

1           **The impact of maturing food safety culture and a pathway to economic gain**

2           Authors

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12

13           Abstract

14           Research into the connection between organizational effectiveness and culture has been  
15   documented since the early nineteen nineties. A connection between economic performance and  
16   organizational culture has been established directly linking strong cultural drivers to economic  
17   performance in both the finance and retail sectors. This research proposes a similar association

18 between food safety culture, the measures of maturity and cost of poor quality. Through data  
19 collected at five multi-national food companies, this association is explored, and an improved  
20 food safety maturity model suggested. The authors also propose a dynamic model of food safety  
21 culture, segmenting it into 4 building blocks: I. Organizational effectiveness, II. Organizational  
22 culture norms, III. Working group learned and shared assumptions, and behaviours, and IV.  
23 Individual intent and behaviours; and discuss the crucial role of actions between building blocks  
24 as part of the pathway to realizing economic gain.

### 25 Highlights

- 26 1. Explores organizational culture, effectiveness, and performance in the food industry
- 27 2. Demonstrates theoretical economic gain from building food safety culture maturity
- 28 3. Refines and strengthens a food safety culture maturity model for practical application
- 29 4. Proposes a dynamic model of food safety culture building block and interactions
- 30 5. Empirical study of culture performance within five global food manufacturing companies

### 31 Keywords

32 Food safety culture, economic impact, food safety maturity model, cost of poor quality,  
33 food safety culture dynamic model.

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**1. Introduction**

To solve the specific challenges related to food safety performance, e.g., consumer death, illness and injury (Maberry, 2016; World-Health-Organization, 2015), and impact on brand and economics (Hussain & Dawson, 2013; Ribera et al., 2012) throughout the food supply chain it is now widely recognized that food safety culture plays an integral role (Ball, Wilcock, & Aung, 2009; Griffith, 2010; Griffith & Jackson, 2017; Nayak & Waterson, 2017; Powell, Jacob, & Chapman, 2011; Taylor, 2011). It is also understood that to get to a stronger sub-culture (e.g., safety culture, food safety culture, innovation culture) one must consider the broader organizational culture and its effectiveness (Denison, Hooijberg, Lane, & Lief, 2012; Denison & Mishra, 1995; Schein & Schein, 2017). Quoting Harvard Professor Emeritus James L. Heskett, “Organization culture is not a soft concept, its impact on profit can be measured and quantified. And in organizations with large numbers of customer-facing employees, the sum of the effects of employee turnover, referrals of potential employees by existing ones, productivity, customer loyalty, and referrals of new customers attributable to culture can add up to half of the difference in operating income between organizations in the same business” (Kotter & Heskett, 1992). It is this contrast between perceived soft (e.g., principles of organizational and behavioural sciences) and hard (e.g., financial performance) concepts that makes organizational cultures and sub-cultures both intriguing and challenging for practitioners and scientists to understand and makes it important to conduct further work to elucidate how these concepts apply in different settings, e.g., food manufacturing, thus addressing the research gaps in these areas.

56 Crosby (1972) defines quality as ‘conformance to requirements’ and makes the claim that  
57 “management unintentionally cause an increased cost of quality for the organization by not  
58 understanding this simple definition.” Crosby also suggests, like Kotter and Heskett (1992), that  
59 a culture revolution through a planned strategy is the key to reducing cost of quality in any  
60 organization. Through the ‘Quality Management Maturity Grid’, Crosby defines six  
61 measurement categories by which an organization can evaluate its current stage of quality  
62 maturity. Using the grid, he demonstrates the connection between decreasing cost of quality and  
63 increasing quality culture maturity; thereby directly linking the culture of an organization to  
64 organizational financial performance. Crosby shows how as much as 20% of sales can be lost as  
65 cost of poor quality (COPQ) in contrast to losses in a high-level maturity culture of 2.5%. The  
66 American Society of Quality (ASQ) builds on the work by Crosby and divides COPQ into four  
67 activities: prevention costs, appraisal costs, and internal and external failure costs (Duffy, 2017).  
68 Through these activities, costs related to e.g., systems maintenance and training, conformance to  
69 specification, verification activities, waste and scrap, and complaints, are tracked to quantify the  
70 percentage of sales due to poor quality. Schiffauerova and Thomson, (2006) report that each  
71 industrial sector has unique quality cost elements but that there is no set structure or accounting  
72 standard for quality costing (Schiffauerova & Thomson, 2006). Thus, the decision on the cost  
73 structure of the COPQ model is generally left to the judgment of quality managers and may  
74 differ considerably between companies. Nevertheless, since prevention, appraisal, and review of  
75 internal and external failures have been related to food safety management effectiveness in food  
76 manufacturing companies (Hutton, 2001; Surak & Wilson, 2007; Wallace, Sperber, &

77 Mortimore, 2010), it is logical to surmise that costs of these activities will form quality cost  
78 elements for calculating COPQ in food manufacturing. Thus, the authors of this research suggest  
79 that COPQ, as defined by Crosby and ASQ and applied to food companies, includes specific  
80 food safety metrics (Table 1) and is therefore a relevant measure for estimation of economic  
81 impact of a company's food safety culture maturity, although this has not yet been tested by  
82 empirical research.

83 (Table 1)

84 In order to further explore the potential impact of food safety culture maturity on  
85 economic indicators such as COPQ, it is necessary to establish the relevant theoretical  
86 background in organisational and food safety culture. This now follows along with a delineation  
87 of the aims of this research.

## 88 **2. Theoretical background and research aims**

### 89 2.1 Organizational culture, effectiveness and impact on financial gains

90 Principles from organizational culture have been incorporated into research on food  
91 safety culture by most of the researchers in the field. As such, the authors seek to provide a  
92 review of research that specifically focused on showing the connection between organizational  
93 culture, organizational effectiveness and the impact of both on economic performance.

94 Kotter and Heskett (1992) studied culture in 207 U.S. firms through surveys and detailed  
95 interviews and found a direct connection between organizational culture and financial

96 performance. While the authors clearly stated that many confounding variables impact an  
97 organization's financial performance, they also discovered a substantial difference in financial  
98 performance between performance-enhancing cultures and non-performance enhancing cultures  
99 within two groups of 12 companies (Table 2). In the group that invested in a performance-  
100 enhancing culture, the increase across the financial indicators ranged from more than 200% to  
101 more than 900% for specific indicators. Kotter and Heskett (1992) described 'performance-  
102 enhancing cultures' as those which have organizational values that include managers deeply  
103 caring about customers, and strongly value people and processes that create useful change.  
104 Conversely values in non-performance enhancing cultures are described as managers mostly  
105 caring about themselves and their immediate work group and emphasising consistent  
106 management processes that reduce risks within their immediate area of responsibility.

107 (Table 2)

108         Similar to Kotter and Heskett (1992) Denison (1997) explored the connection between  
109 organizational culture and effectiveness. Denison's research sought to answer the question "what  
110 can the cultural characteristics of an organization tell us about effectiveness?" and demonstrates  
111 the connection between four organizational traits: Involvement, Consistency, Adaptability, and  
112 Mission and organizational effectiveness. Denison measured organizational effectiveness  
113 through behavioural performance using the established scale 'Survey of Organizations (SOO)'  
114 and financial performance through income/sales ratio and income/investment ratio. Denison  
115 found a valid connection between these cultural traits to both behavioural performance and

116 financial effectiveness (Denison, 1997; Denison & Mishra, 1995). Graham *et al.* (2017) defined  
117 an effective culture as “one that promotes the behaviours needed to successfully execute the  
118 firm’s strategies and achieve its goals”. Data were gathered from 1,348 North American firms  
119 through surveys and interviews with senior executives. The authors found that organizational  
120 effectiveness is the result of interaction between an organizations values, norms, and formal  
121 systems (Graham *et al.* (2017). In this context, values are defined as the aspirations of the  
122 organization, norms as the day-to-day practices that live out the values, and formal systems as  
123 their written policies and procedures. Human behaviours are conditioned through the integration  
124 and adaptation of organizational norms, and norms are, in turn, an interpretation and adaptation  
125 to the organization’s values and formal systems. Graham *et al.* (2017) demonstrates that norms  
126 enhance business outcomes, but values do not. Their research also suggests that the marketplace  
127 influences executives’ investment in culture as well as the organizational values they promote  
128 (Graham *et al.* 2017). This external adaption is also captured in Schein’s updated (2017)  
129 definition of organizational culture as “... the accumulated shared learning of the group as it  
130 solves its problems of external adaptation and internal integration...” (Schein & Schein, 2017).  
131 Schein thereby integrates external and internal triggers of change as confirmed by the findings of  
132 Graham *et al.* (2017).

133           The ‘Great Place to Work<sup>®</sup> Institute’ is a global organization dedicated to providing  
134 knowledge on how to build and sustain high performing work place culture. Its database contains  
135 data from more than 5,500 companies operating in 45 countries collected through annual

136 assessment surveys and is used for the ‘Great Place to Work<sup>®</sup> Institute’ own publications on  
137 workplace culture as well as being made available for academic study (Great-Place-to-Work,  
138 2017). Through analysis of the survey data, researchers found that proclaimed values appeared  
139 irrelevant to an organization’s effectiveness (Guiso, Sapienza, & Zingales, 2014). This supports  
140 the findings of Graham *et al.* (2017) that values alone do not drive business outcomes, but norms  
141 do. The research also shows that if executives are perceived as trustworthy and ethical the  
142 company’s performance will be stronger. In analysing S&P 500 companies the researchers found  
143 that 80% of the companies mention ‘innovation’ followed by ‘integrity and respect’ in their  
144 corporate values. A culture of integrity was found to add value and positively correlated with  
145 financial performance and attractiveness of job offerings and negatively correlated with the  
146 degree to which the company’s workforce was unionized or not (Guiso *et al.* 2014).

147 Causality between culture and organizational effectiveness measured through  
148 performance, was proven in a six-year longitudinal study with car dealers. The study proved that  
149 ‘culture does come first’ and performance will follow. Further, the positive effect of culture on  
150 vehicle sales was fully mediated by customer satisfaction ratings (Boyce, Nieminen, Gillespie,  
151 Ryan, & Denison, 2015).

## 152 2.2 Measuring food safety culture maturity

153 An extensive list of researchers (Ball *et al.*, 2009; Boeck, Jacxsens, Bollaerts, & Vlerick,  
154 2015; Griffith, 2014; Hinsz & Nickell, 2015; Jespersen, Griffiths, & Wallace, 2017; Nayak &  
155 Waterson, 2017; Nickell & Hinsz, 2011; Nyarugwe, Linnemann, Hofstede, Fogliano, & Luning,



156 2016; Powell et al., 2011; Taylor, Garat, Simreen, & Sarieddine, 2015; Yiannas, 2009) have built  
157 the current knowledge base of food safety culture and its assessment and improvement, which  
158 the authors seek to further through this research.

159 Focussing on food safety culture maturity, Jespersen et al completed five studies aimed at  
160 measuring this construct (Jespersen & Edwards, Submitted; Jespersen, Griffiths, Maclaurin,  
161 Chapman, & Wallace, 2016; Jespersen, Griffiths, et al., 2017; Jespersen, MacLaurin, & Vlerick,  
162 2017; Jespersen & Wallace, 2017). The initial study (Jespersen et al., 2016) suggested that by  
163 applying a mixed method approach using quantitative (questionnaire) and qualitative (interviews  
164 and document coding) elements, a comprehensive insight could be gained through profiling  
165 using a maturity model. The initial model was built on principles from organizational culture,  
166 specifically Schein's five dimensions (Schein, 2004) as well as learnings from maturity models  
167 in other domains: quality management (Crosby, 1972), health care (Goonan, Muzikowski, &  
168 Stoltz, 2009), and information technology (Ali, 2014). The progressive five stage food safety  
169 model breaks down food safety culture into five capability areas. To ensure content validity of  
170 the model a Delphi method was applied with three rounds of review and revision with a seven-  
171 member panel. Following finalization of the model this was applied to the measurement of food  
172 safety culture at one Canadian protein company (Jespersen et al., 2016). To validate the model  
173 and mixed method a comparative study of eight existing evaluation systems was conducted  
174 (Denzin, 2012; Jespersen, Griffiths, et al., 2017). One of the key findings in the comparative  
175 study was general weakness in how the evaluation systems were validated. None of the

176 evaluation systems had applied and published a structured triangulation as a commonly applied  
177 method for validating social science scales (Denzin, 2012; Jespersen, Griffiths, et al., 2017). A  
178 content analysis method was proposed to accurately reflect an organization's food safety culture  
179 (Jespersen, 2017; Jespersen & Edwards, Submitted; Jespersen & Wallace, 2017) as well as a  
180 method to assess response bias in the form of social desirability (Jespersen, MacLaurin, et al.,  
181 2017). Five dimensions of food safety culture ( Values and Mission, People Systems,  
182 Adaptability, Consistency, and Risk Awareness) were proposed based on the results from the  
183 comparative study (Denzin, 2012; Jespersen, Griffiths, et al., 2017). These dimensions have been  
184 adopted by the Global Food Safety Initiative (GFSI) in the GFSI position paper on a culture of  
185 food safety (Quentin & Jespersen, 2018).

### 186 **2.2.1 Development of a self-assessment scale**

187 The scale was developed by Jespersen et al. (2016) and includes question statements  
188 pertaining to four areas (Table 3) to measure food safety culture maturity; social norms,  
189 behavioural intent, motivation, and social desirability. Social norms are measures that relate to a  
190 person's perception of what other people would approve of regarding given behaviours. The  
191 individual participants were asked a series of statements 'Most people whose opinion I value  
192 would approve of...'. Behavioural intent is measured through statements designed to gauge a  
193 participant's intent to carry out a specific food safety behaviour consistently. Motivation in a  
194 cultural context is measured by asking the respondent to prioritize who in their social network  
195 they are motivated by to carry out food safety behaviours; manager, peers, family/friend, or self.

196 Social desirability is a social science research measure that quantifies the tendency of study  
197 participants to answer questions in a way to be viewed favourably by others. It can take the form  
198 of over-reporting ‘good behaviour’ or under-reporting ‘undesirable behaviour’ and rated on a  
199 scale from zero to 18. The objective is to get a score of zero where study participants answer  
200 truthfully independent of other’s views of them. Research can be advanced by considering social  
201 desirability, statistically speaking, as a control variable. By measuring humans’ tendency to  
202 answer food safety related questions in manner that will be viewed favourably by others, the  
203 food industry can get a more authentic and valid assessment of food safety culture (Jespersen,  
204 MacLaurin, et al., 2017).

205 (Table 3)

### 206 **2.2.2 Developing a textual coding framework**

207 Textual data, including documents and, following transcription, semi-structured interview  
208 data involve large amounts of text that is commonly subjected to content analysis to determine  
209 patterns, trends and relationships as well as frequencies of words used in a document or by an  
210 interview subject (Vaismoradi et al, 2013). A deductive content analysis approach was chosen in  
211 order to apply method triangulation to increase validity of food safety culture evaluation results.  
212 This used a coding framework based on the dimensions of food safety culture identified by  
213 Jespersen, Griffiths and Wallace (2017) from a study of eight culture or food safety culture  
214 evaluation systems. The content analysis of food safety performance documents provided an  
215 insight into the documented food safety culture e.g., level of consistency, adaptability, and

216 perceived value of food safety, whilst the analysis of interview data explored the lived food  
217 safety culture as vocalized by the interview subjects.

218         The process for developing the coding framework and coding content was reported by  
219 Jespersen and Wallace (2017) and is shown in annex 1. Detailed research questions were  
220 defined (step 1) and the theoretical framework of five dimensions of food safety culture  
221 (Jespersen, Griffiths and Wallace (2016)) was used as a starting point for determination of  
222 coding nodes. Two independent coders first read and re-read the data to gain an immersive  
223 sense of the whole before deducing appropriate sub-nodes and establishing the coding  
224 framework (step 2). The framework (annex 2) was an important component as it connects the  
225 coded data to the theoretical framework and the research domain. The nodes and sub-notes were  
226 input into NVivo (step 3) and, following this, coders were trained (step 4) and two documents  
227 coded by same coders (step 5). The results were analyzed by detailed review of verbatim data to  
228 look for similarities and differences between coders. A decision was made to go back to the  
229 coding framework and update with addition of sub-nodes and to go back to the test documents  
230 for recoding (step 6). Following this loop, the decision was made to carry on with the full  
231 document coding as coders were considered “consistent” based on another detailed verbatim  
232 review (step 7). Midway discussions between coders allowed comparison of experience, and  
233 discussion of coding difficulties and issues. These results led to another rework of the two  
234 selected documents and finalization of the 30 documents (step 8). Finally, the data was analyzed  
235 to derive information to answer the research questions (step 9).

236 The process included two checks for consistency evaluated through calculation of  
237 percentage pairwise agreement. (Neuendorf, 2002) argues that the goal for pairwise agreement in  
238 social sciences often are .8 but that .9 levels are most appropriate. This higher threshold level has  
239 also been suggested to account for some weaknesses in this method (Lombard, Snyder-Duch, &  
240 Bracken, 2002). Based on these references the standard for this research for pairwise agreement  
241 level was set to .9 (90% agreement).

### 242 **2.2.3 Constructing the food safety maturity model**

243 The maturity model was designed to assesses food safety culture on a scale from zero to  
244 five. The model and scale are sub-divided into five stages each with a description of a capability  
245 area e.g., people systems at a given maturity score e.g., three. The descriptor for a company's  
246 people system in a maturity stage three is 'deep understanding for the importance of food safety  
247 systems with clearly defined and communicated responsibilities.'

248 Each stage on the maturity scale has two identifiers a numerical and textual i.e., stage  
249 1/doubt, stage 2/react to, stage 3/know of, stage 4/predict, and stage 5/internalize. The numerical  
250 identifiers are aligned with the scale used in the online self-assessment. For example, a self-  
251 assessment of two in the self-assessment equals a 'disagree' on the Likert scale of 'strongly  
252 disagree to strongly agree' and a stage 2/react on the maturity scale. In addition, the maturity  
253 scale was aligned to the levels of Crosby's Quality Management Maturity Grid (Crosby, 1972).

254 To apply the maturity scale, all responses from each of the participants in the self-  
255 assessment were added and a mean maturity rating for each capability area and aggregated mean

256 for all capability areas calculated. Depending on the mean ratings a maturity score for the  
257 capability areas, the plant over all, or the company over all could be estimated. As such, maturity  
258 ratings could fall into any of the five stages on the maturity scale and model, and an  
259 interpretation of stages could be provided based on the descriptors of the stages and the detailed  
260 content of the capability areas in the maturity model as shown in the maturity model construct  
261 (Table 4).

### 262 2.3 Research aims

263 As previously stated, gaps were identified relating to the validation of assessment methods  
264 (Jespersen, Griffiths and Wallace, 2017) and how food safety culture research has not yet  
265 progressed to include an evaluation of organizational performance and effectiveness. Thus, it is  
266 not currently possible to determine the impact of food safety culture on the economic  
267 performance of a business. Therefore, it is important to understand how validated assessment  
268 measures of food safety culture maturity can be combined with economic performance measures  
269 such as COPQ to understand how improvement of food safety culture can support business  
270 effectiveness. In order to move forward the debate in this area, this research aims to, 1) validate  
271 or revise the initial food safety maturity model based on new learnings, 2) apply the principles of  
272 cost of poor quality to assess economic value of maturing food safety culture, and 3) suggest a  
273 dynamic model that captures the constant interactions that cause sub-cultures to adapt to and  
274 integrate change in a food manufacturing setting.

275 **3. Materials and methods**

276 This research was part of a large study of food safety culture performance conducted in  
277 collaboration with five multi-national North American-based food manufacturing companies  
278 from October 2015 to March 2016.

279 3.1 Data collection at five global food manufacturing companies

280 Five companies were approached to participate in the study based on their previous  
281 interests in the subject and willingness to have the researcher collect data virtually and on-site in  
282 all their manufacturing plants. Study data collection methods included an online survey,  
283 interviews and review of performance documents. Data were collected from 21 food  
284 manufacturing plants and 1,273 leaders in executive, management, and supervisory roles from all  
285 functional areas were asked to participate in the online survey, 379 documents were collected  
286 and coded, and 42 on-site interviews were conducted and coded (Table 5).

287 (Table 5)

288 3.2 Maturity calculation using method triangulation

289 Three methods were applied in the study of triangulation (Jespersen and Wallace, 2017)  
290 with the aim of collectively minimizing the method weaknesses of the individual methods and  
291 providing complementary data from the plants under investigation based on the strengths and  
292 practicalities of each: Method 1- Self-assessment scale, analyzed quantitatively using SPSS;  
293 Method 2 – Performance document content analysis, qualitative analysis using NVivo; : Method

294 3 – Semi-structured interviews, qualitative analysis using NVivo. Strengths and weaknesses of  
295 each method were explored and are reported elsewhere (Jespersen and Wallace, 2017). For  
296 example, survey and interviews can help assign causation, survey can help mitigate impact of  
297 interviewer skill and experience, content can help penetrate the group language and symbol  
298 mechanisms, content and survey can get data to close the attitude to behaviour gap, survey social  
299 desirability and interviews can help identify insincere respondents. Application of the methods  
300 was as follows:

301 *Method 1: Self-assessment scale.* All salaried staff in each manufacturing plant were  
302 invited to participate in an online survey between November 2015 and March 2016. The scale  
303 was developed by (Jespersen et al., 2016) and included questions pertaining to four areas to  
304 measure food safety culture maturity; social norms, behavioral intent, motivation, and social  
305 desirability. Response data were imported into SPSS [Computer Software] IBM Corporation,  
306 New York, U.S.A. from Qualtrics [Computer Software] Qualtrics, Provo, Utah, USA and readied  
307 (e.g., removal of incomplete data sets, reversal of negative scales) for analysis. An aggregated  
308 maturity score (mean and standard deviation) as well as maturity level by dimension (mean and  
309 standard deviation) were calculated for each plant with control for social desirability score  
310 (Jespersen, MacLaurin, et al., 2017).

311 *Method 2: Content analysis of performance documents.* Each of the manufacturing plants  
312 were asked to share food safety documents (e.g., food safety audit reports, food safety meeting  
313 minutes, inspection reports, and Good Manufacturing Practice (GMP) records) dating back 12-



314 months from November 2015. Content analysis was applied to these documents using the  
315 predefined coding framework of Jespersen and Wallace (2017) (See 2.4 and Annexes 1 and 2)  
316 which was translated into nodes in NVivo [Computer Software] QSR International, Doncaster,  
317 Australia. Each document was imported into NVivo and all documents were coded by two  
318 researchers.

319 *Method 3: Content analysis of semi-structured interviews.* Semi-structured interviews  
320 with senior plant leader and senior food safety leader were arranged through the participating  
321 company sponsors. Senior leaders at a plant were all invited to participate and the focus on  
322 senior leaders was chosen as direction for an organizations culture is generally set at a senior  
323 level (Denison et al., 2012; Graham, Harvey, Popadak, & Rajgopal, 2017). Interview questions  
324 were shared in advance with the interviewees and informed consent obtained for each interview.  
325 All interviews were recorded and each audio file transcribed and codified to ensure anonymity of  
326 the interview and uploaded to NVivo for content analysis. The same coding framework was used  
327 for the interview files as the food safety documents (Jespersen and Wallace, 2017) (See 2.4 and  
328 Annexes 1 and 2).

### 329 3.3 Further development of the food safety maturity model

330 Based on the findings in this research the model was revised to incorporate learnings  
331 from the five companies and increase its applicability. As such, the capability areas were  
332 evaluated against the dimensions found in the comparative analysis (Jespersen, Griffiths, et al.,  
333 2017) and amended to better integrate learnings from organizational culture e.g., the first model

334 was found to have an overemphasis on the dimension ‘consistency’ through the capability areas  
335 process thinking, technology enabler, and tools/infrastructure but an under representation of the  
336 dimension ‘adaptability’ which was found to assess how an organization’s culture prepares,  
337 accepts, and sustains changes. The capability characteristics were also reviewed to better  
338 understand if these were described as organizational norms e.g., ‘people system’ in stage react  
339 ‘Individuals are recognized sporadically after having solved a food safety problem’ was not  
340 changed as this was already defined as an organizational norm whereas the capability area  
341 ‘perceived value’ in stage internalized ‘ongoing business improvement and growth enabled by  
342 food safety’ was found not defined as an organizational norm and redefined to ‘Frontline  
343 employees are trusted to act correct and celebrate food safety performance on their line/in their  
344 area.’ The content for each value and stage intersect was redefined as norms by finishing the  
345 sentence ‘Food safety <VALUE> at company x can be described as <STAGE> through ...’ This  
346 was different from the content of the original model (Jespersen et al. 2016) where content was  
347 derived by summarizing the behaviours behind each capability area and stage. This method ties  
348 dimensions, values, and norms to food safety culture through each stage of maturity, resulting in  
349 a model that is simpler for organizations to apply in the context of their own organizational  
350 values and norms. This also provides a path to improve food safety culture directly tied to stated  
351 value, norms, and organizational effectiveness as demonstrated by other studies (Denison et al.,  
352 2012; Graham et al., 2017; Kotter & Heskett, 1992). A fifth dimension specific to ‘Hazards and  
353 Risks’ was added as this was a significant topic during the interviews and was included to reflect  
354 the importance of organizational awareness specific to a company’s products and processes.

355 This dimension was also found to be included in other food safety culture assessment systems  
356 (De Boeck, Mortier, Jacxsens, Dequidt, & Vlerick, 2017) through the comparative analysis of  
357 Jespersen, Griffiths and Wallace (2017).

### 358 3.4 Estimation of cost of poor quality

359 The cost of poor quality (COPQ) was calculated using the proposed percentage of sales  
360 per maturity stage (Table 6) (Crosby, 1972).

361 (Table 6)

362 To enable this calculation, the stage descriptors in the food safety maturity model were  
363 aligned to the stages of the Crosby model. For example, Crosby's stage 1 describes a stage of  
364 'reacting' 'blaming' 'hiding', and 'firefighting' similar behaviours are included in the stage 1 of  
365 the food safety maturity model. The Crosby model also describes a progressive maturation from  
366 reacting to understanding to integration of quality. The food safety model applies a similar  
367 progressive maturation specific to food safety.

368 The COPQ results were estimated by applying the percentages in table 6 to each of the  
369 company's annualized sales in U.S. dollars and the mean maturity that had been calculated using  
370 the triangulation method. A mean COPQ (based on actual maturity assessment) and estimates for  
371 moving one stage up and one stage down on the maturity model were estimated to illustrate the  
372 cost of a deteriorating food safety culture compared to an improved food safety culture.

373 These estimates are indented to illustrate the potential economic impact of food safety maturity  
374 and to call upon further empirical research to validate the food safety components of each of the  
375 four components of COPQ (table 1).

### 376 3.5 Development of dynamic model for food safety culture

377 Through the study of existing research of organizational culture, organizational  
378 effectiveness, and economic impact (Denison, 1997; Graham et al., 2017; Kotter & Heskett,  
379 1992) a summary of key learnings was developed and this information was used to identify  
380 potential building blocks of a dynamic model for food safety culture. The findings from this  
381 existing research in organizational culture were augmented with the findings from research of  
382 food safety culture where predictive validity had been proven by Ball (Ball *et al.*, 2009), De  
383 Boeck (De Boeck et al., 2017), Hinsz (Hinsz & Nickell, 2015), Jespersen and Edwards  
384 (Jespersen & Edwards, Submitted), and the results of this study. Synthesising the information  
385 from these sources and discussion and integration within this academic and industry-based  
386 research team allowed the establishment of likely building blocks and design of the suggested  
387 model of dynamic interactions between building blocks.

388

389 **4. Results**

390 4.1 Organizational characteristics

391 Organizational characteristics were calculated based on demographic data collected in  
392 the survey (Table 7).

393 (Table 7)

394 Mean age of respondents (n=816) was 34-44 years, with 10-14 years of experience in the  
395 food industry and current company, and 5-9 years in current role. Comparing the individual  
396 company mean to this baseline group mean, respondents in company A were older – 45-54 years.  
397 Respondents in company B had less experience in both current company and role – 5-9 years.  
398 Respondents in company C also had less experience – 5-9 years in current company but 2-4  
399 years in role and thereby the least experience in the study. Respondents in company D were older  
400 than the mean baseline – 45-54 years and had the longest tenure in the industry – 15-19 years and  
401 the company and role – 10-14 years. Respondents in company E also had shorter tenure in their  
402 current role – 2-4 years, but unlike company C, were at baseline for experience in both industry  
403 and company – 10-14 years. Mean industry tenure ( $F(3, 925) = 6.88, p < .001$ ), company  
404 tenure ( $F(3, 925) = 5.74, p < .001$ ), tenure in current role ( $F(3, 925) = 5.89, p < .001$ ) and age  
405 ( $F(4, 925) = 7.65, p < .001$ ) were all found to be significantly different between the companies.

406 Functional ratios (%MFG/%FSQ) for companies A, B, and D were similar – 86/13,  
407 82/18, and 85/12. Respondents from company C were mostly involved in manufacturing – 92/8;

408 while company E had the lowest participation from manufacturing – 78/22. Despite these  
409 differences, many respondents in all companies were, not surprisingly, from manufacturing. It  
410 should be noted that manufacturing in this context includes all functions except food safety and  
411 quality with a direct reporting relationship to a senior manufacturing leader e.g., S. VP  
412 Manufacturing or plant manager (e.g., sanitation, maintenance, and finance).

413 The span of control ratios (%Leader/%Supervisor) for companies A and E were similar –  
414 37/63 and 35/65 – with these companies providing most supervisors in the study. Respondents  
415 for company B had slightly more supervisors responding at 46/54 and company’s C and D had  
416 the most leaders of the five companies responding – 58/42 and 55/45.

#### 417 4.2 Food safety maturity

418 Based on the self-assessment scale, aggregated maturity for companies A, B, and D were  
419 in the ‘Know’ stage at 3.36, 3.31, and 3.05. Company C had the lowest maturity of 2.80 and in  
420 the ‘React’ stage. Finally, company E had the highest maturity of 4.01 and in the ‘Predict’ stage  
421 (Table 8).

422 Maturity was found to be significantly different ( $F(4, 785) = 5.727, p < .001$ ) across the  
423 five companies. In analysing social desirability, the companies were also found to be  
424 significantly different, ( $F(4, 460) = 10.079, p < .001$ ). Companies A and E scored the lowest at  
425 mean 4.10 and 4.98 out of a total possible score of 18. Company C had the highest score of all at  
426 7.56 with companies B and D lower at 7.16 and 6.67 respectively. Maturity was also found to be

427 significantly different between functions ( $F(4, 460) = 10.079, p < .001$ ). FSQ rated on average  
428 maturity 16% higher than manufacturing and other functions. Span of control also influenced  
429 maturity ratings and were significantly different ( $F(4, 460) = 10.079, p < .001$ ). As such,  
430 average maturity rating of supervisors was 28% lower than that of leaders. This supports the  
431 findings by Manning (2017) who investigated the impact of subcultures on food safety  
432 management and the stratification that naturally occurred due to these sub-cultures (Manning,  
433 2017).

434 The individual triangulation scores (Figure 1) shows how the assessment results vary by method  
435 with the self-assessment scores (black circle) tends to show a higher maturity score than those of  
436 the interviews and performance document reviews.

437 (Figure 1)

#### 438 4.3 Revised food safety maturity model

439 Based on the method described in section 3.3. food safety maturity model 1.0 (Jespersen  
440 et al., 2016) was updated to version 2.0 (Table 9). Dimensions and values that were updated are  
441 highlighted in table 9.

442 Table 1: Food safety culture - maturity model version 2.0

443

444 (Table 9)



445 4.4 Estimated cost of poor quality and economic impact

446 Company A spent most, due to it also having the highest annualized sales, but this was

447 followed by company C with the second highest COPQ due to its low maturity rating.

448 Collectively it is estimated that the companies spent \$1.14 billion in sales on COPQ annually in

449 their current stages of maturity. If they all slide down one maturity stage they would spend an

450 additional \$0.38 billions of sales and if they all move up one stage they save an additional \$0.43

451 billions of sales (Figure 2).

452 (Figure 2)

453

454 4.5 Suggested model of dynamic interactions in food safety culture

455 The suggested model of dynamic interactions developed through this research is portrayed in

456 Figure 3. This is presented as a model for further testing and examples are given to illustrate the

457 dynamic nature of the model and the connectivity between the building blocks and interactions in

458 response to a food safety marketplace trigger.

459 The structure consists of cultural building blocks and dynamic interactions. Each building

460 block is connected to others through the interactions. There are four main building blocks; I.

461 Organizational effectiveness, II. Organizational culture norms, III. Working group learned and

462 shared assumptions, and behaviours, and IV. Individual intent and behaviours. There are seven

463 interactions between the building blocks that indicate how each building block is either

464 influenced or is influencing. For example, the external environment influences an organizations  
465 culture and norms e.g., recall of products from a competitor, a shortage of qualified employees  
466 (arrow #1). Such interactions can cause a review of formal systems arrow e.g., are policies and  
467 procedures actually guiding behaviours and actions everyday? (arrow #2) and the organizations  
468 values e.g., is a value of ‘integrity’ translated in to behaviours of ‘see something – say  
469 something’ everyday? (arrow #3) which in turn triggers an alignment of values to the formal  
470 systems e.g., is a value of ‘integrity’ translated into the formal system for performance  
471 evaluation? The organizations norms influence how working groups take decisions everyday  
472 e.g., recognizing those that consistently bring forward issues to solve (arrow #5) and the  
473 individual’s intent to behave (arrow #6 and #7) e.g., ‘I see others get recognized by our manager  
474 when speaking up, I better do so as well if something needs correction.

475 (Figure 3)

## 476 **5. Discussion**

477 This research sought to address three areas to further the scientific knowledge base for  
478 food safety culture, 1) validating or revising the initial food safety maturity model based on new  
479 learnings, 2) applying the principles of cost of poor quality to assessing economic value of  
480 maturing food safety culture, and 3) suggesting a dynamic model that captures the constant  
481 interactions that cause cultures to adapt to and integrate change.

482 By applying three data collection methods (Jespersen & Wallace, 2017) the research was  
483 able to calculate a food safety maturity score for five global companies and 21 of their  
484 manufacturing plants. The companies aggregated maturity scores were found to be significantly  
485 different and ranging from stage 2 – Doubt – to stage 4 – Predict of the food safety maturity  
486 model. The qualitative data gathered through the coding of 379 performance documents and 42  
487 interviews with plant leaders and food safety managers were applied to further develop the  
488 existing food safety maturity model (Jespersen et al 2016). The maturity model was redefined to  
489 provide a path for food manufacturers seeking to improve their food safety culture and to provide  
490 a link to existing literature on cost of poor quality as a function of organizational maturity  
491 (Crosby, 1972; Duffy, 2017; Schiffauerova & Thomson, 2006). It was found that dimensions of  
492 food safety culture could be described across the maturity model stages in forms of norms, e.g.,  
493 ‘Frontline teams and supervisors make use of leading indicators to improve food safety systems’  
494 (dimension = consistency), to better integrate food safety into a food company’s existing values.  
495 A fifth dimension was added ‘Risks and Hazards’ to better link the importance of hazard  
496 awareness and learnings from HACCP deployment (Wallace, 2009; Wallace, Holyoak, Powell,  
497 & Dykes, 2012). This Risks and Hazards dimension was identified by Jespersen, Griffiths and  
498 Wallace (2017) in their comparative analysis of existing food safety culture evaluation systems.  
499 It has been questioned whether this dimension should be part of a food safety culture framework  
500 or whether it should be considered in the evaluation of food safety management systems and risk  
501 awareness (Jespersen and Wallace, 2017) as it is one of the least tangible and least defined  
502 dimensions in food safety culture research (De Boeck *et al.* 2018). However, it was included due

503 to the importance of understanding the organization's overall approach to managing risks and  
504 hazards as opposed to the technical detail of hazard analysis which is addressed in food safety  
505 management systems. It is hoped that the delineation of maturity over the Risks and Hazards  
506 dimension presented here will help to further understanding of the interactions between cultural  
507 and technical systems in food safety.

508 By use of the maturity model and the data collected, an aggregated maturity score was  
509 used to calculate aggregated 'cost of poor quality' per company to demonstrate the economic  
510 impact the maturity of the company's food safety culture. This cost varied substantially by  
511 company, partially due to the dependence on company sales in the equation and the difference in  
512 food safety maturity level. As such, cost of poor quality ranged from \$400M to \$2.4B when  
513 calculated using Crosby's guidance for percentage per maturity stage (Crosby, 1972). It shows  
514 the significance of food safety maturity and its potential economic impact on a food  
515 manufacturer's performance.

516 To realize this economic value the research suggests a need to apply learnings from  
517 studies that have demonstrated predictive validity of cultural factors and their impact on food  
518 safety behaviours and performance. As such, a dynamic model of food safety culture is proposed  
519 to better understand the interactions that must be considered when taking steps to mature food  
520 safety culture. The four building blocks are: organizational effectiveness, organizational culture  
521 norms, learned and shared assumptions of working groups, and individual intent and behaviours.  
522 It is proposed that it is through actions and interactions between these building blocks that a food

523 manufacturer's food safety culture maturity can be evaluated and improved such that the  
524 individual employee adapts to organizational norm.

525 This research builds on empirical findings from studies conducted on organizational  
526 culture (Denison, 1997; Graham et al., 2017; Guiso et al., 2014; Kotter & Heskett, 1992) and as  
527 such is an adaptation of proven relations between organizational culture and economic  
528 performance, as well as the connection between culture, values, norms, and behaviours. The  
529 research also makes use of predictive research conducted specifically in the food safety domain  
530 and further develops the field of food safety culture by integrating factors impacting food safety  
531 performance in the revised maturity model and the food safety culture dynamic model building  
532 blocks.

533 It is through the integration of all cultural building blocks and interactions rather than  
534 through focus on a single block or action that sustainable results are achieved, that food safety  
535 culture is matured, and the company can realize both risk reduction and economic gain. This  
536 research is innovative in that it connects maturity, cost of poor quality, and predictive factors of  
537 food safety.

538 The limitations in the research lie in its geographical reach, as the participating  
539 organizations are global but with headquarters situated in North America. In addition, the five  
540 companies were approached to participate in the study based on their previous interests in the  
541 subject and willingness to have the researcher collect data virtually and on-site in all their  
542 manufacturing plants. As such, the findings may have been affected by existing company

543 interests in food safety culture and the results cannot be generalised across all food  
544 manufacturing plants. Also, the theoretical application of the COPQ proportions has yet to be  
545 tested in practice within the food industry. Further research is needed to empirically demonstrate  
546 the connection between food safety culture and economic performance and this should be global  
547 in scope and include food manufacturing companies of all sizes and representative of all  
548 commodities. Similarly, further research is needed to test the food safety dynamic model and  
549 interactions across a range of food industry organizations.

550 In conclusion, as food companies recognize more and more the strategic importance of  
551 their food safety culture, its reliable and valid evaluation gains importance. This research  
552 provides a framework for maturing food safety culture to be integrated into an organization's  
553 culture, its values, and norms. By quantifying food safety maturity using a validated,  
554 triangulation method, companies can estimate the proportion of their sales wasted through cost of  
555 poor quality, and design interventions specific to the four cultural building blocks individually  
556 proven to impact food safety performance. This might facilitate a change in the design of  
557 interventions to strengthen food safety management and control activities.

## 558 **6. Acknowledgements**

559 The authors would like to acknowledge, among others, Bush Brothers, Cargill, and Land O'  
560 Frost for their leadership and openness to allow this research to take place.

561

565 Table 2: COPQ activities and examples of possible quality and food safety activities(Adapted from Duffy, 2017,  
566 Hutton, 2001; Surak & Wilson, 2007; Wallace, Sperber, & Mortimore, 2011; Mortimore and Wallace, 2013)

<b>COPQ activities</b>	<b>Quality examples</b>	<b>Food safety examples</b>
Prevention cost	Establish specification for incoming ingredients and all employee training.	Metal detector calibration, process equipment preventative maintenance, and all employee training.
Appraisal cost	Quality audits.  Checking incoming ingredients against specification.	Food safety audits.  Metal detector checks, environmental monitoring, and GMP audits.
Internal failure cost	Waste in the form of products that cannot be shipped.	Incorrect cooking temperature causing rework.
External failure cost	Product withdrawal.	Product recall.

567 Table 3: Financial performance differences between companies who invested in a performance-enhancing culture  
 568 and those that did not (Kotter and Heskett, 1992).

	<b>Average increase for 12 firms with performance-enhancing cultures</b>	<b>Average increase for 12 firms without performance-enhancing cultures</b>
Revenue growth	682%	166%
Employment growth	282%	36%
Stock price growth	901%	74%
Net income growth	756%	1%

569

570 Table 4: Sample statements per area in the self-assessment questionnaire

Area	Sample statements
Social norms	Most people whose opinion I value would approve if I review the preventive control plan(s) quarterly to verify effectiveness. Most people whose opinion I value would approve if I always acknowledge manufacturing leaders who make good food safety decisions.
Behavioural intent	I will do all I can whenever my team does not have the right tools to complete food safety tasks. I will improve food safety processes every day
Motivation	I want to do what my manager thinks I should do for food safety. I want to do what I have learned through food safety training.
Social desirability	I appreciate other people's opinions regarding food safety. It bothers me if people dislike me because of my views about food safety.

571

572 Table 5: Maturity model construct

Stages	Stage 2	Stage 3	Stage 4	Stage 5
Stage 1				



	Doubt	React to	Know of	Predict	Internalize
Stage characteristic	Most food safety actions are taken due to external pressures (e.g., regulators).	Food safety actions are solved by the quality department and mostly to close gaps and remove issues.	Food safety knowledge is prevailing across the organization and everyone acts to improve food safety.	Food safety actions are taken based mostly on results from predictive analysis'.	Food safety actions are driven by everyone and mostly based on managing risks.
Capability area characteristic (sample from the 'People System' capability area)	Individuals complete food safety tasks out of fear for negative consequences.	Individuals are recognized sporadically after having solved a food safety problem.	Leaders recognize teams and individuals according to a documented system of positive and negative consequences.	Leaders reward teams for collectively improving food safety processes/procedures.	Cross functional/level teams nominate other teams for being proactive and thinking strategic around food safety.

573

574

575 Table 6: Data collected from the five participating companies

Data	Company					576
	A	B	C	D	E	Total (Mean)
Number of plants	11	3	2	2	3	21
Survey Response rate (Percentage)	72	77	72.5	77	59	(72)
Performance documents (#)	268	3	33	50	25	379
Interviews (#)	22	8	4	4	4	42

577

578 T

579 able 7: Maturity stages and cost of quality as percentage of sales (Crosby, 1972).

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

580

581 Table 8: Aggregated company demographics and baseline (mean and total)

Category	Measure	Company					Mean (Total)
		A	B	C	D	E	
Demographics	# plants	11	4	2	2	2	(21)
	Years in food industry (mean)	10-14	10-14	10-14	15-19	10-14	10-14
	Years in the company (mean)	10-14	5-9	5-9	10-14	10-14	10-14
	Years in current role (mean)	5-9	5-9	2-4	10-14	2-4	5-9
	Age (mean)	45-54	34-44	34-44	45-54	34-44	34-44
	Functional distribution (%MFG/%FSQ*)	86/14	82/18	92/8	85/12	78/22	n/a
	Role distribution (%Leader/%Supervisor)	37/63	46/54	58/42	55/45	35/65	46/54

582 \*Manufacturing and Food Safety & Quality

583 Table 9: Food safety maturity by company

Category	Measure	Company					Mean (Total)
		A	B	C	D	E	
Cultural performance	Culture Stage	Know	Know	React	Know	Predict	Know
	Maturity [1-5]	3.36	3.31	2.80	3.05	4.01	3.3
	Social desirability [1-18]	4.10	7.16	7.56	6.67	4.98	6.09

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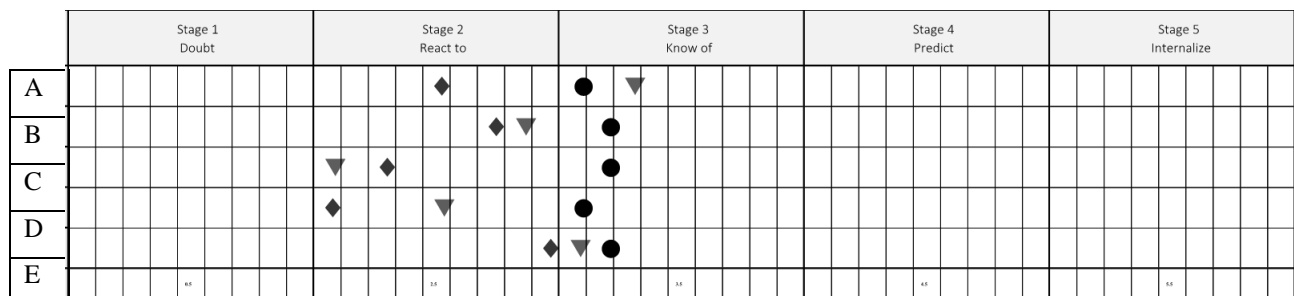


Figure 1: Plant Maturity - Plot of mean values as per method triangulation. Ledger: Dot = Self-assessment scale result, Diamond – Performance document coding result, and Triangle = Interview coding result.

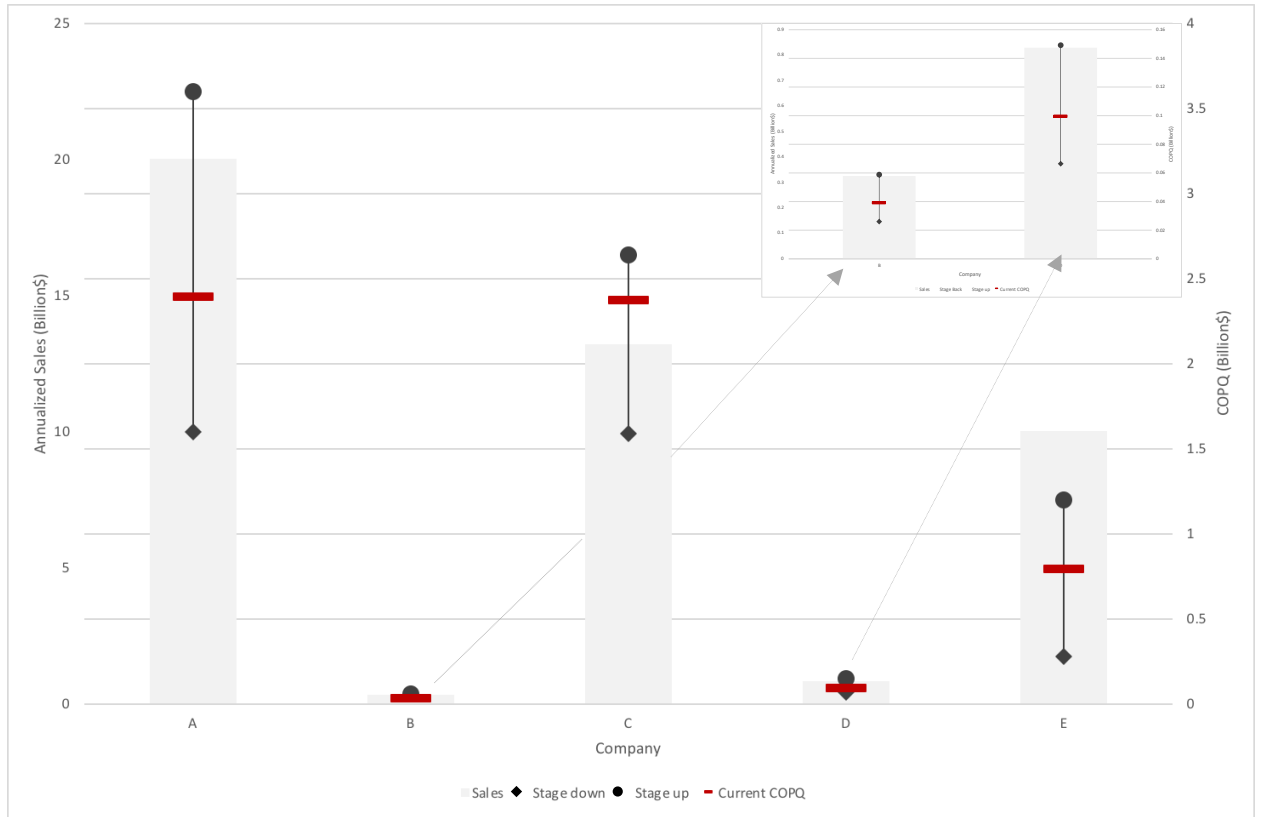
586 Table 10: Food safety culture - maturity model version 2.0

Dimension	Values	Stage				
		Stage 1 Doubt	Stage 2 React	Stage 3 Know	Stage 4 Predict	Stage 5 Internalize
Values and Mission	Integrity and trust	Employees have little trust that management will act on food safety without external pressure	Employees trust that management will act and do the right thing for food safety after an issue have occurred	Everyone trusts that food safety issues are solved because we know it protects our business	Everybody is trusted to invest in food safety information to make future performance stronger	Frontline employees are trusted to act correct and celebrate food safety performance on their line/in their area
	Being responsible	Nobody knows who has the duty to deal with food safety	Everybody readily takes responsibility, but it is unclear what that means	Detailed food safety responsibility is written into job descriptions for everybody	Decision makers are certified food safety professionals and responsible for driving cost out of the food safety system	Frontline is responsible for bubbling improvement plans to leaders, leaders are responsible for incorporating these into long-term business planning
	Ethics	Moral principle ...don't look	Moral principle...invest if we must	Moral principle...improve system	Moral principle...reduce cost by taking out variation	Moral principle...grow business
People System	Reward and recognize	Individuals complete food safety tasks out of fear for negative consequences	Individuals are recognized sporadically after having solved a food safety problem	Leaders recognize teams and individuals according to a documented system of positive and negative consequences	Leaders reward teams for collectively improving food safety processes/procedures	Cross functional/level teams nominate other teams for being proactive and thinking strategic around food safety
	Competently communicating	Top-down 'tell' with little 'why' content and understanding of the importance of the task	Food safety information is communicated by FSQ as problems occur using, if available, facts discovered as the problem was solved	There is a deep understanding of the food safety system and performance is communicated by some functional leaders on a regular basis	Frontline leaders are having regular communications on food safety performance using data and tracking the teams' improvement actions	Food safety communication cadence is an organizational habit that involves everybody in specific team discussions
	Together we make the difference	silos...	problem communication...	fragmented delivery of information...	Food safety and quality critical conversations...	habit...



Adaptability	Innovate	Scrambling to meet changed requirements	Aware of coming change but do not update procedures before last minute	Change is analysed and incorporated into written food safety system including changes to competencies/job descriptions	Innovation is driven by data internally to reduce food safety costs	Innovation is suggested by frontline teams and bubbling up to impact companywide system. Quick to adapt as they have technology interface in their hands
	Embrace and drive change	Nothing is stable, so it does not matter if we must change...again	We know change is coming and will deal with it last minute...	We know the change and have analysed the impact on individuals and teams according to a pre-defined change curve...	We look for cost reduction opportunities and plan these in our continuous improvement program...	Frontline teams have full autonomy to drive change in the food safety system, support teams are responsible for spreading new and best practices across the company...
Consistency	Data and reporting	Data are not used to solve problems and mostly sitting in a filing cabinet or in unused reports	It is left to the individual to identify needed data and ways to derive information from these	Leading indicators are used to find root causes of food safety problems and solutions are built into the food safety management system	Leading indicators are continuously updated through precisely and accurately collected data	Frontline teams and supervisors make use of leading indicators to improve food safety systems
	Technology enabled success	Little to no new value placed on buying or adopting technology	Technology is bought in reaction to a specific need e.g., faster pathogen testing results	Technology is seen in the context of the business system to integrate functions, procedures, and capabilities (e.g., ERP specification system)	Automation is used frequently and seen as an integral part of reducing food safety cost	Enterprise Resource Planning (ERP) is used in an integrated way with automated workflows that make the enterprise quick to adapt
	Quality of all we do	Unstructured problem solving to remove the immediate pain	'plan, do, check, act' with emphasis on control and expectation of 100% perfect solutions from the start	Structured, documented problem solving with high risk of analysis paralysis	'plan, do, study, act' with emphasis on study and an iterative approach to improvement	Identifying risks through horizon scanning and continuous improvement followed by mitigation plans built into the food safety system
Risks and Hazards	Risk perception	The organization relies mostly on external sources and inspections to understand and act on its risks and doesn't identify risks internally	Actions to manage risks are mostly taken in response to external audits or inspections and internal identification is sometimes incorrect	Risks are understood and continually challenged by a cross-functional team through planned risk management	Understanding and reducing risks are an integral part of the organization's continuous improvement efforts	The organization relies on frontline teams to manage existing risks and to identify new ones through peer observations

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591 Figure 2: Annualized sales per company and COPQ based on evaluation result (bar), one maturity stage up (dot),  
592 and one stage down (diamond).

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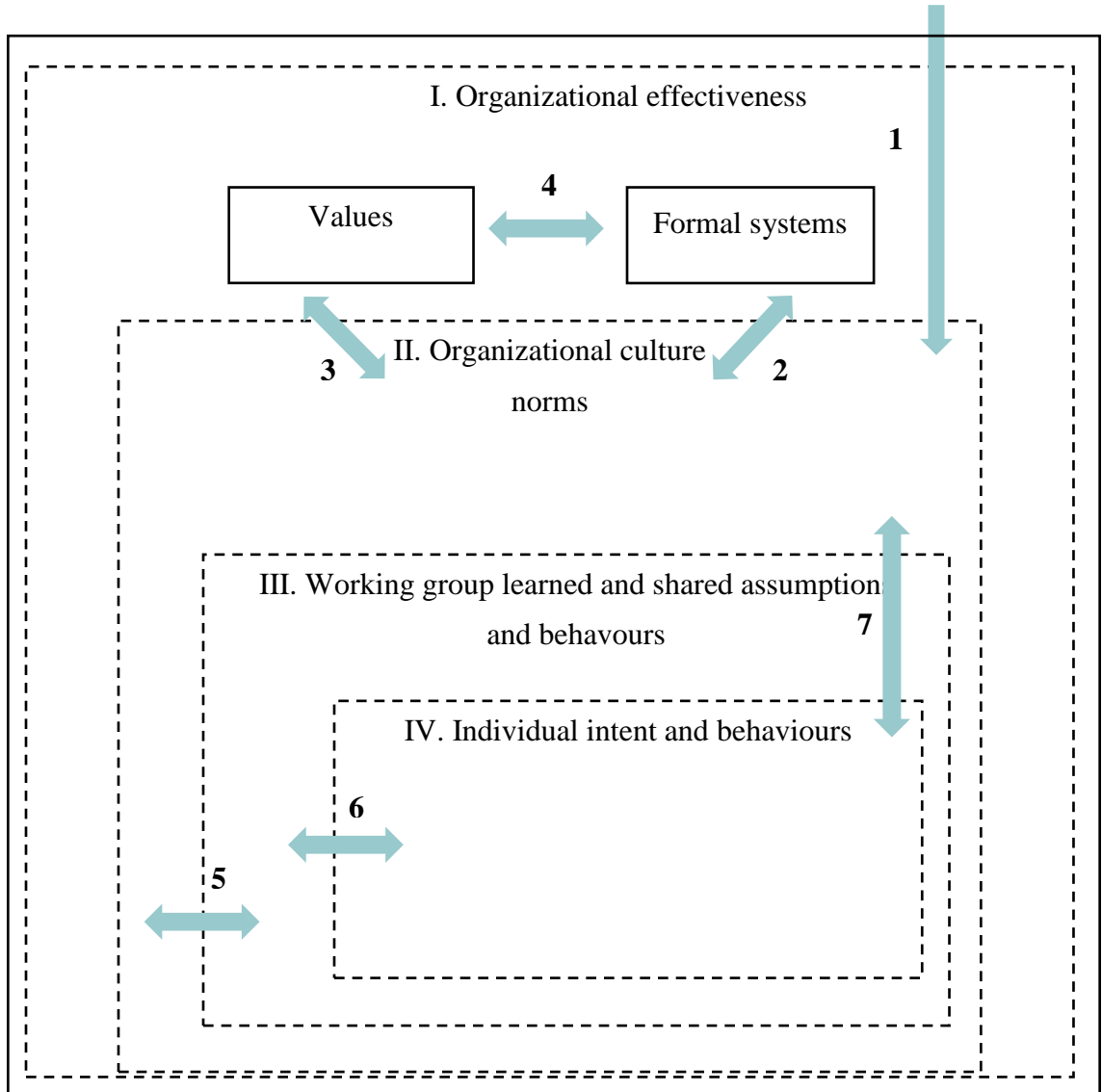

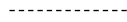
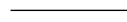
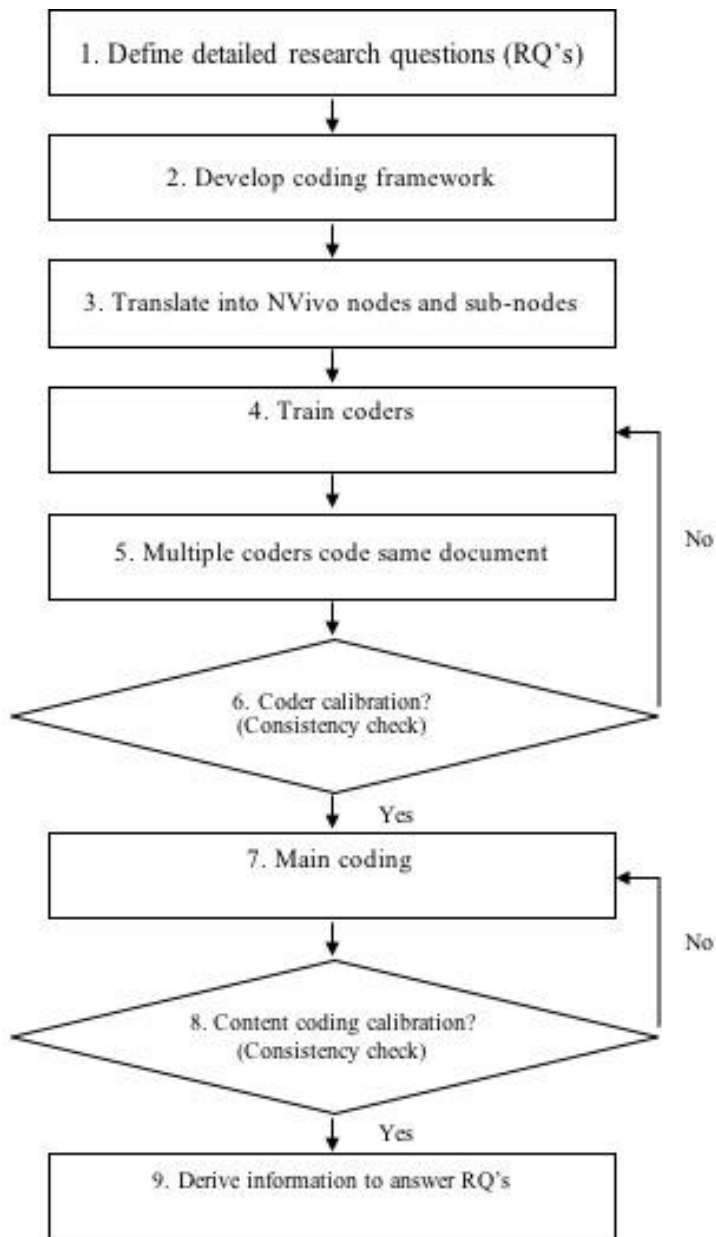


Figure 3: Dynamic model of a culture of food safety

-  'Interactions' e.g., adapt and integrate
-  Culture building blocks
-  External environment boundary



600 Annex 1: Coding process applied to deriving data through content analysis (Source: Jespersen  
601 and Wallace, 2017)  
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607 Annex 11: Coding framework used in the content analysis of textual data (Semi-structured  
608 interviews and performance documents) (Source: Jespersen and Wallace (2017)).

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Node	Sub-Nodes
Values and Mission	Compliance. Measures/metrics/KPIs. Mission, vision, goals. Ownership/owning. Plan/roadmap, direction. Recall/recalls/withdrawals. Responsibility, accountability, commitment. Direction, setting expectations, corporate direction. Financials, budgets, and prioritizing.
People Systems	Any reference to persons' role/education/job and group or team and references to individuals. Behaviour/practice, work routine. Communication and dialog. Involvement. Consequence, escalation. Pride. Rewards and celebration. Training, education, learning, proficiency. Cross-functional. Unionized. Rotation and retention. "Making choices..."
Consistency	Actions, tasks, action due date. Non-conformance, reoccurring. Technology. Tools, infrastructure, and policies/procedures. References to third party standards. Problems, breakdowns, and issues.
Adaptability	Change readiness, open to change, change ready. Improvement, must improve, continuous improvement, improvement process, improvement system, continuous improvement, Six Sigma, Lean manufacturing.
Risks and Hazards	Leaders risk awareness and perception. Operator risk awareness and perception. Risks, hazards.

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612 **7. References**

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