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An intercontinental analysis of food safety culture in view of food safety governance and national values

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ABSTRACT

Taking food safety culture into account is a promising way to improve food safety performance in the food industry. Food safety culture (FS-culture) research is expanding from an organisational perspective to include characteristics of the internal and external company environment. In this study, the prevailing food safety culture in 17 food companies from four countries on three continents (Africa, Asia and Europe) was assessed in view of food safety governance and national values. The internal environment characteristics, i.e. food safety vision, food safety program and food production system vulnerability, were also assessed. Statistical analysis revealed little variation in FS-culture scores between the companies within the same country. Overall the FS-culture for Greek and Zambian companies was scored proactive, while for Chinese and Tanzanian companies an active score was achieved. Both the internal and external company environment seemed to influence the prevailing FS-culture. Cluster analysis showed that Tanzanian and Zambian companies exhibited similarities in the implementation of food safety programs, and in their national values and food safety governance as compared to Greece and China. Food safety governance was reflected in the food safety programs and supportiveness of the organisation to food safety and hygiene. All cultural dimensions were correlated with risk perceptions, with masculinity and long-term orientation also significantly correlated with the enabling conditions and attitude. Understanding how national values and food safety governance approaches differently influence food safety culture is expected to enable formulation of best approaches tailored for companies operating in countries with different company environments, to improve food safety performance.

1. Introduction

Best approaches to improve food safety performance urgently need to be identified in view of existing food safety concerns (Kamau Njage et al., 2017). Research on food safety has therefore increased attention on food safety culture (FS-culture) as a measure to improve food safety performance (De Boeck, Jacxsens, Bollaerts, & Vlerick, 2015; Fatimah, Strohbehn, & Arendt, 2014; Griffith, Livesey, & Clayton, 2010; Nyarugwe, Linnemann, Nyanga, Fogliano, & Luning, 2018; Powell, Jacob, & Chapman, 2011). To date, much of the research has been focused on the assessment of FS-culture and food safety climate within the internal company environment (De Boeck, Jacxsens, Bollaerts, Uyttendaele, & Vlerick, 2016; Jespersen, Griffiths, Maclaurin, Chapman, & Wallace, 2016; Nyarugwe et al., 2018). However, Nyarugwe, Linnemann, Hofstede, Fogliano, and Luning (2016) and Taylor (2011) acknowledged national culture as a key determinant for conducting FS-culture research as all organisations, whether national or multinational, inevitably operate within a specific national culture context. Moreover, several authors proposed that characteristics of the external environment, such as national values, could have a significant role in shaping organisational culture, and influencing the operation and performance of organisations (Lok & Crawford, 2004; Newman & Nollen, 1996). Meshkati (1995) concluded that an organisation's safety culture interacts with its environment and therefore should be considered in the context of national culture. However, the role of the external business environment, encompassing national values and food

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Table 1
Characteristics of the 17 participating companies and the respondents.

	Country and company code																
	China (n = 55)					Greece (n = 54)				Tanzania (n = 56)					Zambia (n = 33)		
	C1	C2	C3	C4	C5	G1	G2	G3	G4	T1	T2	T3	T4	T5	Z1	Z2	Z3
Company characteristics																	
Product type	D	Y	L	D	B	D	D	D	D	D	D	D	D	D	L	D	M
Size	M	L	L	L	M	S	M	S	M	M	S	S	M	M	L	L	L
FSMS implemented	ISO 22000	HACCP	HACCP	ISO 22000	ISO 22000	ISO/FSSC 22000, ISO/TS 22000/1	FSSC 22000, ISO 22000, HACCP	BRC, HACCP ISO 22000	BRC, HACCPISO 22000	None	ISO 22000	HACCP	HACCP	HACCP ISO 22000	HACCP	HACCP	ISO 22000
Demographic characteristics																	
Gender																	
Male	**5**	**7**	**6**	6	7	5	17	**7**	14	**15**	6	**3**	**5**	**4**	**6**	**9**	**7**
Female	6	4	5	**5**	**4**	**6**	**1**		1	4	**4**	6	5	4	4	1	6
Age																	
18–20																	1
21–25	1		1	**3**	1					3	**3**	2	1	3		4	2
26–30	1	2	6	4	1	1	4		4	5	4	3	**4**	**3**	2	1	**7**
31–35	4	1		1	5		3	1	1	**3**		**2**	4		**2**	**4**	3
36–40	**3**	**5**	1	1	2	2	**3**	1	2	2			1	1	2	1	
41–45	1	2	**1**		1	2	8	3	5	2		1		1			
46–50	1	1	1	1		5	1	1	3	2	1				2		
51 and above			1	1	**1**	**1**		**1**		2	2	1			2		
Position																	
Managers	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**1**
Machine operators	10	10	10	10	10	6	7		3	15	5	5	8	3	3	6	10
Food handlers						4	11	7	12	2	4	2	1	4	5	3	2
Years employed																	
0–5	9	**10**	3	**6**	4	2	**6**	1	4	10	**9**	**7**	**7**	**7**	3	6	**8**
6–10	**2**		4	4	3	1	7	3	**5**	1	1		2	1	**4**	**3**	5
11–15		1		1	2	**4**	3	2	2	5			1		2		
16–20			1		**2**	2	3		4	1		1					
21 to 25			1			1			1							1	
26 and above			**2**			1		**1**		**2**		1			2		
Employment type																	
Contract	7	4	3	1	6	4			2	**11**	2	6	**10**	6	3	2	**6**
Permanent	**4**	**7**	**8**	**10**	**5**	**7**	**19**	**7**	**13**	8	**7**	**5**		**2**	**7**	**8**	7
Educational level[a]																	
Primary						2				1		3			7		2
Secondary	5	4			1	6	14	5	6	8	4	1	2	2			1
Tertiary	5	6	10	10	9	2	4	1	7	9	5	4	6	5	2	8	8
Nationality	**11**	**11**	**11**	**11**	**11**	**11**	**16**	**6**	15	17	**10**	8	**10**	**8**	9	7	**13**
Nationality (other)							2(A,G)	2(A,G)		**2**(K,U)		**1(K)**			**1(I)**	**3(I)**	

C1-C5, G1-G4, T1-T4, Z1-Z3 etc. refers to companies in China, Greece, Tanzania and Zambia, respectively.
For product type, D = dairy products, Y = yoghurt, L = liquid milk, B = baby formula, M = meat.
For company size, S = small (between 10 and 49 employees), M = medium (between 50 and 249 employees) and L = large (more than 249 employees).
For nationality, A = Albanian, G = German, K = Kenyan, U = Ugandan and I = Indian.
In bold, QA managers data included.
[a] For educational level, data for QA managers was not included as it was irrelevant to ask them this question.

safety governance, in shaping the prevailing FS-culture of an organisation has been scarcely studied (e.g. Nyarugwe, Linnemann, & Luning, 2020).

National culture is that "collective programming of the mind that distinguishes the members of one group or category (nation) of people from others" (Hofstede, Hofstede, & Minkov, 2010). Hofstede defined six cultural dimensions i.e. power distance, individualism, masculinity, uncertainty avoidance, long-term orientation and indulgence (Hofstede et al., 2010), which have been widely used to assess differences in national values and to investigate the role of national values in an organisation's safety performance (e.g. Newman & Nollen, 1996; Noort, Reader, Shorrock, & Kirwan, 2016; Van Oudenhoven, 2001). The first dimension, power distance (PD) measures the degree of inequality between employees and their bosses. In high PD cultures, decision-making is centralised, and in a low PD culture, decision-making is consultative and decentralised. Individualism distinguishes individualistic societies, where self-interests prevail over the group and collectivistic societies, where group interests prevail. Masculine cultures are characterised by people who are assertive whereas feminine cultures are characterised by modesty and valuing relationships (Hofstede et al., 2010). Uncertainty avoidance (UA) measures the degree to which people feel threatened by ambiguity. In high UA cultures, people avoid ambiguous situations and are more expressive, and in low UA cultures, people are less expressive. In long-term oriented cultures, long-term planning and goals are evident, whereas, in short-term oriented cultures, the focus is on prevailing issues. The last dimension, indulgence measures the "*tendency to allow relatively free gratification*" whereas the opposite i.e. restraint reflects suppressed gratification. Wallace (2009), Taylor (2011) and Nyarugwe et al. (2020) proposed that these dimensions could potentially influence the performance of an organisation's food safety management system (FSMS) and prevailing FS-culture.

In addition to being reflected in the way people behave, e.g. at work, national values are also reinforced by government policies and national legislation (Van Oudenhoven, 2001). For example, the EU, has developed extensive legislation (EC., 2004) to assure food safety when compared to countries in sub-Saharan Africa, where legislation is usually still outdated and poorly enforced (Kussaga, Jacxsens, Tiisekwa, & Luning, 2014a; Morse, Masuku, Rippon, & Kubwalo, 2018; Nguz, 2007). However, within the EU, member states also have different enforcement practices, leaving room for industrial self-regulation (Caduff & Bernauer, 2006; Jacxsens et al., 2015; Kirezieva et al., 2015b). Companies, therefore, adopt and implement different public and private standards, to which they need to conform to remain competitive and gain market access (Fulponi, 2006; Jacxsens et al., 2011; Luning et al., 2009). These public legislation, private standards, and public and private enforcement practices, typically describe food safety governance (Kirezieva et al., 2015b). Food safety governance issues such as legal frameworks, enforcement philosophies, strategies, and practices can mould FSMS design and operation (Kirezieva et al., 2015b; Sampers, Toyofuku, Luning, Uyttendaele, & Jacxsens, 2012) and therefore need to be studied in FS-culture assessments as they could also influence the prevailing FS-culture of organisations.

In a previous study (Nyarugwe et al., 2020), a FS-culture research framework was developed to enable the analysis of an organisation's FS-culture within its national context. The prevailing FS-culture was assessed in view of the internal and external company characteristics. The results of that study implicated that the external environment of a company could have a role in the prevailing FS-culture of an organisation. However, this assumption could not be confirmed as the analysis was confined to companies in one country. Therefore, the objective of this study was to evaluate the role of food safety governance and national values in the prevailing FS-culture of organisations by investigating the FS-culture in food companies in countries differing in national values and the food safety governance approach. We therefore assessed companies operating in countries that differ in national values and their food safety governance approach to establish whether this relationship exists or not, and whether national culture and the food safety governance approach could be useful and/or relevant in explaining the prevailing FS-culture of the companies.

2. Materials and methods

2.1. Study design

Ethical approval was granted by the Wageningen University Social Sciences Ethics Committee (SEC) before conducting the research (see Appendix).

2.1.1. Selection of respondents

The study was conducted in four countries, namely China, Greece, Tanzania, and Zambia (Table 1). The focus was on countries from different continents were national values and the food safety governance approaches were expected to be different on the basis of Hofstede et al. (2010) and Kirezieva et al. (2015a). In each of the countries, companies producing high-risk products (mostly dairy companies) were chosen because of their high susceptibility to microbial contamination (Qian, Guo, Guo, & Wu, 2011). Companies with at least 10 employees (European Union Commission, 2003) were selected, as approximately 10 food handlers and 1 QA manager were required for the interviews.

Companies were invited to participate in the study via email, LinkedIn and ResearchGate. Local researchers in the participating countries who were committed and knowledgeable in the research field facilitated the acquisition of respondents through visits, emails, and telephone calls. Participation was voluntary, and countries, companies, and respondents were selected based on their willingness to participate. In total 17 companies participated, namely five from China (C1-C5), four from Greece (G1-G4), five from Tanzania (T1-T5) and three from Zambia (Z1-Z3). Characteristics of these companies and their respondents are presented in Table 1.

2.1.2. Research framework

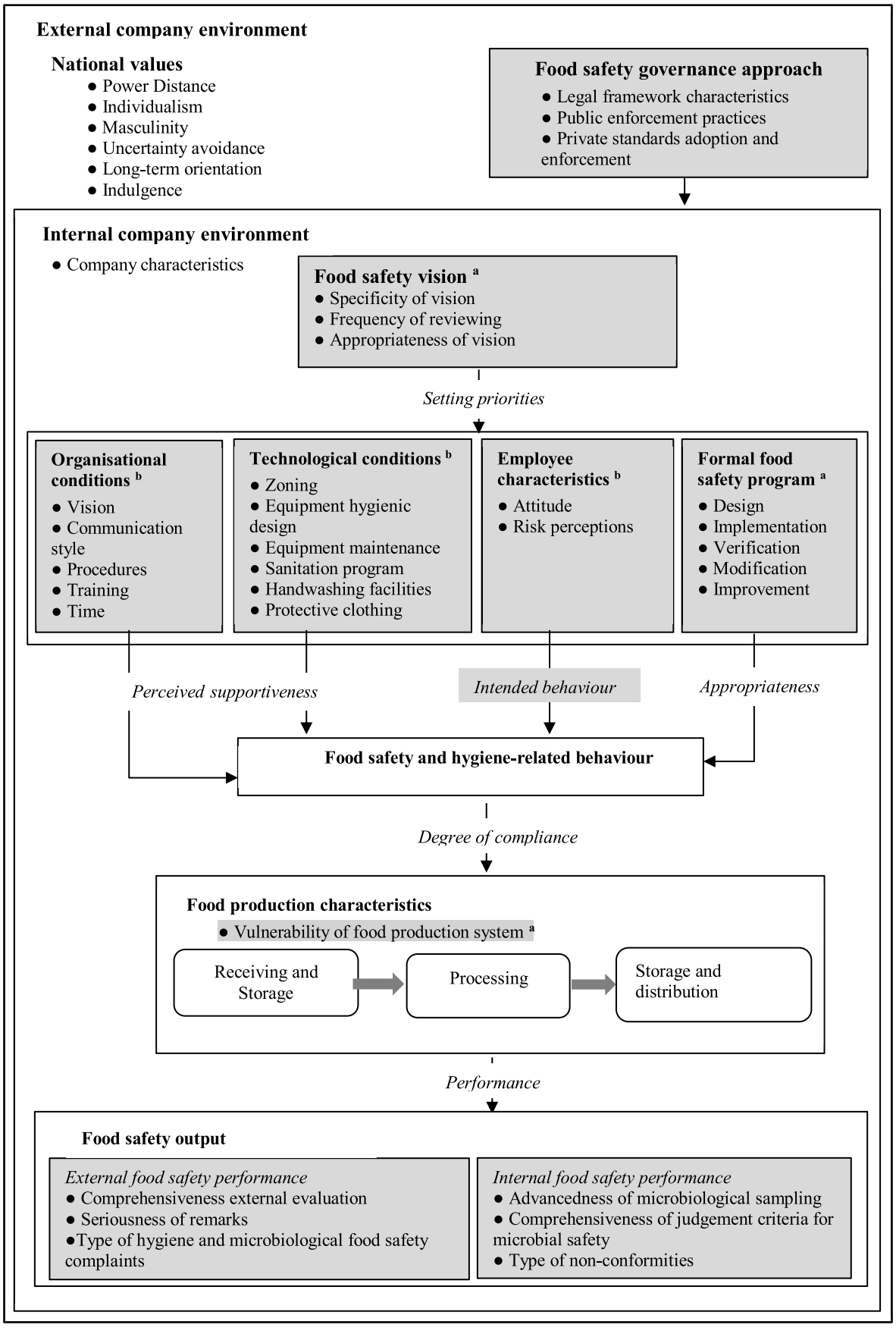
Fig. 1 shows the framework used to analyse an organisation's prevailing FS-culture within its company environment. It shows elements used to analyse an organisation's prevailing FS-culture i.e. organisational and technological enabling conditions and employee characteristics, and the internal company environment (i.e. food safety vision, vulnerability of food production system and food safety program). It also shows elements used to analyse the external company environment i.e. national values and food safety governance approach. For each element, variables used to collect essential aspects of the elements and subsequently give an indication of the actual situation in the assessed companies are given. Nyarugwe et al. (2018) and Nyarugwe et al. (2020) provide detailed descriptions of the elements and their assessment (details in supplementary materials).

2.2. Data on national values

The country comparisons accessed from Hofstede Insights (https://www.hofstede-insights.com) were used to typify the national values (Hofstede et al., 2010). The values are presented as index scores and given as absolute values ranging between 0 and 100 to get an insight into the country score (Hofstede & Minkov, 2013).

2.3. Questionnaires

Two questionnaires, one for the quality assurance (QA) managers and one for the food handlers were designed based on a previous FS-culture research framework and previously validated studies (Nyarugwe et al., 2018, 2020). Questions and response options for each of the assessed elements were framed based on the situational descriptions from these previous studies, reflecting score 1, 2 and 3 (details in supplementary materials). The questionnaires were modified,



(caption on next page)

Fig. 1. Structure of the framework to analyse prevailing FS-culture of a company within its environmental context. Adapted from Nyarugwe et al. (2020)
a Elements used to measure the internal company characteristics b Elements and variables used to assess an organisation's prevailing FS-culture Food handlers' questionnaire was used to assess the FS-culture variables and intended behaviour QA managers' questionnaire was used to assess the food safety governance approach, food safety vision, formal food safety program, vulnerability of food production system and the food safety output.
In grey are the elements measured in this study.

translated, and tested to suit the purpose of an online survey (see Appendix for full questionnaires). Modifications were mainly methodological, such as the replacement of the card-aided interviews by closed questions. The English version was translated into Swahili, Greek and Chinese. Translation into Swahili was first done by a native speaker with experience in the research field. The translations were double-checked by comparing the original document with the translated document by two more independent native speakers with experience also in the research field and modifications made in consultation with the researchers. The Greek questionnaire was translated by a professional native speaker from a company providing translation services and were also confirmed by a native speaker also knowledgeable in the FS-culture research field. For China translations were done by a native speaker experienced in the food safety research field. All translations were translated back to check whether the English meaning was retained, and any modifications incorporated into the final versions.

The questionnaires could be filled out through a link to an online survey (SurveyMonkey®). For China, the questionnaires were disseminated through Wenjuanxing, a Chinese online survey system (https://www.wjx.cn/). Occasionally questionnaires were downloaded and manually disseminated when this was more convenient for respondents.

2.3.1. Questionnaire for QA managers

The questionnaire for QA managers consisted of open questions for company characteristics and demographic variables such as type of products and nationality, and closed questions on the vulnerability of product and production characteristics, food safety vision, formal food safety program, food safety governance, and food safety performance indicators (complete questionnaire in Appendix). Vulnerability of product and production characteristics relates to the perceived riskiness in context that puts demands on the level of design of food safety systems and could influence the food safety output (Sawe, Onyango, & Njage, 2014). Food safety vision "communicates a company's reason for existence and how the company translates this into expectations" (GFSI, 2018). A formal food safety program is a formally documented program that "identifies and controls food safety hazards in the handling of food in a food company" (Food Safety Policy and Regulation, 2007). The food safety governance approach refers to characteristics of the country's food safety regulatory environment and enforcement practices (Kirezieva et al., 2015a). Food safety performance gives a measure of the food safety output (Jacxsens et al., 2010).

The questionnaires contained questions to check for reliability, i.e. consistency in responses. Closed questions described implied proactive (score 3), active (score 2) and reactive (score 1) situations, with the answer categories randomised to avoid response bias. Assessment of vulnerability of product and production characteristics encompassed four questions, each with three answer categories scored 1–3 based on Luning, Jacxsens, et al. (2011) and Luning, Marcelis, et al. (2011). Scores 1, 2 or 3, respectively indicated a high, potential and unlikely susceptibility to (cross) contamination (Sampers et al., 2012). For the food safety vision, three questions comprising three answer options each scored 1–3, modified from Nyarugwe et al. (2020), were used. A total of 15 questions were presented for the formal food safety program, which encompassed questions on design and documentation (7 questions), implementation (2 questions), verification (1 question), modification (4 questions) and improvement (1 question). For each question, four answer options were presented with three of the questions corresponding with a non-existent (score 1), incomplete (score 2) and fully complete (score 3) food safety program. The fourth option, i.e. do not know, also scored 1. The scoring system and scale used were modified from criteria developed by Nyarugwe et al. (2020). For the food safety governance approach seven questions, each with four answer categories corresponding with an unsupportive (score 1), partially supportive (score 2), fully supportive (score 3) and a do not know option (score 1) were included in the questionnaire, also based on Nyarugwe et al. (2020). For the food safety performance, seven questions giving an indication of the hygiene and microbial safety performance of the company were included. Four answer categories were given. The questions and scale used were derived from Jacxsens et al. (2010). If the food safety performance indicators scored 1, 2, 3, then the scores reflected poor, moderate and good food safety performance, respectively. Data on vulnerability, food safety program and food safety performance indicators were entered into a database designed in Microsoft Office Excel 2016 and interpreted based on Jacxsens et al. (2010) and Luning, Jacxsens, et al. (2011) and Luning, Marcelis, et al. (2011). If the mean score was between 1 and 1.2 the assigned score was 1, between 1.3 and 1.7 (1_2), between 1.8 and 2.2 (2), between 2.3 and 2.7 (2_3), and between 2.8 and 3.0 score 3 was given. Predominant scores were used to get an overall impression of the food safety governance and food safety vision.

2.3.2. Food handlers' questionnaire

The food handlers' questionnaire comprised six sections, including general characteristics of the individual, attitudes, risk perceptions, organisational support, technological support and intended behaviour. Questions pertaining to general characteristics were both open (regarding e.g. type of products, job title, nationality of birth and current nationality) and closed (concerning employment status, number of years employed, the highest level of education and gender). Attitude is the predisposition towards compliance with food safety and hygiene requirements (Nyarugwe et al., 2018). Risk perception measures how food handlers evaluate and ascribe meaning to their work environment regarding the risks of foodborne illness resulting from their food safety and hygiene practices (De Boeck et al., 2015; Rossi, Stedefeldt, da Cunha, & de Rosso, 2017). Intended behaviour refers to the intention to comply with food safety and hygiene requirements and gives an indication of the extent to which individuals are willing to try and put effort into performing the required behaviour (Ajzen, 1991).

Statements on attitudes (n = 12), and organisational (n = 14) and technological (n = 18) support were rated on a 5-point Likert scale ranging from not at all true, slightly true, moderately true, very true and completely true using a scale modified from Asmawi et al. (2018). The questions were based on how true they were in a food handler's job position (for attitudes) or how accurate they reflected the company situation (for organisational and technological support conditions). The nine statements on risk perceptions were scored from not at all likely, slightly likely, moderately likely, very likely to completely likely to happen, depending on how likely an individual perceived the food safety and hygiene risks to occur and result in food safety problems. The scale used for risk perceptions was based on Rossi et al. (2017), who also measured risk perceptions as the likelihood of the risk of foodborne illnesses caused by food handler practices while working, using a seven-point Likert scale from not at all likely to extremely likely. A higher score on the Likert scale for positive statements, meant the highest possible agreement with the statement and corresponded with a more proactive situation in the company. The opposite was true for negative statements. In our study design, scores 1 and 2 on the descriptive Likert

scale corresponded with a reactive situation (score 1), score 3 with an active situation (score 2), and scores 4 and 5 with a proactive situation (score 3). Scores were therefore reassigned accordingly before statistical analysis. For intended behaviour six closed-ended questions, comprising three answer categories, were presented to check the inclination of food handlers to comply with food safety and hygiene control requirements. A scoring system defined by Nyarugwe et al. (2020) was used whereby scores 1, 2 and 3 indicated a high, moderate, and low inclination towards risky behaviour, respectively. Reassigned scores of each respondent were used in the analyses.

2.3.2.1. Pretesting of questionnaires. As a first check on the understandability, adequacy, consistency, and completeness, both questionnaires were pretested by food safety scientists, QA managers, and students from Belgium, the Netherlands, Ghana, Zimbabwe, Haiti, Greece and Indonesia with a food safety background. Fifteen people willingly pretested the food handler questionnaire and nine the QA managers questionnaire. The process was iterative until the questionnaires were finalised. As a further check, the questionnaires were also pretested in one high-risk company, namely a dairy processing company in Malawi, where at least one QA manager and seven food handlers willingly responded and completed the questionnaires. Based on the pretesting, improvements were mainly on formatting, grammar, ordering of questions, addition of another answer option (i.e. do not know/not applicable), using simpler words -especially regarding food handler questionnaires, and reformulating of some question/answer options for clarity and readability.

2.4. Statistical analyses

For each respondent ($n = 181$) in each of the 17 companies, the assigned scores for the FS-culture variables (i.e. enabling conditions, attitudes, risk perceptions), and the internal and external environment were entered into IBM SPSS software version 25.0 (2017). Descriptive statistics were performed to determine the frequencies, mean, and mode scores for calculating the prevailing FS-culture for all the companies. ANOVA (post hoc: Tukey) was performed to find statistical differences between companies and countries. Pearson correlation was used to describe the strength of association between the prevailing FS-culture, intended behaviour and the company environment characteristics. Correlation analysis was done between the six Hofstede dimensions of each of the four countries and the mean scores (i.e. average scores from respondents in the study) of the FS-culture variables and intended behaviour from the each of the companies in the corresponding country. A negative sign showed that the variables were negatively correlated and a positive sign that they were positively correlated. Higher correlation values indicated stronger correlations. A hierarchical cluster analysis was performed based on the individual scores for each of the FS-culture variables, intended behaviour, and the scores for the internal and external company environment. The hierarchical cluster analysis was performed using Ward's method and the squared Euclidean method (Sarstedt & Mooi, 2014). This method minimises variance within a cluster and keeps the clusters homogeneous. Differences between the mean scores for the indicators used in the three clusters were analysed using the Kruskal-Wallis nonparametric test, with the significance of results established at $p < 0.05$.

3. Results

3.1. Prevailing FS-culture

Our study yielded a total of 181 responses, which were used to analyse the prevailing FS-culture in the 17 participating companies. To give an overall impression of the prevailing FS-culture in each company, Table 2 shows mean scores for the enabling conditions and employee characteristics used to determine the prevailing FS-culture of the companies. Table 2 shows that both technological and organisational enabling conditions in China and Greece predominantly scored 3, indicating that the companies were fully supportive to food handlers in enabling them to execute their tasks appropriately. For both countries, score 3 was also predominant for attitudes, indicating positive attitudes, which reflect a strong and positive predisposition by the food handlers to always comply with food safety and hygiene requirements. An exception was the attitude for monitoring process temperature where Chinese companies scored 1 and Greece companies scored 2, which was indicative of negative and ambivalent attitudes, respectively. Interestingly, Chinese companies scored 1 on most risk perceptions, except for process temperature monitoring, revealing a low perception about the risks posed by a majority of food safety and hygiene issues. In Greece, companies mainly scored 2 for risks pertaining to sanitation, as food handlers were moderately aware of the risks.

In Tanzanian companies, both enabling conditions and employee characteristics predominantly scored 2, reflecting restricted support of the enabling conditions, and ambivalent attitudes (uncertain predisposition) and moderate risk perceptions. For Zambia, companies mostly scored 3 for enabling conditions, indicating that food safety and hygiene were prioritised. Zambian companies also mostly scored 3 on employee characteristics, indicating positive attitudes and high-risk perceptions as food handlers were highly aware of the risks. Based on the general patterns in Table 2, Chinese companies were assigned an overall score 2, implying an active prevailing FS-culture. Tanzania also reflected an active FS-culture (overall score 2). Both Greece and Zambia overall scored 3, indicating a proactive prevailing FS-culture as companies in both countries demonstrated that they mostly prioritised food safety and hygiene.

The ANOVA (post hoc: Tukey) (Fig. 2) was performed on the mean scores of FS-culture variables per company to assess whether differences implied in Table 2 were statistically significant. Statistical analysis revealed that differences in FS-culture scores between companies within the same country were not statistically significant, indicating little variation between the companies. At country level, there were no statistical differences between China and Tanzania, nor between Greece and Zambia. However, the Chinese and Tanzanian companies' FS-culture scores significantly differed from Greece and Zambia.

3.2. Food safety performance

Table 3 depicts the scores used to assess the food safety performance of the companies. Overall, the results show that the food safety performance of Chinese and Tanzanian companies was lower than that of Greek and Zambian companies. Overall Chinese companies scored 2 for both the internal and external indicators, reflecting a moderate food safety performance. An exception was C3, which overall scored (1_2), reflecting a poor to moderate food safety performance owing to score 1 for both FSMS evaluation and seriousness of remarks. This was attributed to the poor FSMS evaluation, and minor remarks on multiple aspects of the FSMS. For Greece, the companies mostly scored 3 on both internal and external indicators, reflecting overall a good food safety performance. However, G2 scored 2 on the external FSMS evaluation as the audits were only done by a third party, and on hygiene and pathogen non-conformities as the company had a restricted number of non-conformities. This resulted in a score of 2_3 for G2, reflecting a moderate to good performance.

In Tanzania, the scores were quite different among the companies. T5 was the only company that at least scored 2_3 (moderate to good performance), although it scored 1 on customer complaints as there was no complaint registration system in place. T1 and T3 overall scored 2, owing to the restricted issues from both the internal and external assessment of the food safety performance of the companies, implying a moderate food safety performance. T2 and T4 scored 1_2 (poor to moderate performance) as minimal criteria were used for food safety performance evaluation and the companies had various food safety

Table 2
Mean scores of the enabling conditions and employee characteristics used in assessing the prevailing FS-culture.

		Company name															
		C1 n=10	C2 n=10	C3 n=10	C4 n=10	C5 n=10	G1 n=10	G2 n=18	G3 n=7	G4 n=15	T1 n=18	T2 n=9	T3 n=7	T4 n=10	T5 n=7	Z1 n=9	Z2 n=9	Z3 n=12
Enabling Conditions																		
Organisational conditions	Vision	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Communication	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Procedures	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3
	Training	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3	3	2
	Time	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3	2
Technological conditions	Zoning	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3	3
	Hygiene Design	3	3	2	3	3	3	3	3	3	2	2	2	2	2	2	3	3
	Maintenance	3	3	3	3	3	3	3	3	3	2	3	2	2	3	3	3	2
	Sanitation	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3
	Protective Clothing	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3	2
	Handwashing Facilities	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Employee characteristics																		
Personal hygiene attitude	Protective clothing	3	3	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
	Wearing jewellery	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Hand wash procedure	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Treating illness	3	3	3	3	3	3	3	3	2	3	3	2	2	3	3	3	2
Attitude on control of crucial parameters	Check T°C	1	1	1	1	1	2	2	2	2	3	1	1	2	1	3	3	3
	Record T°C	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
	Report T°C	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Corrective T°C	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Sanitation attitude	Corrective cleaning	3	3	3	3	3	3	3	3	3	3	2	2	2	3	3	3	2
	Correct detergents	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Colleague behaviour	3	3	3	3	3	2	3	3	2	2	3	3	3	2	3	3	3
	Clean-up	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
Risk perception on personal hygiene	Hand wash after toilet	1	1	1	1	1	3	3	3	3	3	2	2	2	3	3	3	3
	Hand wash before work	1	1	1	1	1	3	3	3	3	3	2	2	2	3	3	3	3
	Wearing jewellery	1	1	1	1	1	3	3	3	3	2	2	2	2	3	3	3	3
Risk perception on sanitation activities	Sanitizing equipment	1	1	1	1	1	2	2	1	2	2	3	2	2	2	1	3	3
	Recording sanitation	1	1	1	1	1	2	2	2	2	2	2	1	2	2	3	3	3
	Cleaning efficacy	1	1	1	1	1	2	3	3	2	2	2	2	2	2	3	3	3
Risk perception on crucial parameters	Monitoring T°C	3	3	3	3	3	2	3	3	2	2	2	2	2	3	3	3	2
	Recording T°C	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	3	3
	Corrective T°C	1	1	1	1	1	2	3	3	2	3	2	2	2	3	3	3	3

Prevailing FS-culture based on mean scores of employee characteristics and enabling conditions. Colour patterns show the degree of pro-activeness of the companies. The darker the shade of grey, the more proactive the prevailing FS-culture based on the responses of the food handlers. Scores 1, 2 and 3 for the enabling conditions represent unsupportive, restricted support, supportive, respectively. For attitudes scores 1, 2, 3 respectively represent negative, ambivalent and positive. Scores 1, 2 and 3 for risk perceptions respectively represent low, moderate and high. Colleague behaviour refers to the behaviour of co-workers

problems from different aspects of the FSMS (details in Appendix). In Zambia, Z1 and Z2 scored 3 on most of the internal and external indicators, reflecting a good food safety performance. However, both companies scored 1 for microbial food safety complaints and 2 for hygiene and pathogen-related non-conformities as both companies did not have microbial complaint systems in place and had a restricted number of non-conformities. In comparison, Z3 overall scored 2, indicating a moderate food safety performance. This could have been attributed to several criteria used for performance evaluation and food safety problems restricted to one problem in the FSMS characteristic of moderate food safety performance as described by Jacxsens et al. (2010).

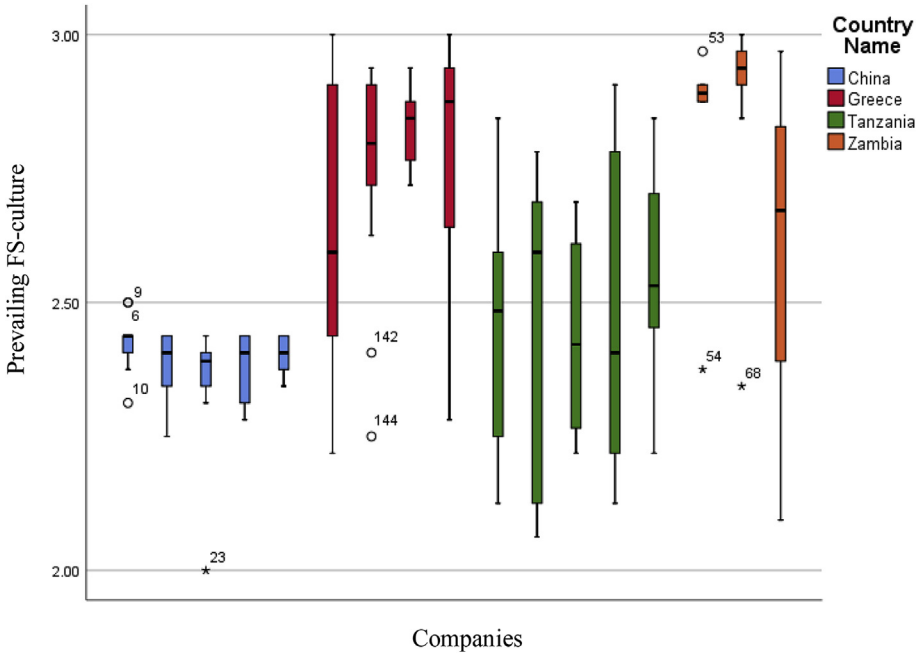


Fig. 2. Boxplots showing differences within and between companies, and countries in the prevailing FS-culture scores.
-For each country, each plot represents a single company, with companies plotted in ascending order e.g. for China, the first plot corresponds with C1 and the fifth with C5 - Plots are based on mean scores of FS-culture variables -Prevailing FS-culture based on mean scores of employee characteristics and enabling conditions - Scores below 1.6 reflect a reactive, ≥1.6 < 2.6, active and ≥2.6–3 proactive FS-culture.

Table 3
Food safety performance.

	Country and company name																
	China					Greece				Tanzania					Zambia		
	C1	C2	C3	C4	C5	G1	G2	G3	G4	T1	T2	T3	T4	T5	Z1	Z2	Z3
External food safety performance indicators																	
FSMS evaluation	3	3	1	3	2	3	2	3		3	1	3	1	3	3	3	1
Seriousness of remarks	2	2	1	2	2	3	3	3		1	2	1	1	3	3	3	2
Customer complaints-microbial	1	2	2	2	2	3	3	3		2	2	3	1	1	1	1	3
Customer complaints-hygiene	1	2	2	2	2	3	3	3		2	1	2	3	1	3	3	1
Assigned score external indicators	*2*	*2_3*	*1_2*	*2_3*	*2*	*3*	*3*	*3*		*2*	*1_2*	*2_3*	*1_2*	*2*	*2_3*	*2_3*	*2*
Internal food safety performance indicators																	
Product sampling strategy	2	2	2	2	2	3	3	3		2	2	2	2	3	3	3	3
Interpretation criteria	2	2	2	2	2	3	3	3		1	3	2	1	2	3	3	2
Hygiene and pathogen non-conformities	2	2	2	2	2	3	2	3		2	1	1	3	3	2	2	2
Assigned score internal indicators	*2*	*2*	*2*	*2*	*2*	*3*	*2_3*	*3*		*1_2*	*2*	*1_2*	*2*	*2_3*	*2_3*	*2_3*	*2_3*
Overall assigned score	**2**	**2**	**1_2**	**2**	**2**	**3**	**2_3**	**3**	*	**2**	**1_2**	**2**	**1_2**	**2_3**	**2_3**	**2_3**	**2**

*Missing values as the QA manager chose not to complete that part of the questionnaire.
C refers to Chinese companies, G refers to companies in Greece, T refers to Tanzanian companies and Z refers to Zambian companies.
FSMS refers to food safety management system.
Assigned scores were based on Luning, Jacxsens, et al. (2011) and Luning, Marcelis, et al. (2011). The overall assigned score was calculated based on the mean score of both the external and internal food safety performance indicators (Jacxsens et al., 2010; Luning et al., 2011). If the mean score was between 1 and 1.2 then assigned score 1, if between 1.3 and 1.7 (assigned score 1_2), if between 1.8 and 2.2 (2), if between 2.3 and 2.7 (2_3), and if between 2.8 and 3.0 then assigned score 3. Score 1 refers to poor food safety performance, score 2 = moderate food safety performance and score 3 good food safety performance.

3.3. Hierarchical cluster analysis

A hierarchical cluster analysis was performed to further assess how the companies grouped according to their prevailing FS-culture, intended behaviour, and their internal and external environment. Table 4 and Fig. 3 present results of the cluster analysis, based on the individual scores of all FS-culture variables (i.e. enabling conditions and employee characteristics) and intended behaviour (Table 4), and the internal and external environment characteristics (Fig. 3). Three clusters (A, B and C) were obtained and consisted of all Chinese (C1-C5), all African (T1-Z3), and all Greek companies (G1-G4), respectively.

3.3.1. Organisational and technological enabling conditions

Table 4 shows differences between the clusters regarding technological and organisational enabling conditions. Closer analysis reveals that for organisational conditions, only cluster B, consisting of the African countries, shows some significant difference ($p < 0.05$) when compared to both cluster A (Chinese companies) and cluster C (Greek companies). Cluster B significantly differed with cluster A ($p < 0.05$) in the food safety communication system and in the availability of time to execute food safety and hygiene activities as cluster B had mean scores of 2.8 and 2.6, respectively, when compared to the 3 and 2.9 of cluster A. Moreover, food safety and hygiene procedures and training significantly differed in cluster B ($M = 2.6$; 2.5) when compared with both clusters A ($M = 2.9$; 2.9) and C ($M = 2.9$; 3).

For technological conditions, cluster B significantly differed with both clusters A and C on five (zoning, hygiene design, equipment maintenance, sanitation program and protective clothing) out of the six variables. Results show that mean scores of these variables were lower in cluster B, e.g. for zoning $M = 2.6$ and maintenance $M = 2.5$ (Table 4), indicating that although companies in African countries prioritised food safety, some food handlers still perceived them to be less supportive in food safety and hygiene when compared to Chinese and Greek companies, which were perceived to be more supportive to food safety in our study. For example, some food handlers in African countries gave responses such as breakdown-related equipment maintenance and inadequate cleaning tools.

3.3.2. Employee characteristics

3.3.2.1. Attitude. Table 4 shows that most differences were between the Chinese (cluster A) and the African companies (cluster B). Cluster B differed with clusters A and C (Greek companies) on protective clothing, handwashing procedures, correct execution of cleaning procedures, and cleaning up in the event of spillages as food handlers in the African companies sometimes scored 1 and 2, indicating negative and ambivalent attitudes, respectively. This is because some food handlers either had a negative or uncertain predisposition to comply with food safety hygiene requirements. Cluster A only differed with both clusters B and C on checking product and process temperatures, where cluster A scored 1 (negative attitude). Cluster C only significantly differed from clusters A and B on cleaning behaviour of colleagues (co-workers) ($M = 2.5$), as some food handlers scored 1 and 2, reflecting negative and ambivalent attitudes.

3.3.2.2. Risk perceptions. Risk perceptions significantly differed for cluster A as compared to clusters B and C (Table 4), because most food handlers in the Chinese companies (cluster A) scored 1, reflecting low risk perceptions as they were not aware of most food safety and hygiene risks.

3.3.2.3. Intended behaviour. Table 4 shows that handwashing behaviour and control of process temperature of food handlers in cluster C significantly differed with that in clusters A and B. Closer analysis of results indicates that the Greek companies (cluster C) scored 2 (moderate inclination to engage in risky behaviour) on handwashing practices and on corrective actions taken when product processing temperature deviated from specifications.

3.3.3. Internal company environment

Fig. 3 shows the mean scores of the internal company environment (i.e. food safety vision, food safety program and vulnerability of the food production system) of the companies in, respectively, cluster A (Chinese companies), B (African companies) and C (Greek companies). The African companies (cluster B) revealed weaker FS-programs as compared to the non-African companies since these either scored 1 (T2, T3) or 2 (T4, T5, Z1, Z2, Z3) as they were still in the process of being implemented or implemented but not yet certified, respectively. An exception was T1, which did not have a food safety program in place. On the contrary, Chinese (cluster A) and Greek (cluster C) companies scored 3 as their programs were all certified. Additionally, some African

Table 4
Frequencies of the individual scores, mode scores, mean scores and the significant differences for the enabling conditions and employee characteristics, and intended behaviour for clusters A, B and C.

		Cluster A (n = 50)					Cluster B (n = 81)					Cluster C (n = 48)				
		1	2	3	Mode	Mean	1	2	3	Mode	Mean	1	2	3	Mode	Mean
Enabling Conditions																
Organisational conditions	Vision	0	4	46	3	2.9	1	13	67	3	2.8		2	46	3	3.0
	Communication		1	49	3	3.0[a]		16	65	3	2.8[a]		4	44	3	2.9
	Procedures	1	3	46	3	2.9[a]	2	26	53	3	2.6[ab]		4	44	3	2.9[b]
	Training		3	47	3	2.9[a]	3	34	44	3	2.5[ab]		1	47	3	3.0[b]
	Time		4	46	3	2.9[a]	1	32	48	3	2.6[a]		8	36	3	2.7
Technological conditions	Zoning		3	47	3	2.9[a]	2	28	51	3	2.6[ab]		6	42	3	2.9[b]
	Hygiene design		20	30	3	2.6[ac]	6	53	22	2	2.2[ab]		3	45	3	2.9[bc]
	Maintenance		3	47	3	2.9[a]	4	34	43	3	2.5[ab]		13	35	3	2.7[b]
	Sanitation		2	48	3	3.0[a]	3	18	60	3	2.7[ab]		4	44	3	2.9[b]
	Protective clothing	1	6	43	3	2.8[a]	2	28	51	3	2.6[ab]		5	43	3	2.9[b]
	Handwashing facilities		2	48	3	2.9	1	9	71	3	2.9		5	43	3	2.9
Attitude																
Personal hygiene attitude	Protective clothing	2		48	3	2.9[a]	10	9	62	3	2.6[ab]		1	47	3	3.0[b]
	Wearing jewelry			50	3	3.0[a]	6	2	73	3	2.8[a]		2	46	3	3.0
	Handwash procedure			50	3	3.0[a]	5	8	68	3	2.8[ab]		1	47	3	3.0[b]
	Treating illness	3	3	44	3	2.8[a]	15	13	53	3	2.5[a]	2	8	38	3	2.8
Attitude on control of crucial parameters	Check T°C	50			1	1.0[ac]	39	6	36	1	2.0[a]	16	5	27	3	2.2[c]
	Record T°C			50	3	3.0[c]	8	3	70	3	2.8	7	3	38	3	2.7[c]
	Report T°C	1		49	3	2.9	5	1	75	3	2.9		1	46	3	2.9
	Corrective T°C			50	3	3.0[a]	7	3	71	3	2.8[a]		2	46	3	3.0
Sanitation attitude	Corrective cleaning	1		49	3	2.9[a]	13	14	54	3	2.5[ab]		2	46	3	3.0[b]
	Correct detergents	1		49	3	2.9	7	2	72	3	2.8		2	46	3	3.0
	Colleague behaviour	4		46	3	2.8[c]	7	5	69	3	2.8[b]	10	6	32	3	2.5[bc]
	Clean-up	1	1	48	3	2.9[a]	12	5	64	3	2.6[ab]		2	46	3	3.0[b]
Risk perceptions																
Risk perception on personal hygiene	Handwash after toilet	50			1	1.0[ac]	19	1	61	3	2.5[a]	5	3	40	3	2.7[c]
	Handwash before work	49		1	1	1.0[ac]	18	1	62	3	2.5[a]	4	4	40	3	2.8[c]
	Wearing jewelry	50			1	1.0[ac]	19	10	52	3	2.4[a]	7		41	3	2.7[c]
Risk perception on Sanitation activities	Sanitizing equipment	50			1	1.0[ac]	31	1	49	3	2.2[a]	27		21	1	2.0[c]
	Recording sanitation	46	1	3	1	1.1[ac]	29	11	41	3	2.2[a]	15	7	26	3	2.2[c]
	Cleaning efficacy	49		1	1	1.0[ac]	17	11	53	3	2.4[a]	10	7	31	3	2.4[c]
Risk perception on control of crucial parameters	Monitoring T°C	8		42	3	2.7	25	3	53	3	2.4	9	2	37		2.6
	Recording T°C	49		1	1	1.0[ac]	24		52	3	2.4[a]	9	5	34	3	2.5[c]
	Corrective T°C	47		3	1	1.0[ac]	17	4	60	3	2.5[a]	10	1	37	3	2.6[c]
Intended behaviour																
	Handwash colleague		1	49	3	3.0[c]	1	5	75	3	2.9[b]	1	26	21	2	2.4[bc]
	Handwashing	1	20	29	3	2.6[c]	1	24	56	3	2.7[b]	3	42	3	2	2.0[bc]
	Process T°C		7	43	3	2.9[ac]		30	51	3	2.6[a]		27	21	2	2.4[c]
	Storage T°C	1	6	43	3	2.8[c]		18	63	3	2.8[b]		27	21	2	2.4[bc]
	Sanitation efficacy	1	3	46	3	2.9	4	11	66	3	2.8	2	1	45	3	2.9
	Cleaning procedure	1		49	3	3.0	2	3	76	3	2.9	1	1	46	3	2.9

- C refers to Chinese companies, G refers to companies in Greece, T refers to Tanzanian companies and Z refers to Zambian companies.
- Enabling conditions and employee characteristics are the FS-culture variables measured in this study.
- Scores 1, 2 and 3 for the enabling conditions represent unsupportive, restricted support, supportive, respectively. For attitudes scores 1, 2, 3 represent negative, ambivalent and positive, respectively. Scores 1, 2 and 3 for risk perceptions represent low, moderate and high, respectively. For intended behaviour scores 1, 2, 3 represent high-risk, moderate-risk and low-risk, respectively.
[abc] respectively symbolizes significant difference ($P < .05$) between clusters 1 and 2, 2 and 3, and clusters 1 and 3, based on Kruskal-Wallis non-parametric test. Where.
No letter is given, there is no significant difference.

companies scored 1_2 (Z3) or 2_3 (T1, T3) for the food safety vision since it only slightly motivated food handlers in doing their work tasks. Companies in Greece (cluster C) significantly differed ($p < 0.05$) in the vulnerability of the production system ($M = 2.3$) when compared to companies in clusters A and B, thereby indicating less susceptibility of the product and production system to contamination, especially regarding product properties and intervention steps.

3.3.4. External company environment

3.3.4.1. Food safety governance. Fig. 3 also shows statistically significant differences ($p < 0.05$) in the food safety governance and national values amongst the three clusters. The QA managers in the Chinese companies (cluster A) scored 3 for legislation and enforcement as they considered both to be supportive, i.e. more facilitative to companies when compared to the private standards, which on average scored 2 (restricted support) as most companies (C1, C2, C3) did not adopt private standards. In comparison, the public authorities in Greece (cluster C) mainly scored 2 owing to the restricted support, especially regarding communication of legislation and the enforcement thereof. However, private standards scored 3 as all companies adopted private standards and these were adequately enforced. In cluster B (African countries), public authorities and private standard bodies scored 2_3 as they provided restricted support, especially regarding clarity, usefulness and communication of legislation, and enforcement. Moreover, private standards were sometimes not adopted. For example, most QA managers (6/9) assigned score 2 for communication of legislation and for enforcement strategy as they regarded them as mostly available upon requisition by the companies and as more punitive, respectively.

3.3.4.2. National values. Analysis of national values (Hofstede et al., 2010) shows that in our study, China (Cluster A) has the highest power distance (80), masculinity (66), and long-term orientation (87) scores, respectively (Fig. 3), depicting a culture were inequality exists, people

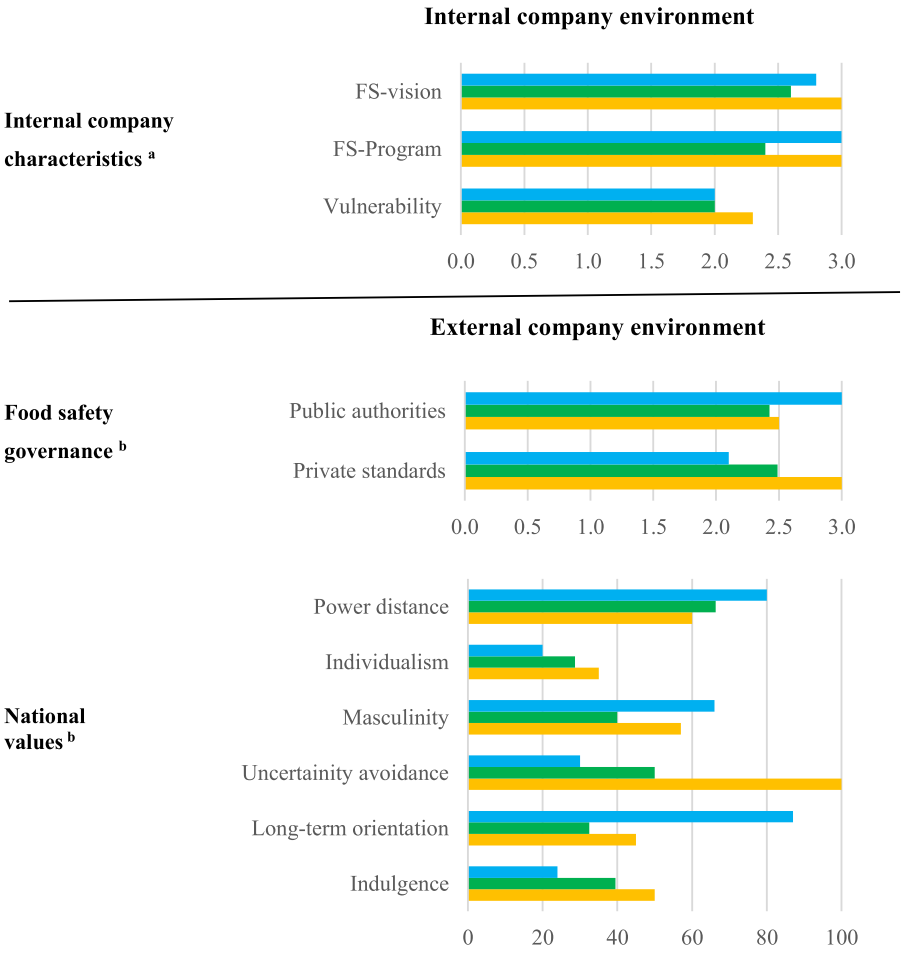


Fig. 3. Mean scores of the company environmental characteristics for clusters A, B and C

Fig. 3 is an extension of Table 4 and was developed based on a hierarchical cluster analysis performed to group companies based on their similarities in the prevailing FS-culture and the internal and external environment. [a] $p < .05$ symbolizes significant difference between clusters 2 and 3 for vision, clusters 1 and 2, and 2 and 3 for food safety program, and 1 and 3 and 2 and 3 for vulnerability based on Kruskal-Wallis non-parametric test. [b] symbolizes significant difference ($p < .05$) between clusters 1, 2 and 3 for both food safety governance and national values. - Scores 1, 2, 3 for the vision, food safety program and food safety governance respectively represent unsupportive, restricted support, supportive. For vulnerability of the food production system, scores 1, 2 and 3 respectively refer to high, potential and unlikely susceptibility to contamination. For national values, low scores represent low power distance, collectivism, femininity, low uncertainty avoidance, short-term orientation and restraint. High scores represent high power distance, individualism, masculinity, high uncertainty avoidance, long-term orientation and indulgence. - Cluster A shows Chinese companies, where country average was 2.8 for vision, 3 for food safety program, 2 for vulnerability, 3 for public authorities and 2.1 for private standards. Cluster B consisted Tanzanian and Zambian companies were country average were respectively 2.7 and 2.6 for vision, 1.9 and 2.7 for vulnerability, 2.3 and 2.6 for food safety program, 2.5 and 2.3 for public authorities, and 2.6 and 2.3 for private standards. Cluster C shows Greece companies, where the country average was 3 for vision, 3 for food safety program 2.3 for vulnerability, 2.5 for public authorities and 3 for private standards. For national values, China.

Cluster A, Cluster B, Cluster C.

are assertive and are future-oriented. However, the lowest scores on individualism (20), uncertainty avoidance (30), and indulgence (24), show that the Chinese culture is typified by collectivism (i.e. group interests prevail), risk-taking and free gratification, respectively. The African countries (Tanzania and Zambia) (Cluster B) had an intermediate to high power distance (60,70), and intermediate uncertainty avoidance (50) as no preference could be depicted. However, although slightly higher than for China (cluster A), low scores were also seen on individualism (25,35), and indulgence (38,42). Differences with cluster A were only seen for masculinity (40) and long-term orientation (30,34) as the culture in the African countries in our study is more feminine and with a short-term focus. Greece (Cluster C) depicts a culture with an intermediate power distance (60), masculinity (57), and long-term orientation (45) and indulgence (50) showing no clear preference. However, they score highest on uncertainty avoidance (100) which means they are risk-averse, and relatively low on individualism (35).

3.3.4.3. Correlation between national values, and the food safety culture variables and intended behaviour. Table 5 shows the correlations between the values for the Hofstede dimensions and the mean values for enabling conditions, for employee characteristics (risk perceptions and attitudes), and for intended behaviour. The data for the Hofstede dimensions and the other variables can be found in Tables 6a and 6b in the supplementary materials, respectively. The Pearson correlation analysis revealed that all six cultural dimensions were statistically significantly correlated ($p < 0.01$) with risk perceptions. More specifically, power distance, masculinity and long-term orientation negatively correlated with risk perceptions ($r = -0.925, -0.718, -0.921$, respectively) whereas individualism, uncertainty avoidance and indulgence positively correlated with risk perceptions ($r = 0.858, 0.680, 0.912$, respectively) at $p < 0.01$. Masculinity and long-term orientation were strongly positively correlated with enabling conditions ($r = 0.782$ and 0.629) ($p < 0.01$ in both cases). Masculinity also significantly positively correlated with attitudes ($r = 0.485$).

Table 5
Correlation between national culture dimensions, and enabling conditions, employee characteristics and intended behaviour.

	Enabling Conditions	Attitude	Risk Perceptions	Intended Behaviour
Power Distance			−0.925**	
Individualism			0.858**	
Masculinity	0.782**	0.485*	−0.718**	
Uncertainty avoidance			0.680**	−0.564*
Long-Term Orientation	0.629**		−0.921**	
Indulgence			0.912**	−0.493*

*$p < .05$.
**$p < .01$.
Correlation analysis based on the six Hofstede dimensions of each of the four countries and the mean scores (i.e. average scores from respondents in the study) of the FS-culture variables and intended behaviour from the each of the companies in the corresponding country.
A negative sign showed that the variables were negatively correlated and a positive sign that they were positively correlated. The higher the value of correlation also meant that the stronger the correlation.

Uncertainty avoidance and indulgence significantly negatively correlated with intended behaviour ($r = -0.564$ and -0.493) ($p < 0.05$).

4. Discussion

This study gained insight into characteristics of the internal and external company environment that could potentially influence the prevailing FS-culture of food companies operating in different countries differing in national values and their food safety governance approach. Overall, our study revealed differences among the four countries with African companies exhibiting more similarities when compared to China and Greece (Table 4, Fig. 3). As such, results are discussed from an intercontinental perspective in view of the external company environment.

4.1. Prevailing FS-culture and food safety performance in view of food safety governance

Findings for China show that food safety legislation and public enforcement are perceived to be supportive to the dairy companies in our study, which probably explains the high scores for the technological and organisational conditions in all the companies (Table 2). This could be typical for the dairy industry, owing to the 2008 melamine incident, where milk and infant formula were adulterated. Since then there has been considerable effort by food safety authorities to reform and enforce the food safety law (Jia & Jukes, 2013; Yang, Huang, Zhang, Thomas, & Pei, 2009). Particularly in the dairy industry, new regulations and standards set out HACCP requirements (Pei et al., 2011). The Food Safety Law established as a basis for food safety governance, was updated in 2015, focusing now more on risk prevention, assessment and communication (Jiang, Stigter, & Monnikhof, 2018; Lepeintre & Sun, 2018). Food safety governance evolved from following the traditional direct command and control approach by the government to social co-regulation, which incorporates multiple stakeholders (Kirezieva & Luning, 2017; Lepeintre & Sun, 2018). Regarding enforcement, an accountability system was put in place, which incentivises companies with positive records and punishes the offenders (e.g. fines, imprisonment) (Jia & Jukes, 2013; Lepeintre & Sun, 2018). However, private standards were not really adopted when compared to the other countries in our study, as companies mainly based their food safety system on national legislation, confirming our supposition of food safety governance reforms in the Chinese dairy industry as principally a public authority intervention.

Evaluation of the food safety performance data revealed a moderate performance in most Chinese companies. This was maybe a result of the low risk perceptions regarding food safety and hygiene risks (Table 2), which could have resulted in non-conformance of actual food safety and hygiene-related behaviour. In their studies, Rossi et al. (2017) and Parra, Kim, Shapiro, Gravani, and Bradley (2014) found that risk perceptions were closely related to safe food handling practices and that risk perceptions guide food safety and hygiene-related behaviour. However, other factors could have influenced this relationship. For example, individual characteristics such as motivation, conscientiousness, attitude, self-efficacy, outcome expectancy, and the psychosocial characteristics such as job satisfaction and burnout, could affect employee wellbeing, and influence food handler behaviour and an organisation's performance (De Boeck, Mortier, Jacxsens, Dequidt, & Vlerick, 2017; Gilling, Taylor, Kane, & Taylor, 2001; Neal & Griffin, 2004). Our results suggest that even if there have been substantial investments and improvements in the food safety programs, technological and organisational support, the human dimension is equally important, as also a shift in perceptions is required. Rossi et al. (2017) suggested that to change behaviour, an improvement in risk perceptions is required.

The overall proactive FS-culture in the Greek companies (Table 2) was consistent with their good food safety performance (Table 3). This could have been due to the supportive private standards as all companies adopted multiple internationally accepted private standards. Moreover, HACCP-based procedures are mandatory for all food business operators (Chaidoutis & Koutou, 2018). Private standards were effectively enforced (score 3), as the private certification bodies immediately acted in cases of non-compliance and supported the organisations by, e.g., providing training and guidance. When compared to China, national legislation was perceived as not openly exchanged with organisations as companies had to request for them. In cases of non-compliance, public authorities resorted to punitive measures rather than assistance by training, incentives etc. This could be due to the national law, Law 4235/2014, which specifies administrative penalties in the food sector (Hellenic Republic, 2014). However, since Greece is within the EU, it has adopted regulations such as (EC) No 178/2002 and (EC) No. 853/2004 on setting general principles and requirements of food law and specific hygiene rules for food of animal origin (EC., 2002; EC., 2004), which are comprehensive. Due to the use of both private and public standards (both EU and national), the enforcement strategy in Greece is based on principles of co-regulation (Chaidoutis & Koutou, 2018; Kirezieva et al., 2015a). Co-regulation involves public–private initiatives and integrates the use of primary regulation and market self-regulation (Eijlander, 2005; Kirezieva et al., 2015a).

Cluster B comprised companies in both African countries (Tanzania and Zambia). Although some companies in both countries showed similarities such as inadequate training and availability of time (e.g. T1, T5 and Z3), and restricted support for equipment maintenance (T1, T3, T4, Z3) and protective clothing (T1, T5 and Z3), Zambian companies had a more proactive FS-culture and a good food safety performance compared to the active FS-culture and moderate performance in Tanzanian companies (Tables 2 and 3). Several reasons could possibly explain the findings for these two African countries. Firstly, regarding internal company characteristics, all Zambian companies were large organisations when compared to the five companies in Tanzania (Table 1), which were mostly small to medium. Fatimah et al. (2014) found an association between company size and employee perceptions. Of the five Tanzanian companies, none had certified FSMS as was the case with the three Zambian companies. This could be because most African companies have certified food safety programs only in place as an export requirement (Kussaga, Luning, Tiisekwa, & Jacxsens, 2014b; Macheka, Manditsera, Ngadze, Mubaiwa, & Nyanga, 2013). The Tanzanian companies in our study also had a highly susceptible production process environment as processes were partially automated with a lot of product handling, which could have partially contributed to the moderate food safety performance. Secondly, regarding the external company environment, a majority (3/5) of the Tanzanian companies, perceived the national legislation to range from generic to only setting general requirements, which was concerning as the companies relied on national legislation only (score 1).

However, the companies in both countries seemed to agree that the legislation was only useful to a certain extent, and not properly communicated and enforced, possibly because legislation in most sub-Saharan African countries is still underdeveloped (Steier & Patel, 2017). For Tanzania, Kashoma, Komba, Abiad, and Kassem (2018) indicated that enforcement of legislation is still weak with limited laboratory capacity. In Zambia, the laboratories at least provide basic lab support service although they still need accreditation (Steier & Patel, 2017). Furthermore, the Tanzania Bureau of Standards (TBS) and Food and Drug Authority (TFDA), the main entities responsible for food safety, are beset by several challenges such as lack of sufficient resources and infrastructure. The food safety control system in Tanzania, as is typical of most sub-Saharan African countries, is fragmented and could potentially contribute to the inadequate food safety performance (Grace, 2015; Kussaga et al., 2014a). Compared to China and Greece, African countries mainly follow the traditional direct command and control approach, where companies mainly use national public standards

(Global Food Safety Partnership, 2018). Still, a small sign of co-regulation exists with the existence of TBS and the Zambian Bureau of Standards (ZBS).

4.2. Prevailing FS-culture in view of national values

The three clusters obtained mainly differed in masculinity, uncertainty avoidance and long-term orientation, with both African countries exhibiting similarities in national values when compared to China and Greece (Fig. 3). This shows that level of assertiveness, risk tolerance and time orientation depicted by the three dimensions could be crucial dimensions to consider as the three were also significantly correlated with two or more variables for FS-culture (i.e. enabling conditions, attitude, risk perceptions) and intended behaviour (Table 5). In addition, of all the FS-culture variables, risk perceptions were seen to be strongly correlated with all the cultural dimensions (Table 5). Seymen and Bolat (2010) also found risk perceptions to be related to masculinity, uncertainty avoidance, and individualism. This could be because food safety and hygiene risks are differently perceived in different cultures (Wallace, 2009).

In our study, companies in China and Greece with more masculine cultures had more supportive enabling conditions and positive attitudes (Table 2). This could be because masculine cultures are assertive, hence the positive attitudes, and are success-oriented as they focus on getting the job done. They also tend to work hard to produce results (Hofstede et al., 2010; Seymen & Bolat, 2010), which could have prompted them to ensure that they had the right (supportive) conditions to do the job right. On the contrary, the African countries, especially Tanzania, were typified to have a feminine culture (Fig. 3) and thus could be perceived as less assertive, and reliant on consensual decision-making as a good working relationship between superior(s) and subordinates is valued. This could explain the restricted support given by the Tanzanian companies to food handlers and the reciprocal negative and ambivalent attitudes by the food handlers (Table 2). Interestingly, Zambian companies had a proactive FS-culture and a good food safety performance when compared to Tanzania (Tables 2 and 3). This could have been partially attributed to the management in Z1 and Z2, who were Indians (Table 1) and the fact that Z2 is an Indian-owned company. Indians typically are considered to be a masculine culture (index score of 57) (Hofstede et al., 2010), which could have contributed to the assertiveness, emphasis on getting things done and consequentially the proactive FS-culture. However, Wallace (2009) postulated that femininity or masculinity could both be beneficial for food safety performance as the ability to work in teams, which is characteristic of feminine cultures and the focus on getting the job done, typical of masculine cultures, are both essential aspects to achieving food safety.

We also found a positive correlation between uncertainty avoidance and the prevailing FS-culture regarding risk perceptions (Table 5). Various safety culture studies also found a relationship between uncertainty avoidance and safety culture (e.g. Burke, Chan-Serafin, Salvador, Smith, & Sarpy, 2008; Håvold, 2007). Greek companies with a very high uncertainty avoidance (100), had good risk perceptions (Table 4) and overall revealed a pro-active FS-culture (Table 2). Bontempo, Bottom, and Weber (1997) and Burke et al. (2008) suggested that cultures that avoid uncertainty, rely on formal procedures and prefer stability in the work environment. Bontempo et al. (1997) further proposed that cultures high in uncertainty avoidance are less risk-taking and suggested that "factors that result in cultural differences in uncertainty avoidance could also affect risk perceptions". Moreover, Seymen and Bolat (2010) suggested that the higher the uncertainty avoidance, the less-risk taking tendencies were preferred by employees. As Greeks are characteristically risk-averse, they dislike ambiguous situations, and are thus reliant on a structured organisation and on rules and regulations, as these provide some sense of control and predictability (Burke et al., 2008). This could explain the adoption of multiple private standards when compared to the other countries (Table 1) and the perceived technological and organisational supportiveness (score 3) to the food handlers in performing their food safety and hygiene tasks. However, uncertainty avoidance was negatively correlated with intended behaviour (Table 5). as in Greece the handwashing behaviour was moderately risky (score 2). This could be due to the statements presented to the food handlers, which could have implied different situations to the norm. In high uncertainty avoidance cultures, employees often depend on standard procedures and have limited adaptability when exposed to different situations other than the norm (Burke et al., 2008). When compared to Greece, Chinese companies showed poor risk perceptions (Table 4), possibly because the Chinese are more tolerant of ambiguous situations (Hofstede et al., 2010) and are more accepting of new ideas as depicted by their low uncertainty avoidance.

Long-term orientation was negatively correlated with risk perceptions and positively with the enabling conditions (Table 5). In their study, Karimi and Toikka (2014) found a negative correlation between long-term orientation and risk acceptance, and that countries that are short-term-oriented tend to rely on structure and technology as they are more inclined to high risk perceptions. Moreover, they (Karimi & Toikka, 2014) suggested that countries high in uncertainty avoidance scored low on long-term orientation, which was typical of Greece, and explained the less-risk taking tendencies of Greek companies.The Chinese being long-term-oriented (Fig. 3), tend to plan for the future and focus on future rewards (Hofstede et al., 2010). As such, they could have invested in the organisational and technological conditions to ensure a good performance of their operations. However, the African countries (Tanzania and Zambia) being short-term oriented (Fig. 3) they focus on short-term planning and on prevailing issues. This probably explained the restricted support by the public authorities in food safety legislation and enforcement thereof.

Furthermore, we found power distance to be negatively and individualism to be positively correlated with level of risk perception (Table 5), in other words, food safety and hygiene risk perceptions were better in conditions of lower power distance and higher individualism. Findings are corroborated by Seymen and Bolat (2010), who found individualism to be positively related with risk perceptions. Hofstede et al. (2010) found that many countries that score low on individualism score high on power distance as the two dimensions are negatively correlated. All countries studied in our research had a high power distance and low individualism, which suggests that other dynamics could have moderated the correlation with risk perceptions. For example, Seymen and Bolat (2010) proposed power distance to be negatively related to employee involvement, which is an aspect we did not study that could have been an influential factor. The level of employee involvement brings other elements such as clarity of communication and standardisation of procedures, which could be beneficial in ensuring correct perceptions (Seymen & Bolat, 2010). Although all countries scored similar, we therefore postulate that our findings could have been related to the level of power distance as the Chinese scored highest on this dimension. This might explain why Chinese employees showed a low perception of the risks posed by most food safety and hygiene issues. A possible clarification could be the centralisation of decision-making, typical of high power distance cultures where employees are told what to do (Mearns & Yule, 2009) and might not feel free to approach their superiors (Gyekye & Salminen, 2005). Some studies suggest that low power distance cultures where employees are empowered, involved, and feel encouraged to participate in the decision-making process can be beneficial for a good safety culture (e.g. Okolie & Okoye, 2012) and operation of HACCP (Wallace, 2009). However, we did not have a comparison with a low power distance culture.

Although countries sometimes had similar national values, e.g. Tanzania and Zambia, the prevailing FS-culture and the food safety performance differed per country (Tables 2 and 3). Other factors such as legislation, political environment, economic environment and food safety approaches at organisational level could have influenced the

organisational and technological support, attitudes and risk perceptions of the employees. In African countries, for example, economic instability might have hindered companies to invest in the organisational and technological enabling conditions (Macheka et al., 2013). Moreover, organisations have their own traits independent of the national culture (Mearns, Rundmo, Flin, Gordon, & Fleming, 2004; Mearns & Yule, 2009; Seymen & Bolat, 2010), which could explain why companies operating within the same cultural context slightly differed in food safety performance. A full understanding of national values of the country companies operate in and of the workforce composition (Mearns & Yule, 2009) is essential for companies to assure best approaches to food safety.

5. Conclusion, limitations and research recommendations

An intercontinental analysis of the FS-culture of food companies in China, Greece, Tanzania and Zambia revealed that Chinese and Tanzanian companies exhibited an overall active FS-culture, whilst Greek and Zambian companies exhibited a proactive FS-culture. No statistically significant differences were found between companies operating within the same country. Findings also showed that food safety performance was consistent with the prevailing FS-culture as companies with a proactive FS-culture reflected better food safety performance.

Cluster analysis revealed that clustering of companies was attributed to the internal and external environment, with African companies clustering together when compared to Greek and Chinese companies. The African countries showed similarities in national values and food safety governance. As such, national values and food safety governance seemed to influence the prevailing FS-culture of the companies. All national cultural dimensions were significantly correlated with risk perceptions, with masculinity and long-term orientation also significantly correlated with the enabling conditions and attitude (Table 5). For the internal company environment, the African companies showed similarities in the implementation of food safety programs, which were not yet certified, when compared to Greek and Chinese companies.

It is important to note that our study is a first explorative empirical study on the possible role of the external company environment (i.e. food safety governance approach and national values) on the prevailing FS-culture of food companies, which comes with its limitations. One limitation was that as an enquiry into the external company environment, this study was comparatively small as it only covered four different nationalities. There is therefore need to study more companies to enhance robustness of the findings. Another limitation was that although findings revealed statistically significant correlations between national values and the prevailing FS-culture, the relationship between these two could have been influenced by other confounding factors such as the economic environment, which could have hindered investments in e.g. technological and organisational conditions. Moreover, differences in e.g. actual production characteristics among the companies could also have influenced this relationship making it difficult to differentiate cause and effect from the associations observed. Further research should include more respondents as this could improve the robustness of the study as the small number of QA managers provided a limited representation of the countries food safety governance approach. Although questionnaires are more appropriate for online surveys, we still advocate for companies to use method triangulation to fully understand their FS-culture. Understanding how national values and food safety governance approaches differently influence food safety culture is expected to enable formulation of best approaches tailored for companies operating in countries with different company environments, to improve food safety performance.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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Appendix A. Supplementary data

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