.0	Our employees feel comfortable, are fully engaged, and understand the importance of food safety incident reporting. We are continuously improving our reporting system. “We know that we have all the information on food safety incidents”.

Source: Authors' own study based on: (Crosby, 1979; www2).

Results and discussion

As already mentioned, 28 people (44% of food handlers) took part in the study carried out by the company, the majority of whom were men (71.4%) (see Table 4). Among the respondents, half had a university degree, while 25% of the studied employees held managerial positions. Most respondents (39.3%) have worked min. 21 years in the profession. The number of people who have been associated with the establishment where they currently work for years is also similar.

Table 4. Characteristics of the research sample

	Number of respondents	%
Total	28	100
Sex		
Women	8	28.6
Men	20	71.4
Education		
Elementary/professional/medium	14	50
Higher	14	50
Managerial position		
Yes	7	25
No	21	75
Work experience in the food industry		
1–10 years	9	32.1
11–20 years	8	28.6
21 years and over	11	39.3
Work experience in the company		
1–10 years	12	42.9
11–20 years	5	17.8
21 years and over	11	39.3

Source: Authors' own study based on the company's documentation.

Based on this analysis, it can be confirmed that the respondents surveyed are rather well-educated, industry-related, and professionally experienced. As researchers confirm, this type of conditioning has a positive impact on food safety management, human behavior, and staff engagement (e.g. Alemayehu et al., 2021; Mohammed et al., 2022).

The proposed set of 17 statements included in the questionnaire reliably measured what it was supposed to measure, as Cronbach's alpha coefficient based on the standardized items was 0.740 (see Table 5). The above result allows us to positively answer question Q1.

Table 5. Cronbach's alpha statistic for a set of statements to assess just culture

Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
0.770	0.740	17

Source: Authors' own study.

The analyzed statements were rated on average by the surveyed employees at 1.63 (S15) to 4.30 (S5). The standard deviation of these ratings ranged from 0.734 (S12) to 1.387 (S13) (see Table 6).

Table 6. Descriptive statistics of the variables analyzed

Variables*	Average	Standard deviation
S1	4.22	0.751
S2	1.96	1.018
S3	3.89	0.751
S4	2.37	1.214
S5	4.30	0.775
S6	2.22	1.050
S7	2.48	1.087
S8	2.15	1.167
S9	2.22	1.086
S10	2.00	1.240
S11	2.67	1.359
S12	1.67	0.734
S13	3.33	1.387
S14	1.70	0.953
S15	1.63	0.926
S16	1.81	1.001
S17	2.04	1.126

* variable designations as in Table 2

Source: Authors' own study.

To define the dimensions of the just culture phenomenon, a factor analysis was conducted using the principal component method using Varimax rotation with Kaiser normalization. In the end, it was decided to adopt 4 dimensions conducive to food

incident reporting. With the four components extracted, the total explained variance is 69.462% (see Table 7 and Table 8).

Table 7. Total explained variance

Component	Sums of squares of loadings after rotation		
	Total	% of variance	cumulative %
1	4.390	25.823	25.823
2	2.948	17.343	43.166
3	2.369	13.937	57.103
4	2.101	12.358	69.462

The factor extraction method – principal components.

Source: Authors' own study.

Table 8. Matrix of rotating components

Variables	Component			
	1	2	3	4
S1	0.082	0.014	-0.394	-0.094
S2	0.078	-0.195	0.351	-0.009
S3	0.201	-0.124	-0.380	0.045
S4	-0.188	0.343	0.120	0.072
S5	0.187	-0.415	-0.045	0.047
S6	0.291	-0.140	-0.052	-0.039
S7	0.248	-0.139	-0.081	0.011
S8	0.142	-0.073	0.143	0.017
S9	0.044	0.116	-0.129	0.142
S10	0.085	-0.004	0.042	0.202
S11	0.014	-0.093	0.057	0.384
S12	-0.052	0.051	0.043	0.306
S13	-0.085	0.023	-0.068	0.388
S14	0.273	-0.101	-0.038	-0.078
S15	0.127	0.178	-0.151	-0.103
S16	-0.002	0.294	-0.122	-0.007
S17	0.144	0.082	-0.064	0.014

Rotation method – Varimax with Kaiser normalization

Source: Authors' own study.

The highest factor loadings were recorded for statements S6, S7, S14, and S17. The result obtained means that we were able to answer positively the Q3 question. An “Atmosphere conducive to reporting created by management” without fear and anxiety about reporting food safety incidents proved to be, in this case, the most important condition for success. The results of our study are consistent with the observations made by Wawersik and Palaganas (2022) regarding nurses' behavior, who confirmed that fear is the most serious barrier limiting error reporting. As mentioned earlier, the role of a supportive environment in this respect, devoid of fear of

oppression, was also demonstrated by Petschonek et al. (2013), Walker et al. (2020), Mahmoudi et al. (2021) or Wiśniewska et al. (2022).

The second group of items with the highest factor loading value was recorded for S4, S5, S15, and S16. Statements with the highest values of factor loadings in the third component were recorded for S1, S2 S3, and S8 and in the fourth component for S9, S10, S11, S12, and S13.

As a result of the procedure, dimensions were defined, and the relevant statements were subordinated to them. The final version of the questionnaire statements assigned to each dimension is presented in Table 9. The proposed dimensions were given the following names: I – An atmosphere conducive to reporting created by management; II – Security and trust; III – Information sharing about food safety incidents; and IV – Employee’s daily behavior. In this way, we were able to answer Q2.

Table 9. The final version of the JCMAT

No.	Dimensions	Statements
I	An atmosphere conducive to reporting created by management (Petschonek et al., 2013; Wiśniewska, 2022; Wawersik & Palaganas, 2022; Walker et al., 2020; Mahmoudi et al., 2021)	<ul style="list-style-type: none"> – employees are usually blamed if any food safety incident occurs (R) (S6) – when food safety incident occurs, employees fear disciplinary actions (R) (S7) – we do not report food safety incidents because we fear reprimands or other negative consequences (R) (S14) – when food safety incident occurs, we tend to feel fear and stress (R) (S17)
II	Security and trust (Petschonek et al., 2013; Rodrigues & de Almeida Fachada, 2021; Kim & Yu, 2021; Wiśniewska, 2022)	<ul style="list-style-type: none"> – staff feel secure discussing food safety incidents with supervisors (R) (S4) – supervisors take seriously any suggestions made by the staff regarding food safety (S5) – we do not talk about food safety incidents because we don’t trust each other (R) (S15) – we do not feel secure when someone informed our superiors about the existence of a food safety incident (R) (S16)
III	Information sharing about food safety incidents (von Thaden & Hoppes, 2005; Barger et al., 2011; Petschonek et al., 2013; Rodrigues & de Almeida Fachada, 2021; Kim & Yu, 2021)	<ul style="list-style-type: none"> – superiors always share information with us about food safety incidents when they occur at our company (S1) – usually, we know nothing about the food safety incidents in our company (R) (S2) – we are informed on an ongoing basis about the decisions related to the occurrence of food safety incidents (S3) – the food safety incidents reporting system is used by employees as a basis for gossiping (R) (S8)
IV	Employee’s daily behavior (Reason, 1997; Barger et al., 2011; Gogalniceanu et al., 2021; Churrua et al., 2021; Wiśniewska, 2022; Wawersik & Palaganas, 2022)	<ul style="list-style-type: none"> – employees discourage each other from reporting food safety incidents (R) (S9) – I follow food safety procedures because I’m afraid of being caught (R) (S10) – I follow security procedures because others do (S11) – I follow food safety procedures because I know there is a corresponding reward (bonus, praise, etc.) (R) (S12) – I follow food safety procedures as I can see my superior is doing the same (S13)

Source: Authors’ own study.

The evaluation of each statement under the proposed dimensions is shown in Figures 1–4.

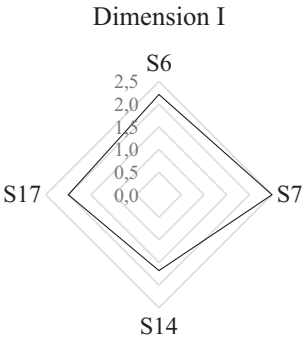


Figure 1. Average rating of statements related to “Atmosphere conducive to reporting created by management” (scale of 1–5)

Source: Authors’ own study.

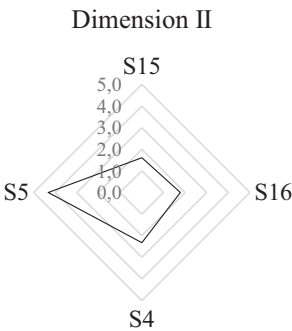


Figure 2. Average rating of statements related to “Security and trust” (scale of 1–5)

Source: Authors’ own study.

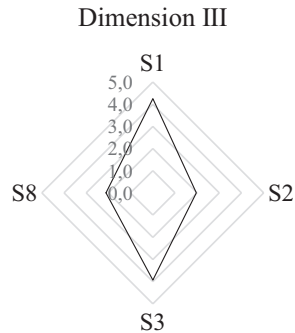


Figure 3. Average rating of statements related to “Information sharing about food safety incidents” (scale of 1–5)

Source: Authors’ own study.

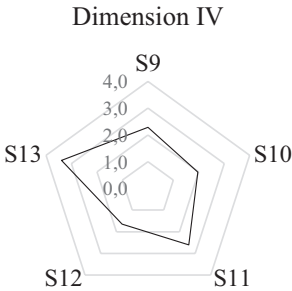


Figure 4. Average rating of statements related to “Employee’s daily behavior” (scale of 1–5)

Source: Authors’ own study.

Finally, considering the results in Table 6, it was also possible to determine the average maturity level of the JC in the studied organization, and it is 2.57. Comparing this result with the indications of Table 3, it was determined that JC’s maturity is at the “Awakening” level and corresponds to the statement: “Some efforts have been made within the organization to create a user-friendly FS incident reporting system. We realized we need FS incident reporting”. The above means that the result is not entirely satisfactory. Nevertheless, it seems to be a positive sign that the organization decided to conduct this survey among its employees, which means that JC is not indifferent to it. As Gupta et al. (2020) claim, becoming aware of the problem and realizing the need for change is the first step toward behavioral change.

The results of the one-way ANOVA analyses of variance for the individual statements included in the questionnaire are shown in Table 10. The evaluation of individual statements, and therefore individual elements of respondents' answers toward JC statements were significantly differentiated by work experience in the company if S8 is found ($F(3,27) = 3.944, p = .020$) and by education in the case of S3 found ($F(1,27) = 4.379, p = .046$). Ratings of the other statements did not differ significantly among the specified groups differentiated by gender, length of service in the food industry, or managerial position. *Post hoc* tests were not performed for S8 and S3 because at least one group had fewer than two observations.

Table 10. Results of one-way ANOVA analysis of variance (only significant relationships)

Work experience in the company						
Statement		Sum of squares	df	Mean square	F	Significance
S8	Between the groups	12.112	3	4.037	3.944	0.020
	Within the groups	24.567	24	1.024		
	Total	36.679	27			

Education						
Statement		Sum of squares	df	Mean square	F	Significance
S3	Between the groups	2.286	1	2.286	4.379	0.046
	Within the groups	13.571	26	0.522		
	Total	15.857	27			

Source: Authors' own study.

As can therefore be seen, the last research question (Q4) cannot be answered completely positively. Indeed, as far as socio-demographic characteristics are concerned, respondents' answers are only influenced by work experience in the company and level of education, and only about two opinions (S8 and S3). Most of the respondents' opinions are therefore not determined by socio-demographic characteristics. The above may mean that the surveyed group of employees has a similar perception of the phenomenon being assessed and the individual elements that comprise it. The observed compatibility may be the result of training (or lack of training), shared values, and beliefs. However, this does not mean that the level of JC is satisfactory, as demonstrated earlier.

Conclusions

Just culture is an important component of food safety culture and plays a critical role in controlling and reducing food safety incidents. It is important to be able to assess the level of JC, following the needs that have previously led to the development of such tools in other industries besides the food industry. The tool developed by the company meets the condition of reliability and can be recommended for further use. The level of JC recognized as “awakening”, is certainly not high. However, the

obtained result may be an impulse for further actions for the organization, consisting primarily in creating by the management such an environment that will be conducive to reporting and will be free from anxiety and fear of punishment. In our research, we have also shown that socio-demographic factors do not matter much in the case of the surveyed respondents.

Our contribution to the existing body of knowledge is to present the state of the art of tools that are used to measure just culture in different industries, a recognized important component of food safety culture. We have also been able to fill a research gap, because, to date, none of the existing work has been dedicated to measuring JC in the food sector. We were also able to identify and propose four JC dimensions, such as “An atmosphere conducive to reporting created by management”; “Security and trust”; “Information sharing about food safety incidents”; and “Employee’s daily behavior”, and we consider this to be our next original contribution. In addition, to better interpret the obtained results we proposed the combination of the classical approach created by Crosby with the modern approach of the Enlighten 4C Food Safety Culture model, which can also be considered original. The social relevance of our research and its results is linked to the fact that we have presented a tool used by the company to protect the consumer and build an organization based on values such as honesty, morality, truth, and openness.

To sum up, the research filled the following gaps:

- exploratory, as there has been a lack of work to date on the measurement of JC in the food sector,
- explanatory, as we have explained the nature of JC and the role of its measurement, pointing to existing tools in other industries,
- methodological, as JCMAT has been developed and verified,
- practical, because our study was based on a case study, and the tool verified can be recommended for further use.

The current research has some limitations that could be addressed in future studies. First, the limitation may be the lack of prior research on a similar topic in the food sector that could serve as comparative material. It would certainly be right to broaden the number of respondents because, in our current survey, we did not have any influence on this. In the food industry in Poland, the first efforts to assess food safety culture are just beginning, and not all companies are willing to share their experiences. The survey should cover all professional groups in the near future. It is certainly worthwhile to continue research in organizations from another food industry.

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