



FOODINTEGRITY

Ensuring the Integrity of the European food chain

613688: Collaborative Project

Seventh Framework Programme

KBBE.2013.2.4-01: Assuring quality and authenticity in the food chain

Deliverable: D17.6

Report on stakeholder attitudes towards information sharing along food supply chain

Author(s): Fien Minnens, Isabelle Sioen, Fred van de Brug, Niels Lucas Luijckx, Wim Verbeke

Beneficiary(s): P 44; P43

Date of preparation: August 2018

Period covered: Months 45-53

Status: version 1

Dissemination level		
PU	Public	X
PP	Restricted to other participants	
RE	Restricted to a group specified by the consortium	
CO	Confidential, only members of the consortium	



The project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 613688.

TABLE OF CONTENTS

1.	Introduction	8
1.1.	Background	8
1.2.	Objective	9
2.	Methods	10
2.1.	Stakeholder consultation in three rounds	10
2.2.	Defining the concept of a food integrity information sharing system	10
2.3.	Round I: quantitative survey	12
2.3.1.	Survey design.....	12
2.3.2.	Survey distribution.....	13
2.3.3.	Data analysis.....	14
2.4.	Round II: feedback survey.....	15
2.4.1.	Survey design.....	15
2.4.2.	Survey distribution.....	16
2.4.3.	Data analysis.....	17
2.5.	Round III: interactive stakeholder workshop.....	17
2.5.1.	Workshop program.....	17
2.5.2.	Break-out sessions	18
2.5.3.	Data analysis.....	18
3.	Results	19
3.1.	Round I.....	19
3.1.1.	Stakeholder participation and dropout during the survey	19
3.1.2.	Description of the sample of Round I	20
3.1.3.	Stakeholders’ perception on the occurrence of food integrity issues.....	23
3.1.4.	Stakeholders’ perception on the risk of food integrity issues.....	26
3.1.5.	Food categories at risk for food integrity issues.....	27
3.1.6.	Industry stakeholders’ attitudes and perception of the usefulness towards information sharing	29
3.1.7.	Advantages of information sharing to prevent food integrity issues	29
3.1.8.	Disadvantages of information sharing to prevent food integrity issues.....	30
3.1.9.	Conditions for take-up of a food integrity information sharing system	33
3.1.10.	Trusted third party.....	35
3.1.11.	Actors participants are willing to share with.....	37
3.1.12.	Types of data	38

3.1.13.	Outputs of an information sharing system	39
3.1.14.	Likelihood of take-up	40
3.2.	Round II.....	41
3.2.1.	Description of the sample	41
3.2.2.	Food integrity issues: occurrence and likelihood of detection	42
3.2.3.	Potential of a food integrity information sharing system to prevent and detect food integrity issues	45
3.2.4.	Trusted third party.....	45
3.2.5.	The role for food safety authorities within a FI-ISS	47
3.2.6.	The role for retail and consumer organisations within a FI-ISS.....	49
3.2.7.	Sharing data and information on volumes and transactions	49
3.2.8.	First steps to develop a food integrity information sharing system.....	50
3.3.	Round III.....	53
3.3.1.	Development of a discussion guide	53
3.3.2.	Break-out sessions	54
4.	Conclusions.....	58
	References.....	60
	Appendices	61
	Appendix I: Explanimation script	61
	Appendix II: Round I Questionnaire	62
	Appendix III: Round II Questionnaire	78
	Appendix IV: Round III Discussion guide	91
	Appendix V: Round III Workshop invitation	92
	Appendix VI: Round III Presentation slides used during interactive workshop.....	93
	Appendix VII: Notes from the working groups during Round III.....	108
	Appendix VIII: Round III Transcript of reporting back sessions	114
	Appendix IX: Submitted manuscript Food Research International.....	120

Tables

Table 1: Structure of the questionnaire used in Round I of the stakeholder consultation.....	12
Table 2: Distribution of participating stakeholders in the first round	14
Table 3: Structure of the questionnaire used in Round I of the stakeholder consultation.....	15
Table 4: Distribution of participating stakeholders in the second round	16
Table 5: Types of stakeholders participating in the Round III workshop.....	17
Table 6: Description of participant dropout along survey length during Round I.....	19
Table 7: Distribution of industry actors' from different companies sizes between three clusters.....	26
Table 8: Mean scores for items on perceived risk of food integrity issues (n= 123)	26
Table 9: Different clusters' mean perceived risk (n=115)	27
Table 10: Round II participants, participation in Round I (n=61).....	41
Table 11: Round II participants' self-identification (n=61).....	41
Table 12: Coded categories of statements made by stakeholders to clarify their answer on the question in Figure 24. Contradictory reasoning signalled in bold (n= 36)	43
Table 13: Food industry stakeholders' perception on when they would join a FI-ISS (n=30).....	51
Table 14: Discussion grid and different comments made by stakeholders during the break-out sessions of Round III (G1= group 1, G2= group 2, G3= group 3, G4= group 4).....	55

Figures

Figure 1: Overview of the three rounds of stakeholder consultation	10
Figure 2: Overall scheme as presented in the explanation video which was used in all three rounds to introduce the concept of a food integrity information sharing system	11
Figure 3: Participants companies' activities in the food industry (n=111, n)	20
Figure 4: Participants' self-identification of different responsibilities within companies (n=111, n) ...	21
Figure 5: Number of participants working with certain food commodities (n=111, n)	22
Figure 6: Geographical scope companies which stakeholders are active in (n=111, n)	22
Figure 7: Company size (n=111, n).....	23
Figure 8: Stakeholders' estimation of the occurrence of food integrity issues at their company or organisation (n=143, %)	23
Figure 9: Stakeholders' estimation of the likelihood of detecting food integrity issues at their company or organisation (n=143, %)	24
Figure 10: Bubble chart illustrating stakeholders' estimation of the occurrence of food integrity issues and of the likelihood of detecting issues (n=133, diameter bubble=n).....	24
Figure 11: Bubble chart illustrating three cluster groups (n=133)	25
Figure 12: Participants perception of the susceptibility of different food categories for food integrity issues - part 1 (n=123, %)	27
Figure 13: Participants perception of the sensitivity of different food categories for food integrity issues – part 2 (n=123, %).....	28
Figure 14: Perceived advantages of information sharing according	30
Figure 15: Disadvantages of information sharing (n=119, %)	31
Figure 16: Conditions for a food integrity information sharing system (n=113, %)	33
Figure 17: Trusted third parties that could manage a food integrity information sharing system (n=113, %).....	35
Figure 18: Actors with whom participants are willing to share within a food integrity information sharing system (n=119, %)	37
Figure 19: Types of data that could be shared within a food integrity information sharing system according to participants (n=111, %)	38
Figure 20: Participants' acceptance of different outputs of a food integrity information sharing system (n=111, %)	39
Figure 21: Participants likelihood of take-up a system for information sharing (n=111, %).....	40
Figure 22: Geographical scope working field participants Round II (frequency, %).....	42

Figure 23: Round II stakeholders’ perception on the estimation of industry stakeholders (Round I) regarding the frequency of occurrence of food integrity issues (n=61,%)	44
Figure 24: Round II stakeholders’ perception on the estimation of industry stakeholders (Round I) regarding the likelihood of detecting food integrity issues (n=58, %)	44
Figure 25: Round II stakeholders’ perception on the potential of information sharing (n=58, %)	45
Figure 26: Round II stakeholders’ reported advantages, coded categories (n=58, n)	45
Figure 27: Round II stakeholders’ agreement with two possible suitable trusted third parties most preferred in Round I (n=50, %)	46
Figure 28: Round II stakeholders’ qualitative statements on the establishment of a new organisation to manage a FI-ISS and the level on which level it should be active, coded into categories (n= 41, n)	46
Figure 29: Round II stakeholders’ qualitative statements on the establishment of a new organisation to manage a FI-ISS and the private public dilemma, coded into categories (n= 41, n)	47
Figure 30: Round II stakeholders’ comments on the involvement of national or international food safety authorities as trusted third parties to manage a FI-ISS (n= 46, %)	48
Figure 31: Criteria a FI-ISS has to meet for food industry actors to share sensitive information, according to stakeholders in Round II (n=49, n).....	50
Figure 32: Innovation Adoption Lifecycle.....	52
Figure 33: Key success factors and discussion points for a food integrity information sharing system	54

Deliverable 17.6: Report on stakeholder attitudes towards information sharing along food supply chain

1. Description of Deliverable

This deliverable presents the results of a stakeholder consultation regarding the potential of a food integrity information sharing system in the European food supply chain. The stakeholder consultation took place between November 2017 and May 2018 in three rounds: an online survey for stakeholders from the food industry, a feedback survey for all stakeholders and an interactive workshop. Key success factors for a food integrity information sharing system and further discussion points are presented in this Deliverable along with challenges for the development of an information sharing system.

2. Achievement of the Deliverable

The Deliverable presents insights into four key success factors for a food integrity information system according to stakeholders, more specifically with regards to (1) the different actors to be involved in a system, (2) the information shared, (3) the third party to manage a system and (4) the role for food safety authorities. Additionally, it formulates challenges and identifies the points of contention on which stakeholders do not reach consensus.

1. Introduction

1.1. Background

Integrity challenges along the food supply chain have received increasing attention by food safety authorities, industry and media over the last years. A variety of measures are being developed and applied to prevent and detect food integrity issues by different actors, both technical and organisational. Ellis, Muhamadali, Haughey, Elliott, and Goodacre (2015) stressed that the ever expanding portfolio of analytical methods, techniques and technologies and future pervasive and predictive computation will together take on the role of a technology-based capable guardian for food systems. Simultaneously, more than ever before, experts recognise that food integrity is a challenge that requires a joint strategy and coordinated efforts involving all stakeholders, and that a strengthening of the collaboration between industry and governments is necessary (Brooks, Elliott, Spence, Walsh, & Dean, 2017). The development of an integrated private-public strategy requires clearly defined roles for each participating stakeholder and clarity and shared agreement on the specific purpose (Spink, Moyer, & Whelan, 2016).

The Elliott review following the horsemeat incident introduced eight pillars of food integrity: consumers first, zero tolerance, intelligence gathering, laboratory services, audits, government support, leadership and crisis management (Elliott, 2014). The recommendations that are formulated for these eight pillars refer multiple times to the need for data, information and intelligence sharing between stakeholders: *“There needs to be a shared focus by Government and industry on intelligence gathering and sharing. The Government should work with the Food Standards Agency (to lead for the Government) and regulators to collect, analyse and distribute information and intelligence; and work with the industry to help it establish its own ‘safe haven’ to collect, collate, analyse and disseminate information and intelligence.”* (Elliott, 2014, p. 7). Following the horsemeat incident, several actions were taken and new initiatives were set up. For example, in the United Kingdom, the incident led to the establishment of the Food Industry Intelligence Network (FIIN) and on a European level the Food Fraud Network (FFN), both aiming at the type intelligence gathering that the Elliott Review recommended (Brooks et al., 2017).

Information and data that could be relevant to identify potential issues of integrity in food supply chains are often firstly and only available to industry experts operating at a specific level of the agro-food supply chain. Ideally, this information and data would be shared, integrated and analysed, in order to help reveal issues faster and more accurately, and help prevent them. Although the integration of food integrity data and information covering the whole food supply chain in one digital system seems futuristic, the digital data revolution and developments in artificial intelligence are

transforming many economic sectors already, and the food sector is often named as one that might benefit substantially from a similar transition too (Fritsche, 2018; Rychlik et al., 2018).

While the development of technologies, systems, and infrastructures is gaining momentum, questions relating to stakeholder acceptance, willingness-to-adopt and participate remained largely unaddressed thus far. It is important to assess stakeholders' attitudes towards information sharing at the present and how information sharing systems will be received with the goal to detect and prevent food integrity issues.

1.2. Aim and objectives

The aim of this study was to investigate food supply chain stakeholders' attitudes towards a food integrity data and information sharing system (further referred to as a FI-ISS). The consultation of stakeholders focused on three objectives which were addressed in three consecutive rounds of data collection. Firstly, we intended to determine how food industry stakeholders receive the idea of a FI-ISS and which preconditions they consider important. The second objective of this study was to determine key success factors for the successful development and adoption of a FI-ISS. Lastly, the study explored in further detail the meaning of the defined key success factors, specific sensitivities facing the introduction of a FI-ISS and the origins of eventual contentious points.

2. Methods

2.1. Stakeholder consultation in three rounds

The design of the stakeholder consultation is inspired by the Delphi method, adapting this method to best fit the objectives of the study. During three rounds, the study explored different stakeholders' perspectives on information sharing to prevent and detect food integrity issues. An overview of the three rounds, time periods and target groups of the different rounds is shown in Figure 1. The complete study extended from November 2017 until May 2018.

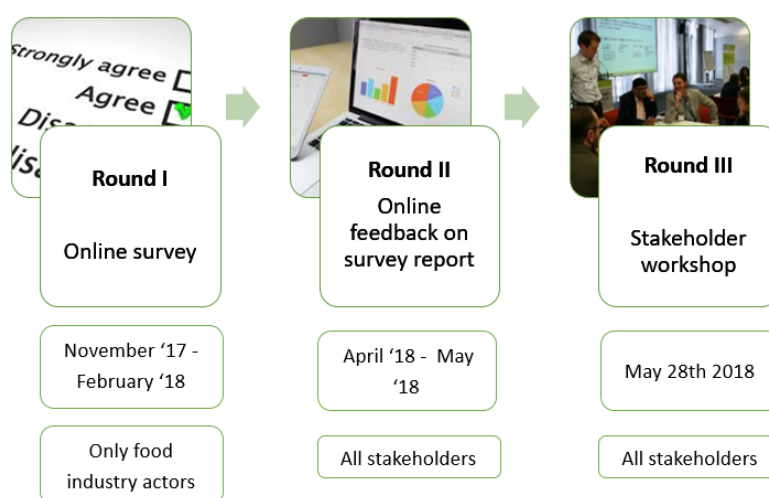


Figure 1: Overview of the three rounds of stakeholder consultation

The different topics that were probed during the three rounds are:

- The **perception** about **food integrity issues** and the current situation of their prevention and detection
- **Attitudes** towards **information sharing** to prevent and detect food integrity issues
- **Key success factors** for a food integrity information sharing system managed by a third party

The first round (November 2017 – February 2018) focused on food industry actors (n=143), while during the second (March – April 2018) (n=61) and the third round (May 2018) (n=37), the target group was broadened beyond food industry stakeholders alone.

2.2. Defining the concept of a food integrity information sharing system

One of the challenges in the study design was explaining the concept of a food integrity information sharing system to the participants without defining detailed features. An animated video, or 'explanation', was chosen as a way to introduce the concept, to reduce the complexity for the

participants. An animation video was developed which describes the main characteristics of a food integrity information sharing system:

- **Information sharing** between all actors could help the identification and the prevention of food integrity issues.
- The actors in the food chain could filter and encrypt certain types of information and **share** them with a **trusted third party**. This trusted third party would integrate, analyse, interpret and manage the received data.
- Useful information such as alerts or detected issues would be communicated **back** to all the actors in the network.
- On top of the data from private companies, external data from scientific studies, NGOs and authorities such as food safety agencies can be added.

These characteristics were visually illustrated with a scheme (Figure 2). The explanation also introduced the remaining questions regarding the concept which would be discussed in the three rounds.

- Which **types of information** can be shared and by whom?
- How to **encourage** the actors to participate? And what are the benefits for them?
- **Who** can act as trusted third party?
- What **information output** would the different actors expect to receive back?

The video can be consulted online through the following link: https://youtu.be/Akk9K6L_ECg. The script for the explanation is attached in Appendix I.

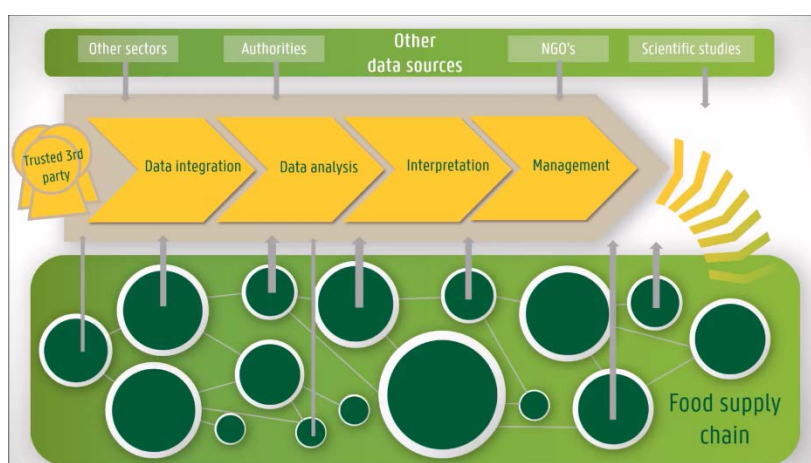


Figure 2: Overall scheme as presented in the explanation video which was used in all three rounds to introduce the concept of a food integrity information sharing system

2.3. Round I: quantitative survey

2.3.1. Survey design

Round I of the Delphi study consisted of an online survey using a questionnaire developed by Ghent University. The aim was to reach at least 120 food industry stakeholders involved in the European supply chain and probe for their attitudes, interests and reactions towards information sharing to prevent and detect food integrity issues.

The full questionnaire is provided in Appendix II of this Deliverable. An overview of the structure of the questionnaire is presented in Table 1. The questions are focused on three sub-themes:

- Industry stakeholders' perception on food integrity issues;
- Industry stakeholders' attitudes towards information sharing to prevent or detect food integrity issues;
- Industry stakeholders' attitudes towards a food integrity information sharing system (FI-ISS).

The questionnaire was web-programmed in the licenced online research platform Qualtrics. The survey was only available in English. For each set of items, participants were provided with the option to add additional items if they felt crucial items were missing.

Table 1: Structure of the questionnaire used in Round I of the stakeholder consultation

Welcome	
Screening	Screening question: Survey only for food industry actors working in the European food supply chain
Explanation	Video of 2.5 minutes explaining the concept of an information sharing in the context of food integrity issues
Food integrity issues	Definition of food integrity issues [Q4] Frequency of occurrence of issues (5-point scale) [Q5] Likelihood of detection of food integrity issues (5-point scale) [Q6] Perceived risk of food integrity issues (5-point scale) [Q7] Perceptions related to susceptible food product categories (5-point scale)
Information sharing	[Q8] Attitude towards information sharing for the prevention of food integrity issues [Q9] Perceived usefulness of information sharing for the prevention of food integrity issues [Q10] Perceived advantages of information sharing for the prevention of food integrity issues [Q11] Perceived disadvantages of information sharing for the prevention of food integrity issues Open-ended question: other advantages and other disadvantages?
Food Integrity Information Sharing System	[Q12] Conditions for take-up [Q13] Trusted third party [Q14] Actors you are willing to share information with [Q15] Types of information to be shared

	[Q16] Output of the information sharing system [Q17] Likelihood of take-up
Self-identification	[Q14] Type of company [Q15] Type of commodity [Q16] Geographical situation of company [Q17] Size of company [Q18] Responsibility in the company

2.3.2. Survey distribution

In the interest of receiving unrestrained answers from food industry stakeholders, an anonymous approach was adopted for the data collection in Round I. After completing the survey, participants were invited to subscribe in a separate form (not linked to their responses) to receive feedback and an invitation to the next rounds. As such, the survey responses were never linked to personal identifiers and not linked between two rounds.

The survey was distributed through an online link to a Qualtrics webpage. This link was shared through email, newsletters and social media. To reach a wide range of potential participants, multiple channels were contacted and several federations and organisations agreed to share the survey link within their networks:

- **Food Integrity network:** an email with an invitation to participate in the study was sent to a selection of the members of this network, by selecting in the network database the members that identified themselves as industry stakeholders
- **Food Integrity partners:** all project partners were contacted and asked to share the link to the survey
<https://secure.fera.defra.gov.uk/foodintegrity/index.cfm?sectionid=19>
- **Food2Know**, the Ghent University Centre of Excellence for feed, food and health has shared the email survey invitation with their industry partners, published the invitation on the website and shared through social media.
<http://food2know.org/en/news/food-integrity-survey>
- **Fevia**, the federation of the Belgian food industry, has published a news item on their website about the survey and in their newsletter in December.
<https://www.fevia.be/nl/nieuws/neem-deel-ugent-enquete-food-integrity-in-european-supply-chain>
- **Flanders' FOOD**, an innovation platform for the Flemish agricultural and food industry, published the invitation on their website and emailed the invitation to their members that have previously showed an interest in food integrity issues.
<http://www.flandersfood.com/nieuws/2017/11/20/de-integriteit-van-de-europese-food-supply-chain-verzekeren-welke-rol-kan-het-dele>
- **ANIA**, the national federation of the French food industry, has published the survey invitation on their website and has shared it through their newsletter and social media.
<https://www.ania.net/alimentation-sante/questionnaire-food-integrity>
- **FNLI**, the national federation of the Dutch food industry, has shared the survey in their newsletter.

- **Food Quality News**, an online news source, has published an article on their website, featured in their newsletter and shared the survey through social media.

<https://www.foodqualitynews.com/Article/2018/01/05/Study-seeks-perspectives-on-food-integrity-issues>

During the period of data collection, several reminders were sent out through these channels. Although 286 participants started the survey, a total of 111 food industry stakeholders completed the survey until the end, completing all questions. The evolution of dropouts is discussed in the results section. Table 2 gives an overview of the stakeholders that participated and their company sizes, including all stakeholders that have completed the most important parts of the survey (n=143).

Table 2: Distribution of participating stakeholders in the first round

Type of stakeholder	n	%
Food industry	143	
Large (>250 employees)	60	42.0
Medium-sized (<250 employees)	22	15.4
Small (<50 employees)	21	14.7
Micro (<10 employees)	8	5.6
Not known	32	22.4

2.3.3. Data analysis

Statistical analyses were carried out with SPSS Statistics 23.0 (IBM SPSS, Armonk, NY, USA). Cronbach's alpha coefficients were computed to measure the internal consistency of the scales. Data processing and analysis included descriptive analysis (frequency distributions) and bivariate analysis (e.g. correlations, chi-square test, t-test, ANOVA, etc.).

2.4. Round II: feedback survey

2.4.1. Survey design

Round II aimed at getting more clarification on a number of findings from Round I, from food industry actors as well as other stakeholders (food safety authorities, academic experts, consumer organisations, consultants, ...). The goal was to further characterise key success factors for a food integrity information sharing system.

The results of the first round were reported in an internal report and an expert group of TNO Netherlands and Ghent University selected topics to be discussed further in Round II. The rationale for the selection of the topics are described in detail in the results section of Round I. A combination of closed-ended and open-ended questions was used allowing to collect both quantitative data and qualitative insight.

The elements covered in the questionnaire of Round II are listed in Table 3 and the full questionnaire can be found in Appendix III.

Table 3: Structure of the questionnaire used in Round I of the stakeholder consultation

Welcome	Objectives of the study Structure of the study: Round I, Round II, Round III Link to Project Food Integrity
Participation first round	Participation in the first round by participant second round (Yes/No) (Note: This question was not used as a screening question)
Explanation	Optional: If interested to watch explanation, optional to watch it.
Self-identification	[Q3] Type of stakeholder (10 options + open field to specify) [Q4] Geographical situation of company/ organisation
Food integrity issues	Overview of the results of Round I: bubble chart on frequency of occurrence and likelihood of detection of food integrity issues and definition of a red, green and orange group [Q5] Identification with a group (question only for food industry actors) [Q6] Perception on estimation of industry stakeholders regarding occurrence of food integrity issues (Underestimate/ Realistically estimate/ Overestimate) + OPEN [Q7] Perception on estimation of industry stakeholders regarding likelihood of detection of food integrity issues (Underestimate/ Realistically estimate/ Overestimate) + OPEN [Q8] Perception on blanc spot in the bubble chart (Yes/No /OPEN)
Potential of a FI-ISS	Overview of the results of Round I, agreement with the statements on potential of a food integrity information sharing system. [Q9] Perceived potential of an FI-ISS to detect food integrity issues (5-point Likert scale + OPEN) [Q10] Perceived potential of an FI-ISS to prevent food integrity issues (5-point Likert scale + OPEN)

Trusted third party	Overview of the results of Round I regarding the suitability of possible trusted third parties. [Q11] Perceived suitability of a new organisation as a trusted third party (5-point Likert scale) [Q12] Open question on type of new organisation as a trusted third party [Q13] Open question on criteria to be fulfilled by a new organisation as a trusted third party [Q14] Perceived suitability of a food safety authority as a trusted third party (5-point Likert scale) + OPEN [Q15] Which Food safety authority (National/ International / Both) [Q16] Role for consumer organisations and retail (OPEN)
Types of data to be shared	Overview of the results of Round I regarding the types of data industry actors are willing to share. [Q17] Opinion on reluctance to share data on volumes and transactions (OPEN) [Q18] Conditions for increasing willingness to share data on volumes and transactions (7 selectable options)
First steps to develop a FI-ISS	[Q19] Opinion on who should take the initiative for FI-ISS (OPEN) [Q20] Opinion on pilot case for a FI-ISS (OPEN) [Q21] Willingness to join a FI-ISS according to innovation adoption cycle (5 options)

2.4.2. Survey distribution

The distribution of the survey of Round II was organised in two ways:

- List of interested stakeholders build up during the distribution of Round I: received an invitation by email to participate in Round II
- Different channels were contacted and several federations and organisations agreed to share the survey link with their network

A total of 61 stakeholders participated in the online survey. Table 4 shows the distribution of participating stakeholders over stakeholder types.

Table 4: Distribution of participating stakeholders in the second round

Type of stakeholder	n	%
Total number of participants	61	
Food industry	30	49.2
Research	10	16.4
Service to the food industry	9	14.8
Food safety authority	5	8.2
Law enforcement	3	4.9
Consumer organisation	2	3.3
Other (e.g. consultants)	2	3.3

2.4.3. Data analysis

Statistical analyses were carried out with SPSS Statistics 23.0 (IBM SPSS, Armonk, NY, USA) and qualitative responses to open-ended questions were imported in QSR International's NVivo 11 qualitative data analysis Software. Cronbach's alpha coefficients were computed to measure the internal consistency of the scales. Quantitative data processing and analysis included descriptive analysis (frequency distributions) and bivariate analysis (e.g. correlations, chi-square test, t-test, ANOVA, etc.). Qualitative data from open-ended questions were coded into categories.

2.5. Round III: interactive stakeholder workshop

The last round of data collection consisted of an interactive workshop where stakeholders and experts in the food supply chain could discuss the results from Round I and Round II in more detail. The workshop was organised as a satellite event of the ASSET Summit on Global Food Integrity in Belfast, on May 28th at Queen's University in Belfast.

The interactive workshop aimed to inform stakeholders on the concept, the results of Round I and Round II and preliminary conclusions. During four parallel working group sessions, more debate was made possible between stakeholders.

The workshop was open to all interested stakeholders. Although, a total of 64 interested stakeholders registered for the workshop, a final number of 37 stakeholders participated at the workshop. The majority of stakeholders present were active in the field of research, as is presented in Table 5.

Table 5: Types of stakeholders participating in the Round III workshop

Type of stakeholder	n= 37	Percent (%)
Research	19	51.3
Industry	4	10.8
Food safety authority	8	21.6
Government	2	5.4
Other (e.g. consultants)	4	10.8

2.5.1. Workshop program

The invitation to the interactive workshop can be found in Appendix V. The earlier findings of Work Package 17 were presented by the partners. The presentation slides used can be found in Appendix VI. The workshop schedule consisted of three parts:

Part 1 - Introduction: two short presentations presenting the results of WP17

Key functions of a future information system to pro-actively support food integrity (TNO)

Early indicators for food non-integrity and the challenges to collect and analyse the data

Results of a large stakeholder consultation (Ghent University)

Insights on attitudes towards information sharing, advantages and disadvantages, conditions, suitable third party, data sharing and transparency.

Part 2 - Break-out sessions

Four groups were moderated by four moderators from TNO and Ghent University, all involved in WP17. All moderators received the discussion guide for the break-out sessions in advance and guided the discussion by using the topic grid (Appendix IV).

Each break-out group selected a reporter, who took notes during the discussion.

Part 3 - Reporting back and conclusions

Each group gave a plenary feedback talk on the main points of consensus and points of discussion in their break-out session.

2.5.2. Break-out sessions

Four break-out sessions were held with random selection of participants. During a total of 45 minutes, the groups discussed the potential of a FI-ISS. Each group was moderated by an expert of the partners of WP17. All moderators were acquainted with the results from Round I and Round II and had a discussion guide (Appendix IV) at their disposal which could be used to steer the discussion.

Each working group assigned a voluntary reporter, who took notes and a person to shortly present the conclusions of their break-out session in plenary afterwards. The discussion guide (Appendix IV) was developed based on the results of Round I and Round II and is further discussed in the results section.

2.5.3. Data analysis

During the interactive workshop, following data were gathered:

- Notes from four break-out sessions, by moderator and/or reporter; summarised in the discussion grid for the four groups (G1, G2, G3, G4)
- Transcript of reporting back speeches from each of the four groups

3. Results

3.1. Round I

3.1.1. Stakeholder participation and dropout during the survey

Data were collected between October 31st 2017 and February 5th 2018. Table 6 presents an overview of the participation rates and participant dropout during the course of the questionnaire, with hypotheses for the reason for dropout. Keeping the stakeholders motivated to complete the survey from start until finish has proven to be a challenge.

Table 6: Description of participant dropout along survey length during Round I

Part of questionnaire finished	Finished (n)	Drop-outs (n)	Possible reason why participants stopped the survey
Do not belong to target group		62	Screened-out because they are not industry stakeholders
Belong to target group	286		
		97	Not able to watch video due to time or other (e.g. ICT) restrictions; While watching the video, participants might have realised the topic of the survey is not in their interest, too complex, or outside their expertise domain
After video	189		
		46	Questions about frequency and likelihood of detection of food fraud issues could be too intrusive, or not relevant for the participant Participant could feel unable to provide answers to the questions asked
Frequency of occurrence	143		
		20	Participants might have found the questions about different food products too long or too difficult to respond
Perceived risk	123		
		4	Participants might have found the survey too long
Attitude and (dis)advantages	119		
		6	Participants might have found the survey too long
Conditions for take-up	113		
		2	Participants might have found the survey too long
Likelihood of take-up until end	111		

Looking at dropout levels for the different questions, we conclude that a lot of valuable data would be lost when only using the data of those participants that have finished the questionnaire from start until finish (Table 6). In this report, all descriptive results are presented for each question using all valid answers, i.e. all input for those participants that have answered that specific question.

One of the explanations for part of the dropouts could be that some questions were too sensitive, intrusive or too difficult for participants to answer. During the survey, the questionnaire used ‘forced response’ on each question page, which means participants were not able to continue without answering each question. In case of unwillingness or inability to answer a question, the only option was to drop-out. For future research about a complex topic with stakeholders we recommend to disable forced responses. Consequently, in the following Round II all questions were programmed without forced responses. Alternatively, participants could receive the option ‘I do not know’ with every question.

3.1.2. Description of the sample of Round I

While 348 people started the survey, only 286 were entitled to continue after screening on being a food industry stakeholder. Finally, a total of 111 food industry stakeholders completed the survey until the end and completed all questions about their profile, which were at the end of the survey. The study has reached stakeholders from companies active at different levels in the food supply chain. Figure 3 shows the different levels of the food supply chain where companies of participating stakeholders are situated. Participants could select multiple answers. The majority of these companies are active on the food processing level.

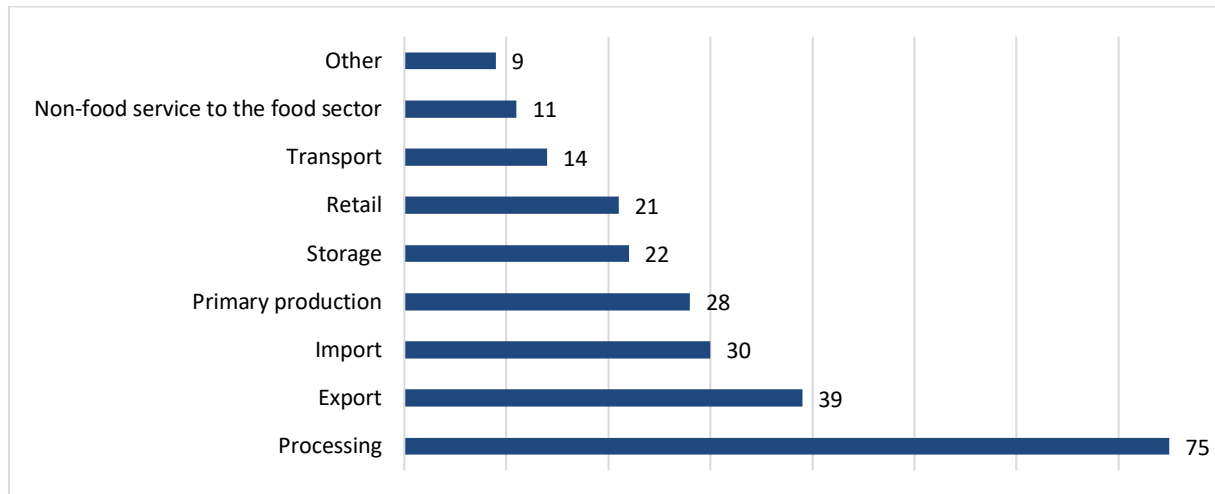


Figure 3: Participants companies’ activities in the food industry (n=111, n)

Participants choosing ‘other’ had the option to mention their specific activities. Other activities mentioned by participants were:

‘analytical lab’, ‘association’, ‘consultancy’, ‘CRO’, ‘inspection organisation’, ‘packaging’, ‘supply chain management software tool’

Furthermore, participants were asked which **responsibilities** they have within their company. The majority of participants in the study are quality managers (Figure 4). Nevertheless, the study reached a wide range of stakeholders from different levels of decision making within companies.

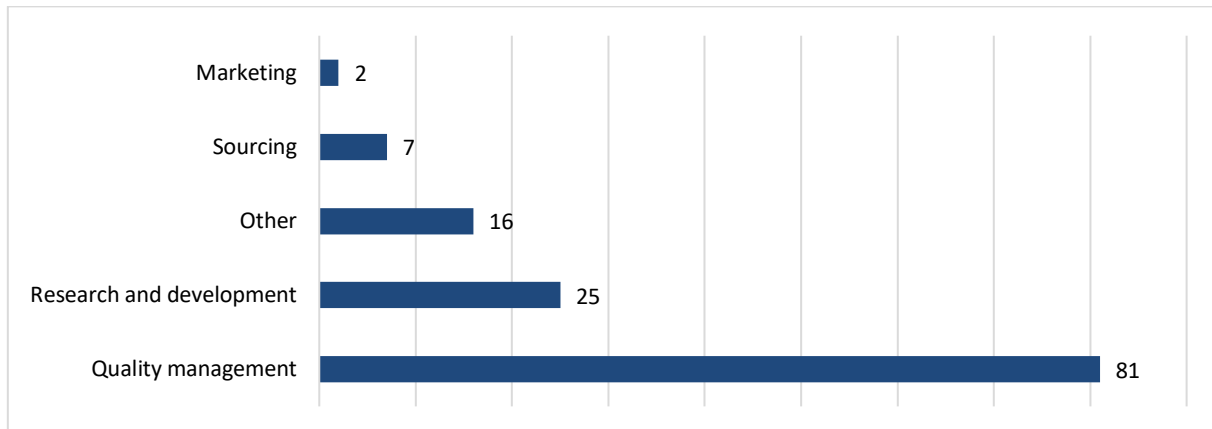


Figure 4: Participants' self-identification of different responsibilities within companies (n=111, n)

Other responsibilities mentioned by participants were:

'food safety', 'general management', 'in transport', 'industry association – director food policy', 'management', 'managing director', 'purchase', 'quality coordination', 'science', 'C-level', 'sales assistant', 'regulatory'

Participants were also asked which **food commodities** they are actively working with. The options consisted of the 10 most vulnerable food commodities to food integrity issues (European Parliament, 2014) and the option to fill in other commodities. The results shown in Figure 5 show that this study reached participants that work with a wide range of these vulnerable commodities. Moreover, all of 111 participants that have completed the survey from start to finish have selected at least one of the vulnerable commodities. This could be due to the fact that the topic food integrity issues appeals more to those working in vulnerable sectors which increased their interest and motivation to participate in the study. When interpreting these results it is important to take the background of participants into account.

Other commodities mentioned were:

'meat' (n=8), 'chocolate' (n=6), 'fruits and vegetables' (n=2), 'sugar' (n=2), 'vitamins', 'alcoholic beverages', 'consultancy in all sectors', 'FMCG', 'software tools', 'vegetable beverage', 'wheat flour'

*: FMCG= fast moving consumer goods

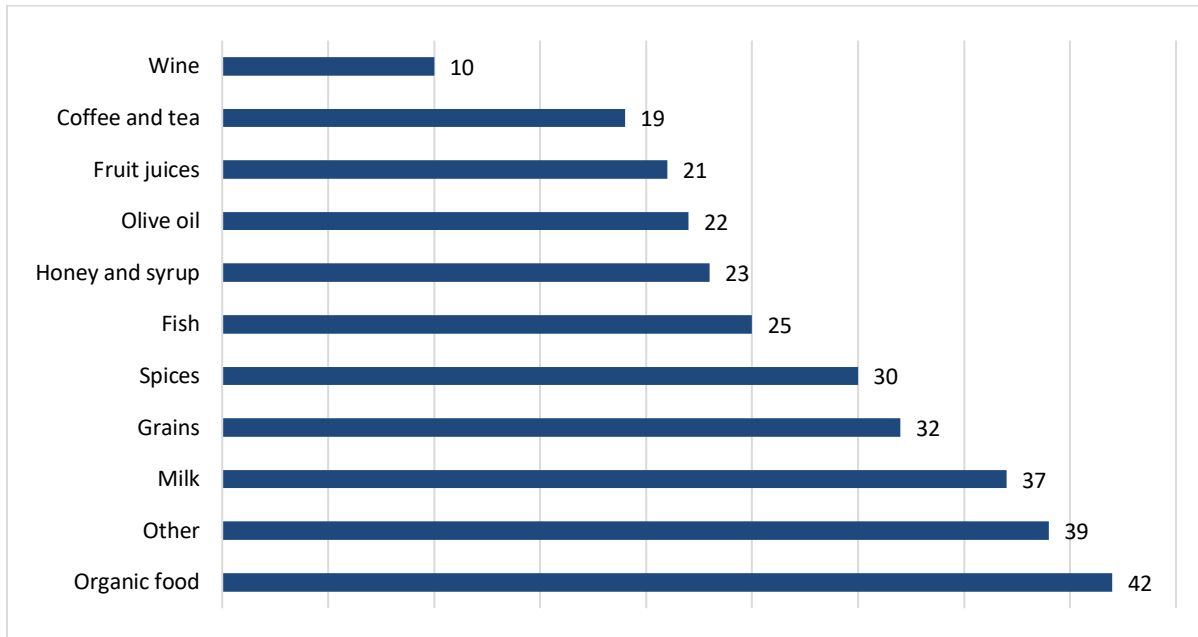


Figure 5: Number of participants working with certain food commodities (n=111, n)

The food supply chain is increasingly globalised which is reflected in the **geographical scope of the companies for which the participants work**. Figure 6 shows that about three thirds of the participants' businesses are active on a global level. During following analysis in this report the stakeholders' companies will be categorised as 'global' (n=74) or 'within EU' (n=37).

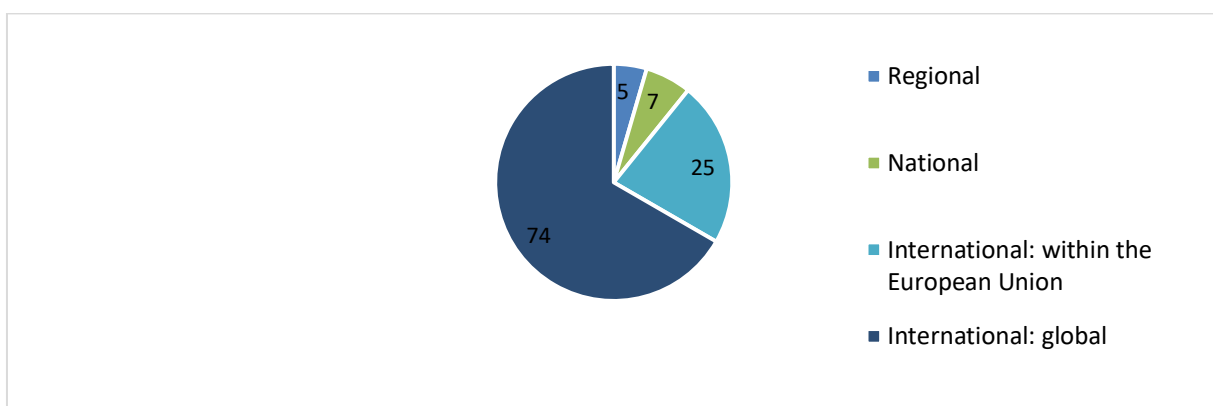


Figure 6: Geographical scope companies which stakeholders are active in (n=111, n)

Categorisation of companies based on their **company size** was done according to the definition of [EU recommendation 2003/361](#), asking participants to choose a category based on the amount of employees. Figure 7 illustrates that over half of participants are from large businesses. What follows in this report will categorise stakeholders according to the company size as 'large' (n=60) or 'SME'(n=51).

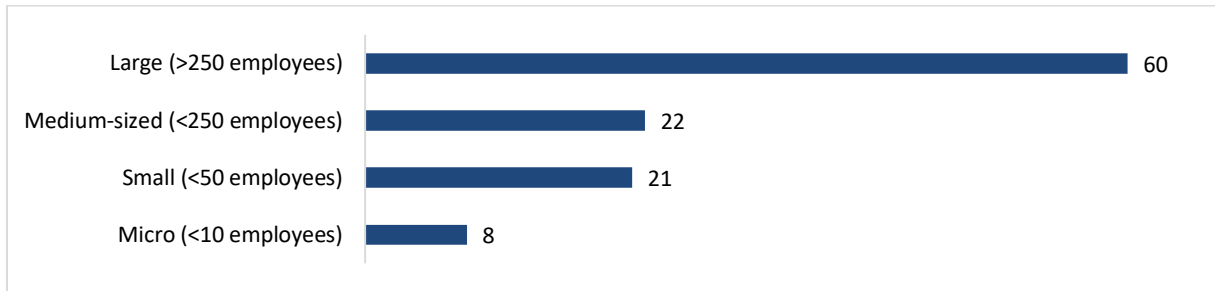


Figure 7: Company size (n=111, n)

3.1.3. Stakeholders' perception on the occurrence of food integrity issues

A total of 143 industry stakeholders completed the questions about the occurrence of food integrity issues and the likelihood of detection of issues within their own organisation. Figure 8 shows how participants estimate the frequency with which their companies have been confronted with food integrity issues over the past five years, ranging from very frequently to never.

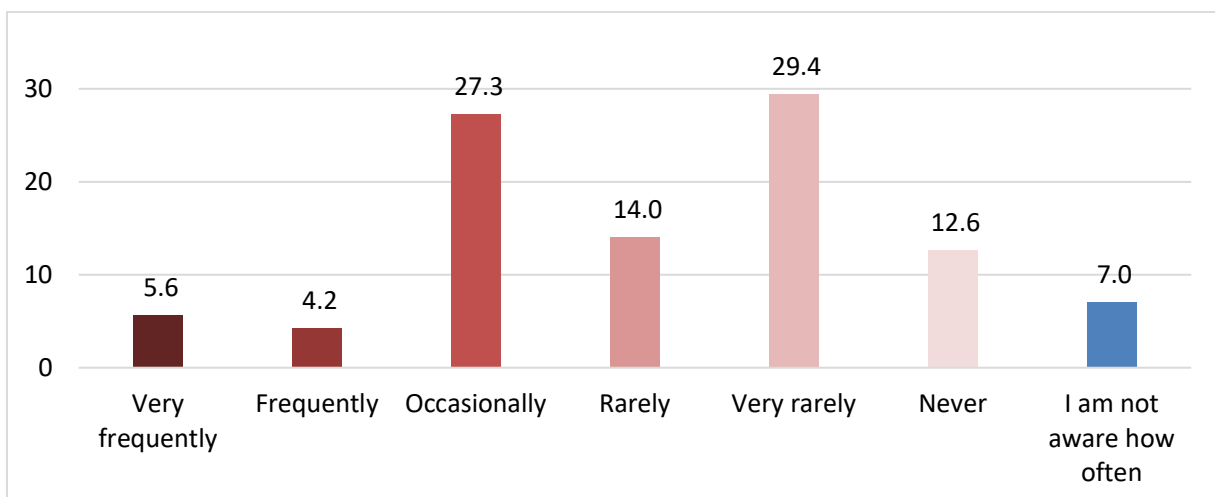


Figure 8: Stakeholders' estimation of the occurrence of food integrity issues at their company or organisation (n=143, %)

Figure 9 shows how the stakeholders estimate the likelihood that such food integrity issues could be detected at their company, ranging from almost certain to almost non-existing.

The participants were categorised into clusters by combining these two variables. Figure 10 shows the frequency distribution of occurrence and likelihood of detection on the x- and y-axis, respectively, and the diameter of the circles represents the number of participants with that specific combination of answers. Both variables contained an extra option for participants who were not aware of the frequency or likelihood. For example, an almost equal number of participants reported an occasional frequency of occurrence combined with the expected detection of the issue being classified as likely (n= 16) or possibly (n=17).

In the bubble chart, participants not aware of the frequency of occurrence of food integrity issues within their company (n=10) were not included.

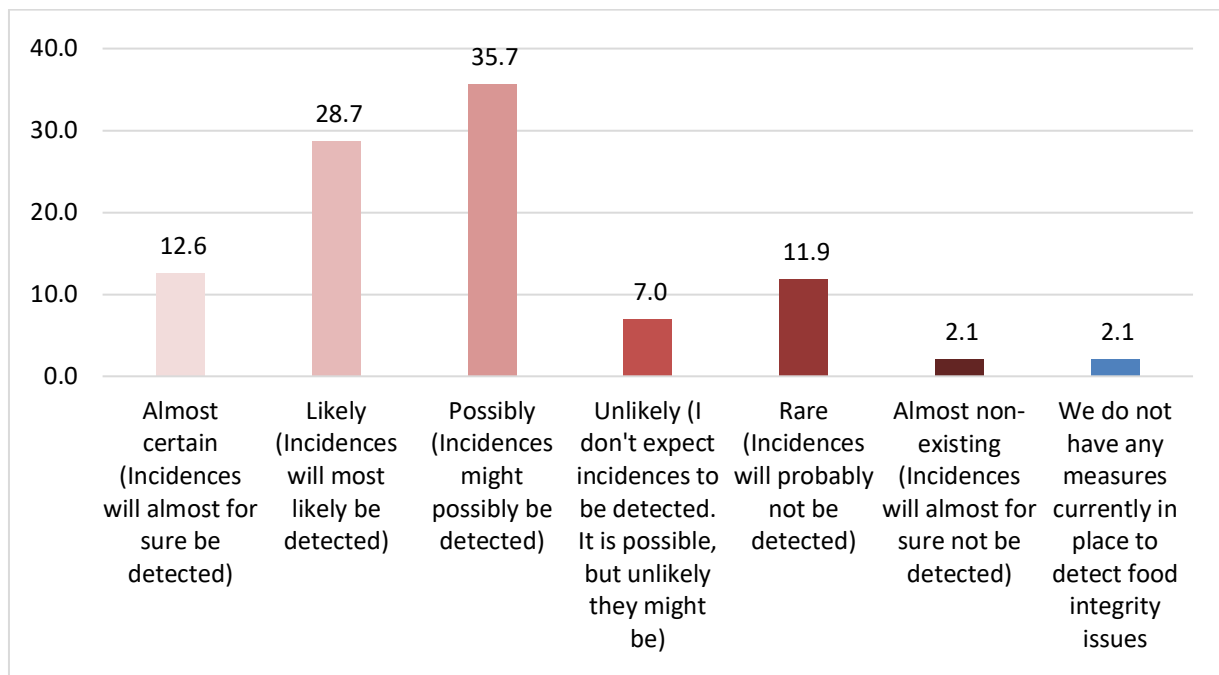


Figure 9: Stakeholders' estimation of the likelihood of detecting food integrity issues at their company or organisation (n=143, %)

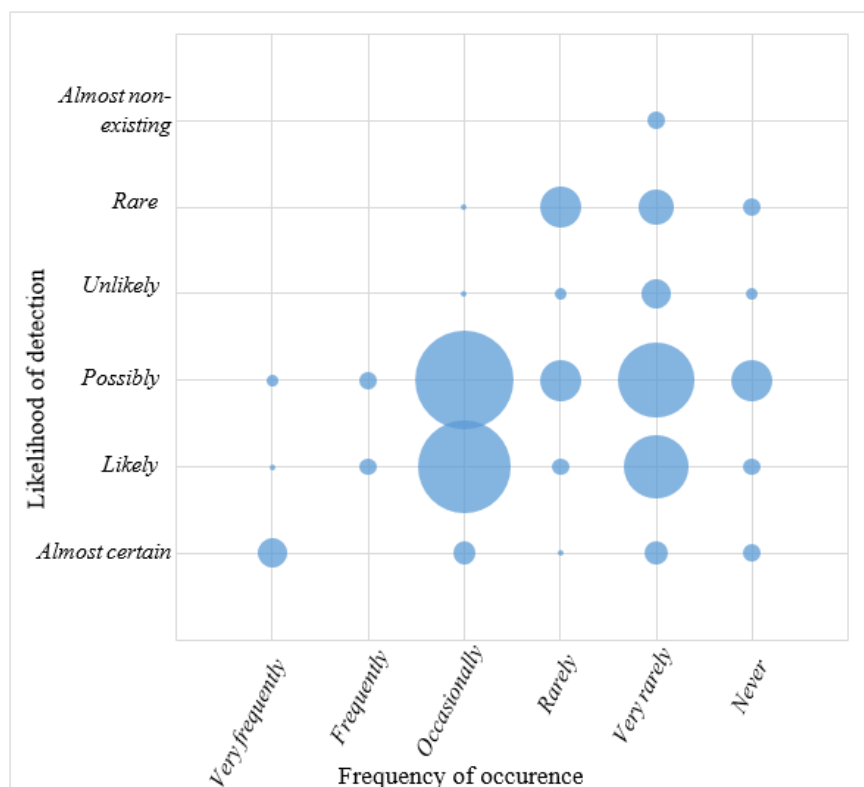


Figure 10: Bubble chart illustrating stakeholders' estimation of the occurrence of food integrity issues and of the likelihood of detecting issues (n=133, diameter bubble=n)

Figure 10 allows us to identify three different clusters of companies, as shown in Figure 11.

- **Cluster 1** (n=51, 38%): **high** frequency of occurrence food integrity issues and **high** likelihood of detection, is depicted in orange.
- **Cluster 2** (n=52, 39%): **low** frequency of occurrence food integrity issues and **high** likelihood of detection, is depicted in green.
- **Cluster 3** (n=30, 23%): **low** frequency of occurrence food integrity issues but **unlikely** to detect food integrity issues, is depicted in red

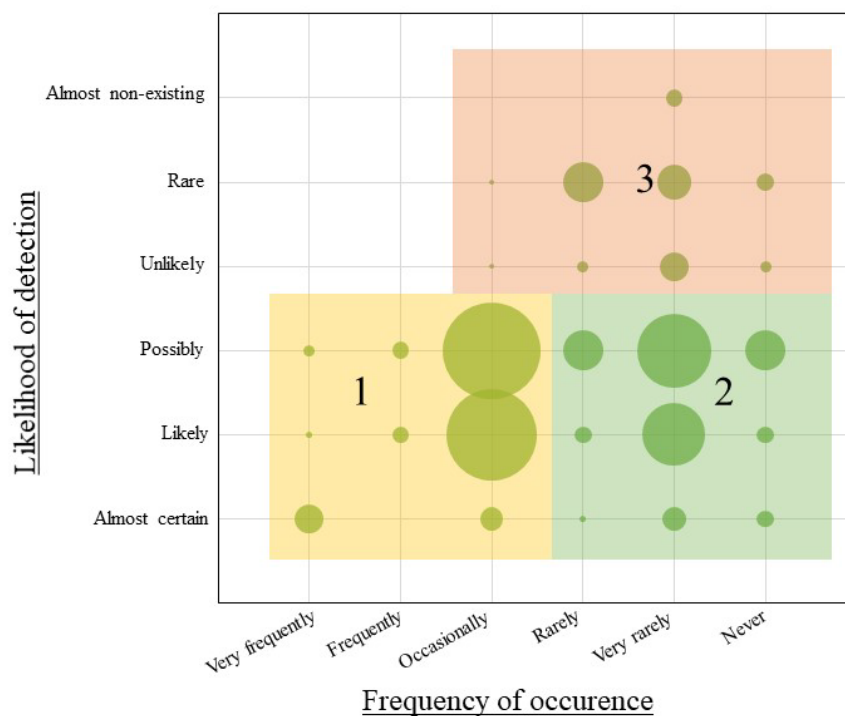


Figure 11: Bubble chart illustrating three cluster groups (n=133)

Table 7 shows that cluster 2 (green) is a balanced mix of stakeholders from different company sizes. Cluster 3 (red) is overrepresented by stakeholders from medium sized companies while cluster 1 (orange) is underrepresented by these. The results indicate that medium sized companies perceive the difficulties they face regarding the detection of food integrity issues worse than smaller or larger companies. Smaller companies might have better control over issues because of the smaller scale of the company. Larger companies on the other hand, might feel more in control because of the measures they have already taken to detect food integrity issues.

Table 7: Distribution of industry actors' from different companies sizes between three clusters

	Total	Cluster			Pearson Chi-square	p-value
		1	2	3		
Size company		(n=51)	(n=52)	(n=30)	17.58	0.001*
Micro & Small	26.10%	33.3%	28.6%	8.7%		
Medium	19.80%	5.1%	19.0%	47.8%		
Large	54.10%	61.5%	52.4%	43.5%		

* significant difference at the 0.05 level

Actors in the food supply chain join efforts to increase the prevention and the detection of food integrity issues. Ideally, this would lead to a situation where food integrity issues occur very rarely or never and should almost certainly be detected. This situation is the lower right corner of the bubble graph and the results show only a small share of stakeholders consider their business to have reached that situation. Improving prevention and detection of issues to reach the targeted protection is not a challenge companies can take up alone but results from joint efforts. Information sharing can be a solution for both prevention and detection.

The results of this section were withheld to be further discussed in Round II. The stakeholders in Round II were asked to give their opinion on the bubble graph and the estimation that industry actors make of the frequency of occurrence and the likelihood of detection of food integrity issues. This will give more insights from a broader range of stakeholders, including food safety authorities and academic experts.

3.1.4. Stakeholders' perception on the risk of food integrity issues

Participants were asked to which extent they agreed with following 3 items on a 5-point Likert scale ranging from 'Strongly disagree' to 'Strongly agree' (neutral = 3.50). The mean scores presented in Table 8 shows that overall, the risk is not perceived high by food industry actors but are close to the 'neutral point' (3.50).

Table 8: Mean scores for items on perceived risk of food integrity issues (n= 123)

	Mean	S.D.
My company is very concerned about becoming a victim of food fraud	3.50	1.190
Food integrity issues are a growing problem in our sector	3.70	1.108
Food integrity issues are one of the main risks our company faces	3.11	1.139

A good internal consistency (Cronbach’s alpha= 0.67) between the three items lead to the aggregation into one variable for perceived risk ($\mu=3.42$, S.D.=0.96). The way participants perceive the risk of food integrity issues is significantly different between the three different clusters. Member of cluster 1 (high frequency, high likelihood) perceive the risk of food integrity issues higher than the other clusters (Table 9).

Table 9: Different clusters’ mean perceived risk (n=115)

Perceived risk	
	Mean (S.D.)
Cluster 1	3.70 (0.90)
Cluster 2	3.26 (0.87)
Cluster 3	3.31 (0.81)
<i>p=0.021 (Kruskal-Wallis test)</i>	

3.1.5. Food categories at risk for food integrity issues

Not all food categories are as susceptible to food fraud as others. Participants answered a question regarding different food categories and one regarding different food commodities. Their answers provide insights into food industry actors’ perception on which foods are more vulnerable than others and are presented in Figure 12.

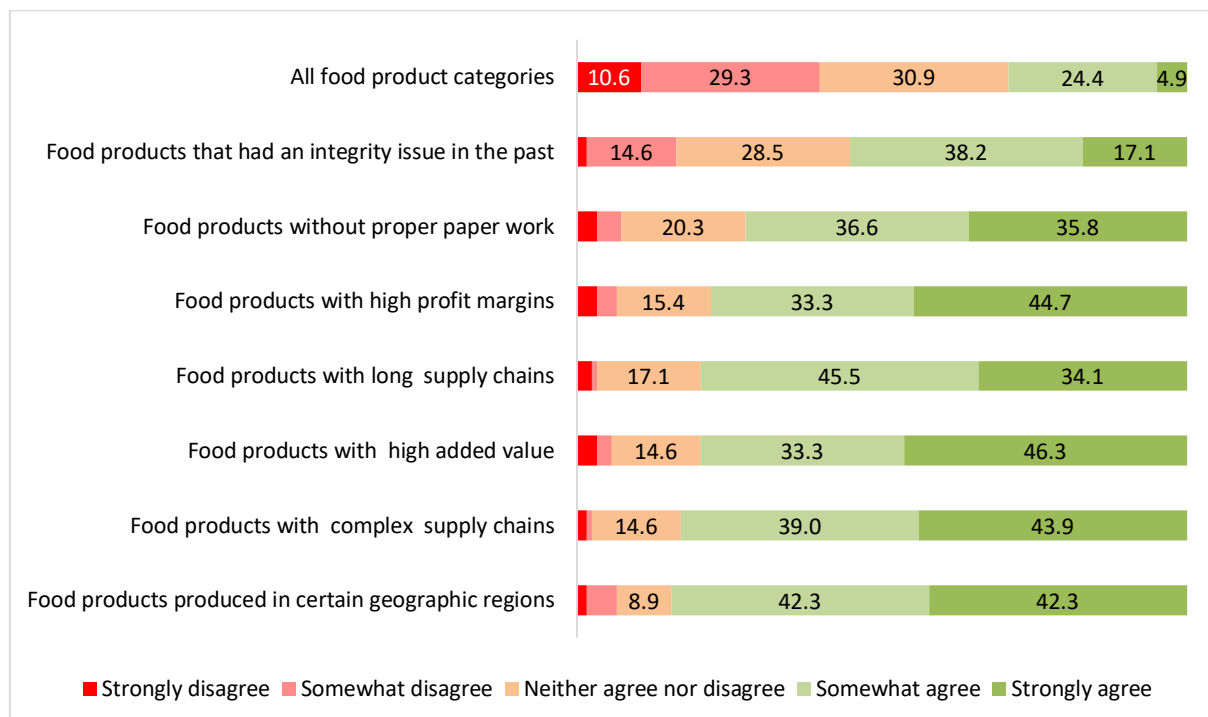


Figure 12: Participants perception of the susceptibility of different food categories for food integrity issues - part 1 (n=123, %)

The highest level of agreement (84.6 % agree) was reached for ‘food products produced in certain geographic regions’. A high level of agreement (over 70% agree) was reached for the items related to the economic incentive for committing fraud such as ‘food products with high added value’ and ‘food products with high profit margins’ and for the items related to the complexity of the food supply chain.

More interestingly are the two items where there is no consensus between industry stakeholders. Considering ‘food products that had an integrity issue in the past’, only 55% agree. More participants disagree (39.8%) with the statement that ‘all food product categories’ are susceptible to food fraud than those agreeing. This raises the question if information sharing would be useful for all food product categories and could be further looked into when discussing on which level a food integrity information sharing system could be organised.

Secondly, participants were also asked to assess how susceptible a list of food commodities were. As discussed before, the items consisted of a list of most vulnerable food commodities regarding food integrity issues. The levels of agreement illustrated in Figure 13 show that highest levels of agreement (over 80% agree) were reached for olive oil, herbs and spices, meat and meat products and honey.

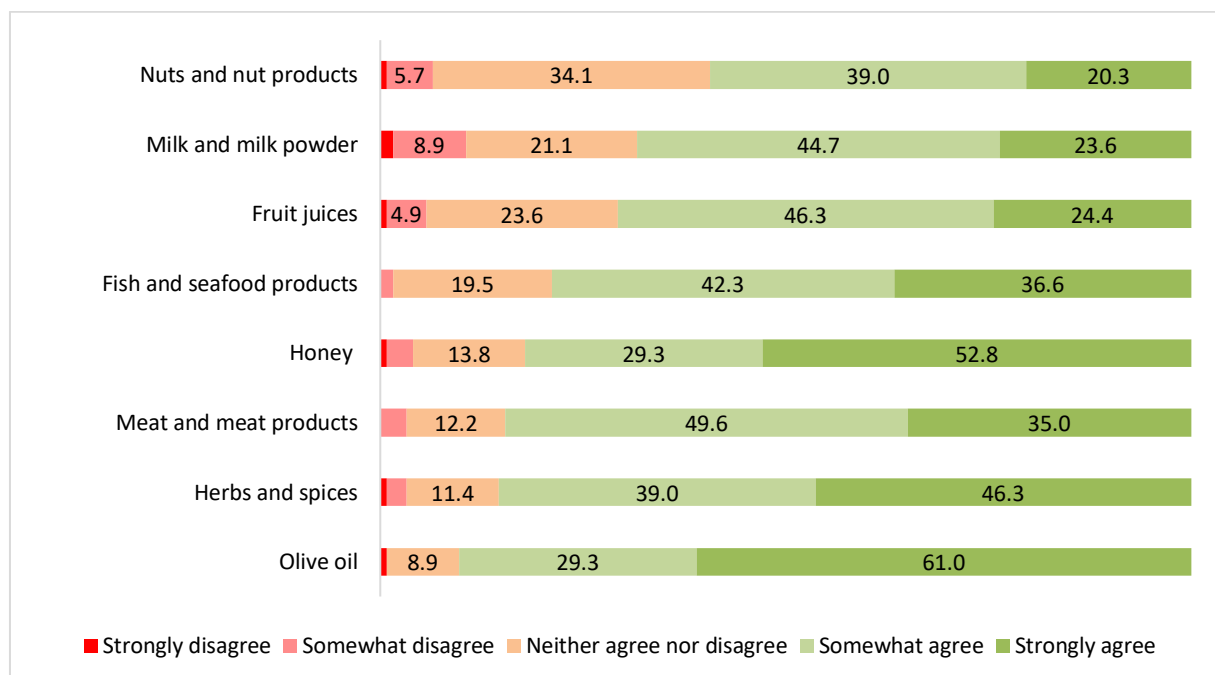


Figure 13: Participants perception of the sensitivity of different food categories for food integrity issues – part 2 (n=123, %)

3.1.6. Industry stakeholders' attitudes and perception of the usefulness towards information sharing

In competitive environments, information sharing could have advantages and disadvantages, depending on the aim and context. In order to assess industry stakeholders' attitude towards information sharing with the aim to tackle food integrity issues, we used 3 items on a 5-point bipolar Likert scale: Negative -Positive; Uninteresting - Interesting; Unimportant – Important.

Cronbach's alpha for the three items was **0.85**, indicating very good internal consistency reliability. The three item scores were aggregated and averaged to obtain an overall attitude score. The mean attitude score was **4.49 (n= 119, S.D.= 0.57)** which indicates that in general, participants have a very positive attitude towards information sharing.

To measure participants' perception of the usefulness of information sharing they were asked to rate following 3 items on a 5-point bipolar Likert scale: Useless – Useful; Irrelevant- Relevant; Unnecessary – Necessary.

Cronbach's alpha for the two items was **0.81**, indicating very good internal consistency reliability. The three item scores were aggregated and averaged to obtain an overall attitude score. The mean attitude score was **4.52 (n=119, S.D.= 0.54)** which indicates that in general, participants perceive information sharing as very useful to prevent food integrity issues.

3.1.7. Advantages of information sharing to prevent food integrity issues

Information sharing could generate different advantages for the actors in the food sector and for the sector as a whole. Participants were asked to probe different statements regarding information sharing and its advantages. Figure 14 shows there is strong consensus among stakeholders about most of the presented advantages, with less than 5% of participants disagreeing. However, disagreement is higher (over 10%) for 'reduces the loss of image of the sector', 'reduces the impact of food integrity issues' and 'lowers incentives to commit fraud'.

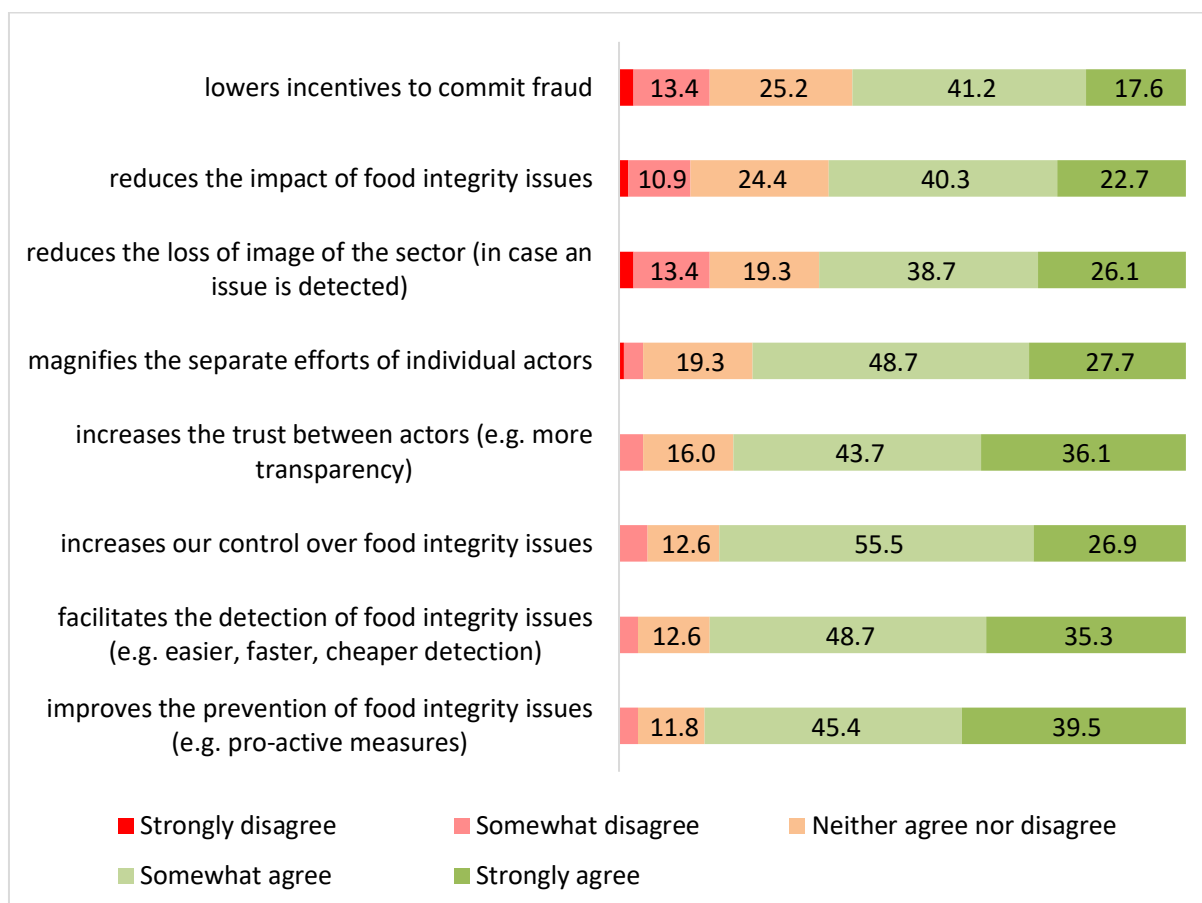


Figure 14: Perceived advantages of information sharing according

In addition, participants were asked if they could think of more advantages that were not mentioned in the statements. Following statements were submitted:

- *'Accountability of people committing unlawful acts'*
- *'Greater protection of public health'*
- *'Helpful to FBOs who do not have significant resource invested in supply chain management'*
- *'Improved customer relations'*
- *'Information can also be used to simplify certification regulations'*
- *'Prevention of reputation loss'*
- *'Saves time and helps to establish its own database on the risk of frauds regarding different raw materials'*
- *'Value for every actor both up and down stream'*

3.1.8. Disadvantages of information sharing to prevent food integrity issues

Sharing information within a food supply chain could also imply disadvantages. The feasibility of a food integrity information sharing system will highly depend on the way it can avoid or tackle these disadvantages. Mapping the possible pitfalls or doubts of stakeholders enables us to better define the requirements of a food integrity information sharing system. Six statements were used regarding

disadvantages of information sharing and participants were asked to rate them on a 5-point Likert scale.

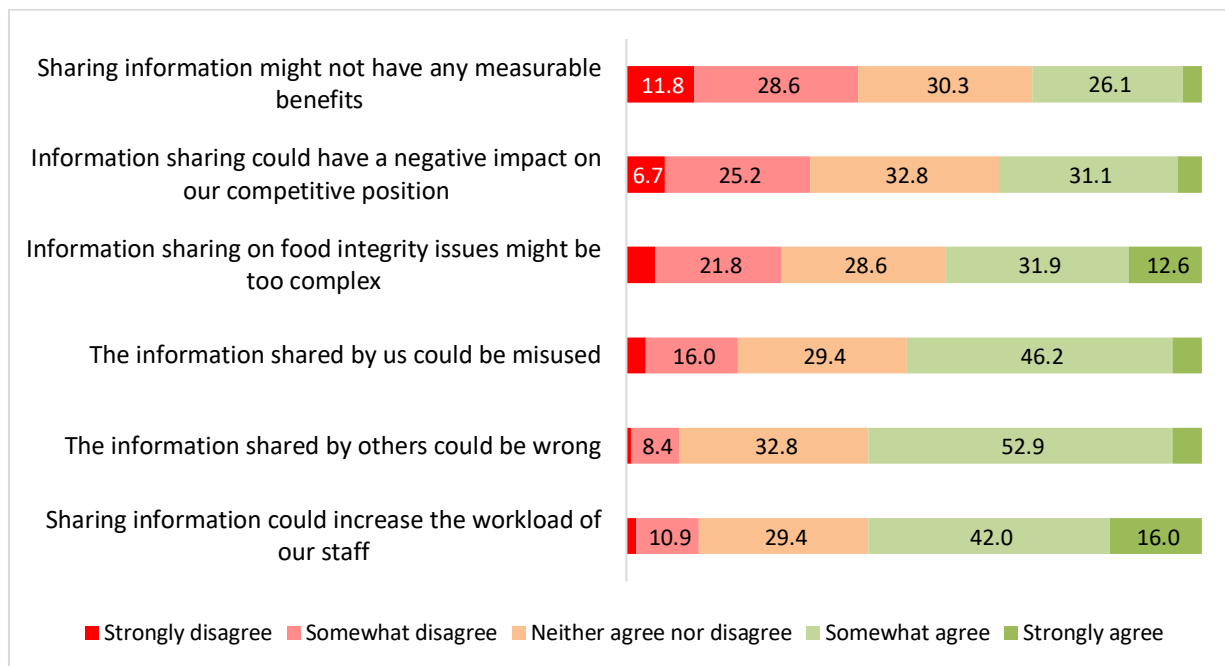


Figure 15: Disadvantages of information sharing (n=119, %)

Compared to the advantages, there is less consensus about disadvantages of information sharing, as shown in Figure 15. One of the main disadvantages is that information sharing might increase the workload of staff, with 58.0 % of participants confirming they consider it a disadvantage. During the development of a FI-ISS this aspect should definitely be taken into account, and communicated well to all actors.

In terms of the data that would be shared between actors, two statements were used. With regards to data that other actors share, 58.0% of stakeholders shared the worry that this information could be wrong and saw that as a disadvantage. Moreover, when considering sharing their own data with other actors, 51.9 % agreed that the risk that others would misuse their data is a disadvantage.

The statement ‘information sharing could have a negative impact on our competitive position’ can be considered as controversial. While 31.9% disagreed, another 35.3 % agreed that this is a disadvantage and 32.8% remained indecisive. Only 29.4% have of participants agree that sharing information might not have any measurable benefits.

Next, participants were asked if they could think of more disadvantages that were not mentioned in the list:

- *‘A lot of notifications to manage’*

- *'Will add an additional layer of administration that will make entry into the market difficult especially for SME'*
- *'More work = more room for errors'*
- *'Fear of change'*
- *'Fear of denunciation or unverified attack'*
- *'Gives ideas to innocent suppliers'*
- *'Information must be reliable, otherwise innocent players might be wrongly accused'*
- *'It requires leadership and global cooperation'*
- *'Probably a waste of time for those companies who audit, validate and verify each ingredient'*
- *'Low reliability of information from particular countries and food categories'*
- *'The non-integrity of the third party in charge of treat the information'*

3.1.9. Conditions for take-up of a food integrity information sharing system

To identify under which conditions actors in the food industry would accept an information sharing system, participants were asked to rate 16 statements on a 5-point Likert scale, as presented in Figure 16.

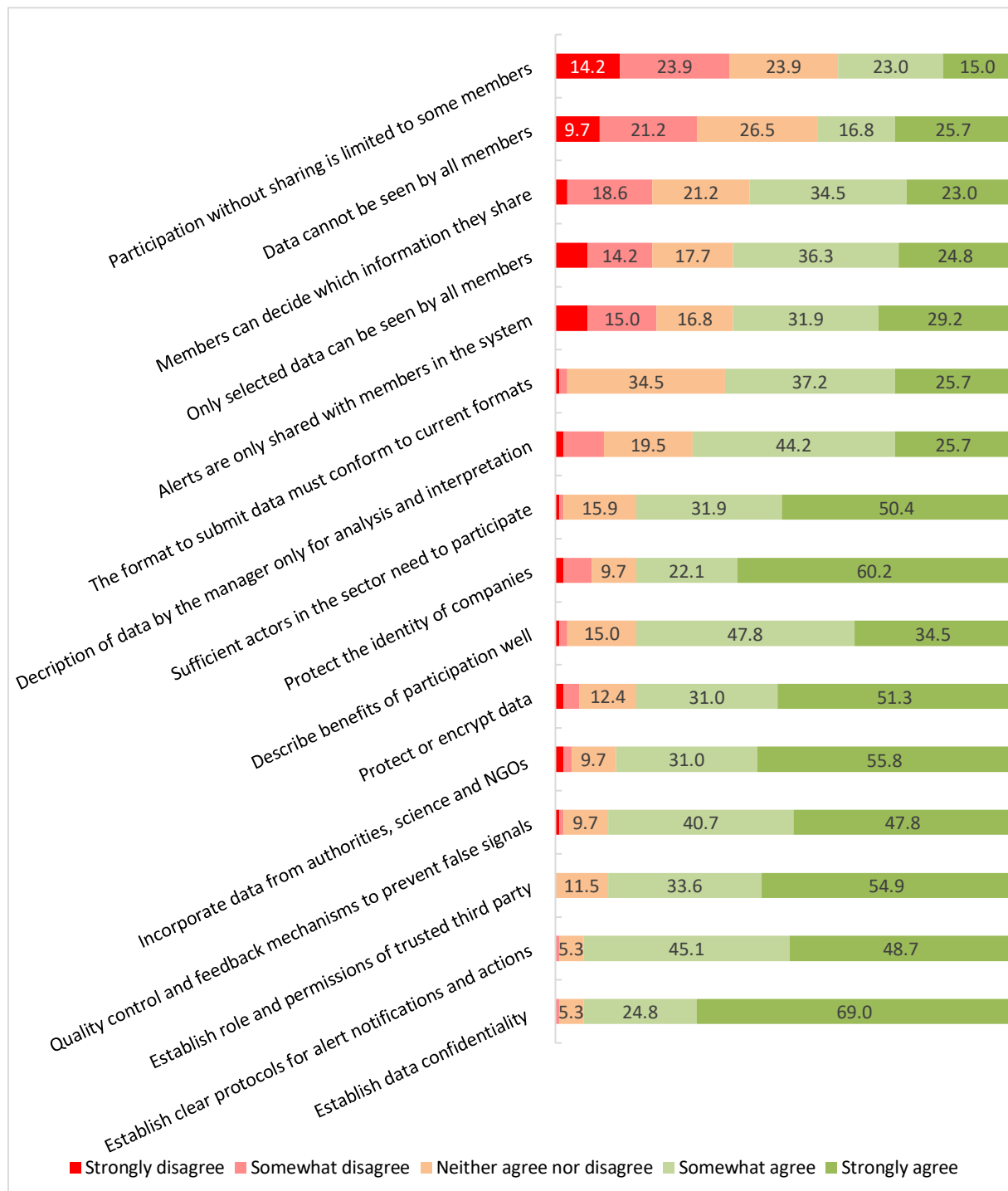


Figure 16: Conditions for a food integrity information sharing system (n=113 , %)

The results show that there is clear consensus on several conditions that a FI-ISS needs to meet. First and foremost, it needs to be clear to the industry actors how the data and information that is shared

will be handled, with the necessary protocols and procedures in place. One important aspect is the confidentiality and encryption of the data and information and anonymity of companies. These results indicate the industry actors consider it an important aspect and would not join if their identity is not protected. Another important issue of consensus, is that the role and rights of a trusted third party need to be well defined, a condition which again stems from a mistrust of sharing data. Industry actors largely agree that data from authorities, research institutes and NGOs should be incorporated in an information sharing system.

Other suggestions made by participants include:

- With regards to the anonymity of the data: *'anonymity of the data', 'security of data', 'scope of data and process to feed data clearly defined'*
- With regards to the type of agreement with the trusted third party: *'free use', 'belong to a professional union', 'signed agreement', 'trusted member with acceptance criteria, food fraud data is sensitive and can give possible ideas for new fraud', 'verification of the members' identity'*
- With regards to the design of a system: *'I strongly recommend to set up a global system where we set up an Electronic ID for each base raw material. This E ID will evolve and follow the process steps of this raw material. Each combined food stuff must have an E ID combined with the building blocks E ID's of the raw materials. Wrong information is then only as good as the system is. More workload is then only as good as the automation is. We, humans, have the technology, why not use it?'*

3.1.10. Trusted third party

One of the main questions about organising a food integrity information sharing system is the choice of the trusted third party that will manage such a system. Figure 17 shows the industry stakeholders opinion about the suitability of different third parties.

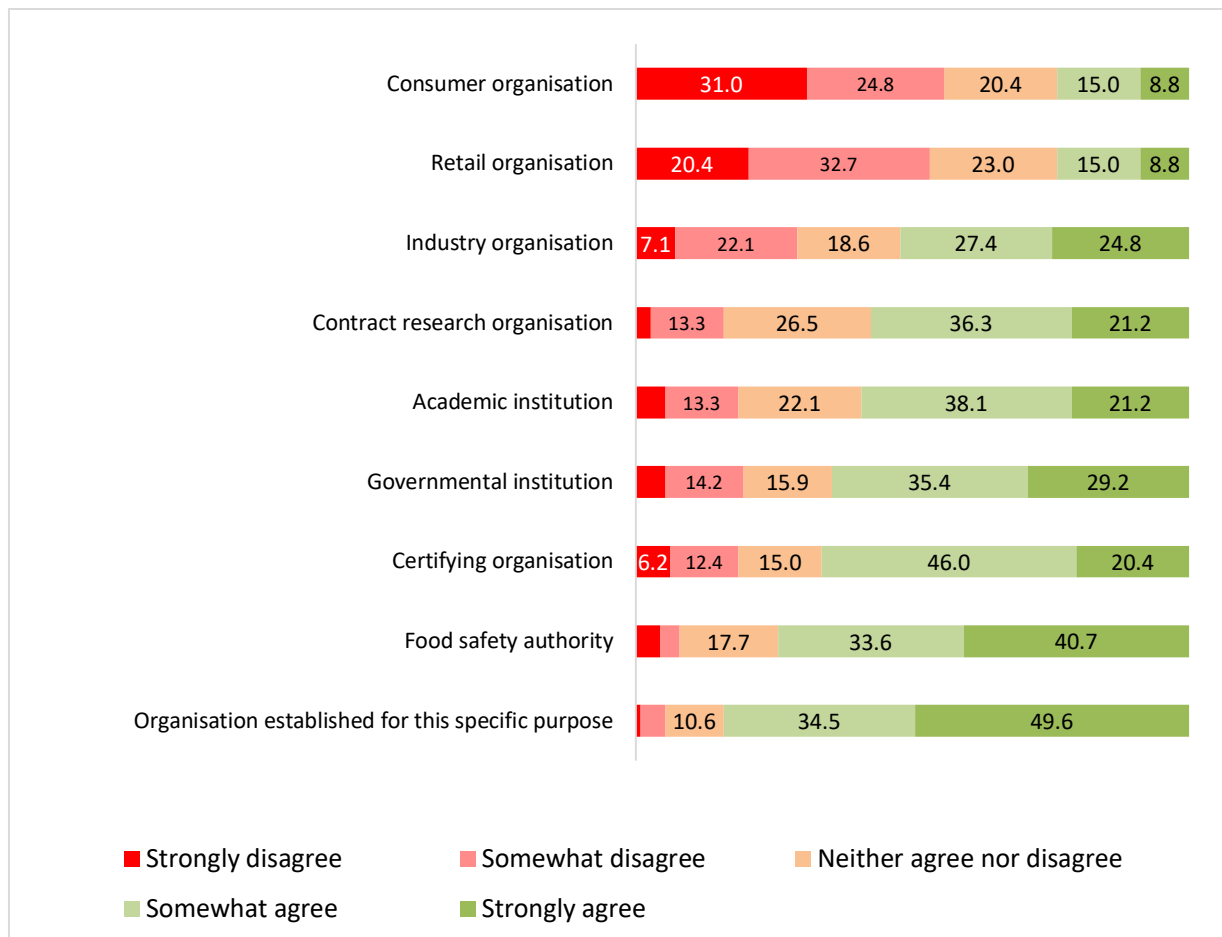


Figure 17: Trusted third parties that could manage a food integrity information sharing system (n=113, %)

A majority of 84.1% of participants agrees that a new organisation established for this specific purpose would be a suitable third party. This raises the question if the creation of such a new organisation is feasible (see 3.1.14 Likelihood of take-up). This result is discussed further during Round II with other stakeholders. For example, in Round II stakeholders from different backgrounds were asked to say which type of new organisation could be established (see section 3.2.4).

Additionally, a food safety authority is also seen as a suitable party by 74.3% of the industry stakeholders. These results are also shown to participants in Round II, further exploring stakeholders' opinion on the role of food safety authorities within a FI-ISS.

In Round I, these further suggestions were made by participants in the survey for a trusted third party to manage a FI-ISS:

- *'Company to industry organisation to government agency'*
- *'IGFS'* (note: Institute Global Food Security)
- *'Independent party'*
- *'IRCA auditors, nutritionist and toxicologist'* (note: International Register of Certified Auditors)

3.1.11. Actors participants are willing to share with

Participants were also asked which actors they would be willing to share certain information with, within an established system. The results are shown in Figure 18.

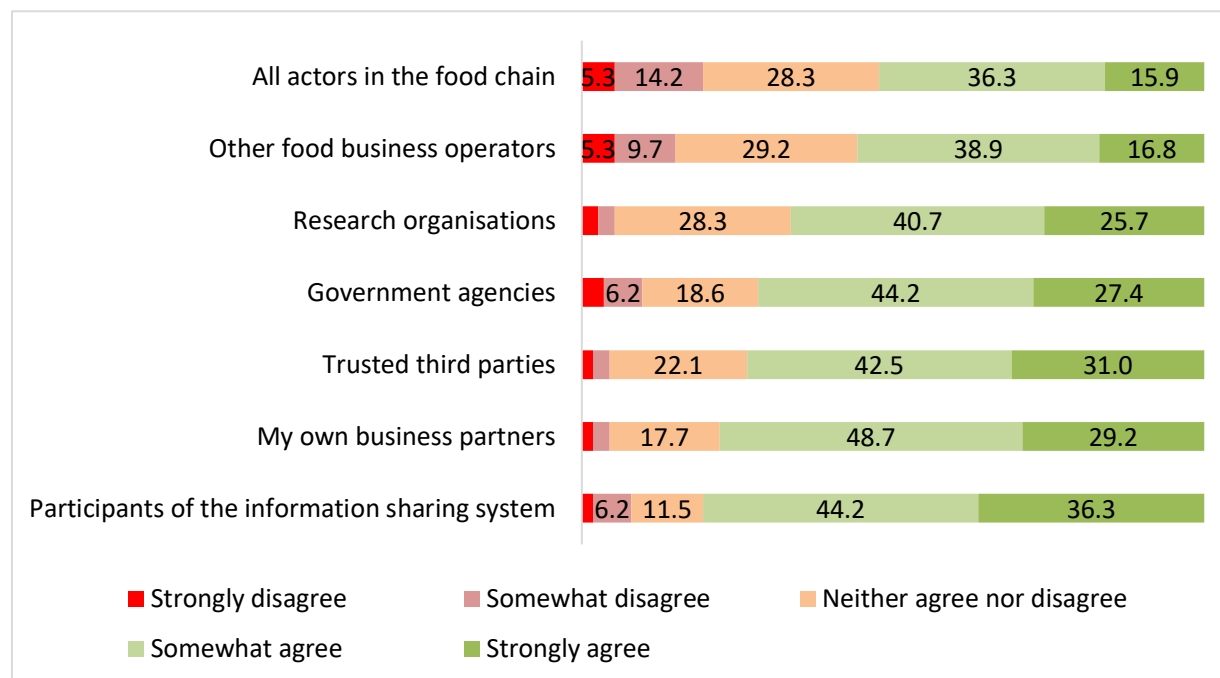


Figure 18: Actors with whom participants are willing to share within a food integrity information sharing system (n=119, %)

Figure 18 shows only 52.2% of participants would be willing to share with all actors in the food chain. There is higher preference for sharing with own business partners compared to other food business operators. Participants' answers to the open question where they could further explain their idea are listed below. Interestingly, consumer organisations were mentioned while not taken up in the list.

- *'As long as the anonymity is guaranteed, any'*
- *'Consumer organisation because consumer are victims at the end : they have the major interest to decrease the impact'*
- *'Food companies in supply chain in UK and EU'*
- *'Industry associations as appropriate to inform internal warning systems'*
- *'Industry organisation, government agency'*
- *'Professional union, authorities'*
- *'Trusted community and blockchain supply members'*

3.1.12. Types of data

Figure 19 shows there are three types of data of which over 70% of participants agree they could be shared within a food integrity information sharing system: monitoring and surveillance data, analytical data on product content and certifications. However, it is interesting to note that for analytical data, 11.7% disagreed that these could be shared. It might be interesting to further analyse why industry stakeholders are reluctant to share that type of information. This coincides with 12.6% disagreeing the share information on sourcing of their products.

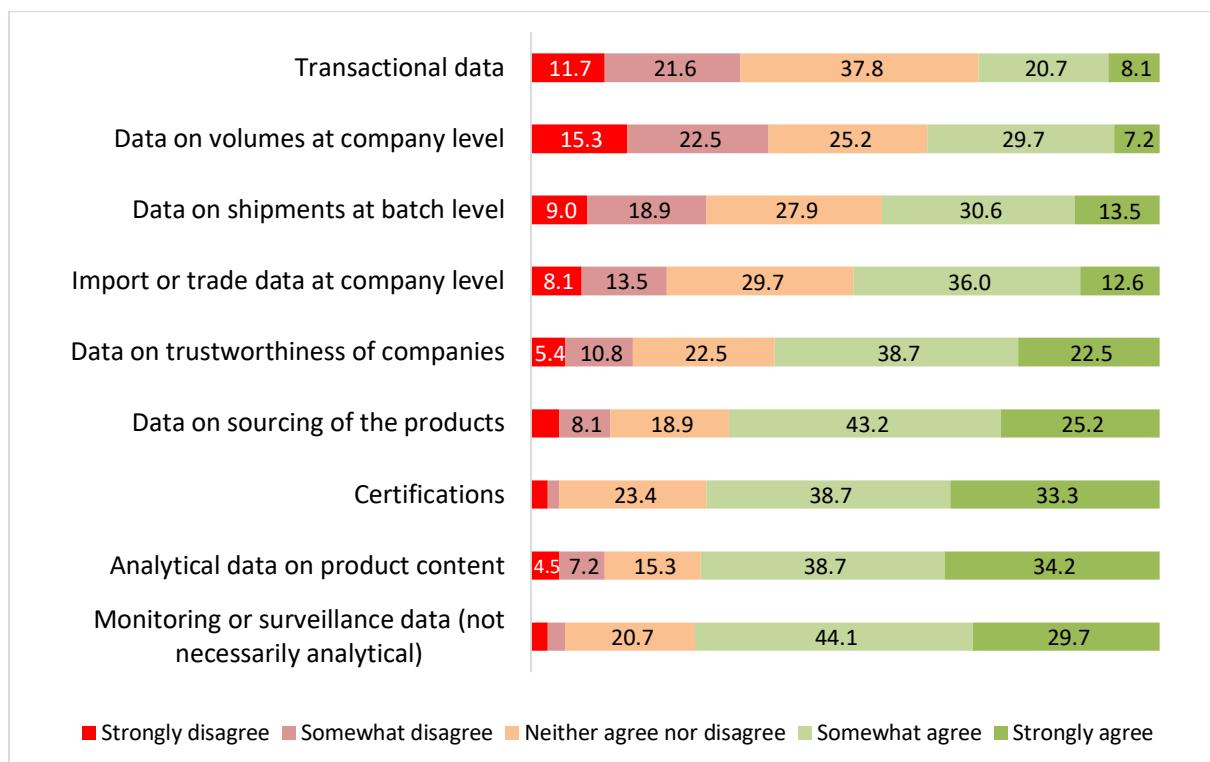


Figure 19: Types of data that could be shared within a food integrity information sharing system according to participants (n=111, %)

3.1.13. Outputs of an information sharing system

An information sharing system can produce different types of outputs. The results show stakeholders' demand for clear protocols for action in case irregularities are detected. Additionally, the results in Figure 20 show that in general, stakeholders were very positive about the different possible outputs and agreed a system should minimally produce these. It is important a food integrity information sharing system has information output available:

- Real time searchable database
- Ad-hoc alerts in case of irregularities
- Timely reports with filtered and analysed information

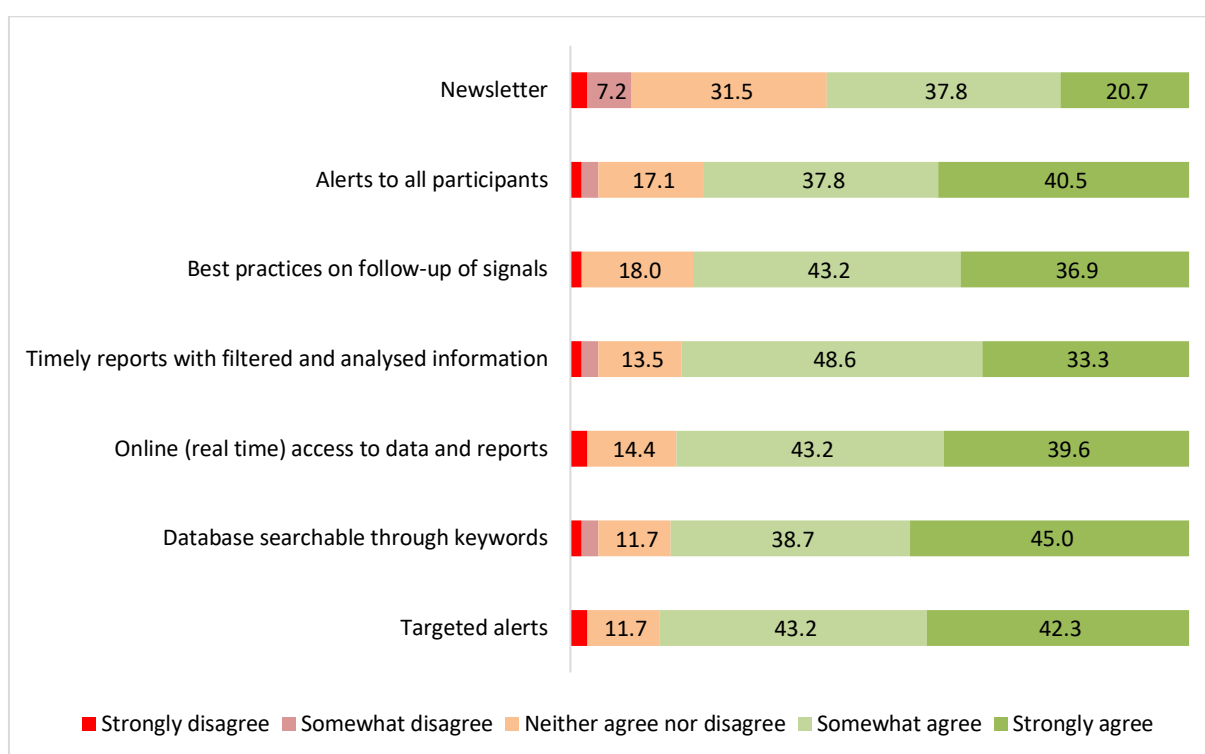


Figure 20: Participants' acceptance of different outputs of a food integrity information sharing system (n=111, %)

3.1.14. Likelihood of take-up

Food industry stakeholders were asked how likely it would be they would join a food integrity information sharing system if their conditions (which they could specify earlier in the survey) were met. The level of participation was described on different levels to gain insights into the willingness of industry actors, to share, recommend and pay for membership of a system. The results are shown in Figure 21.

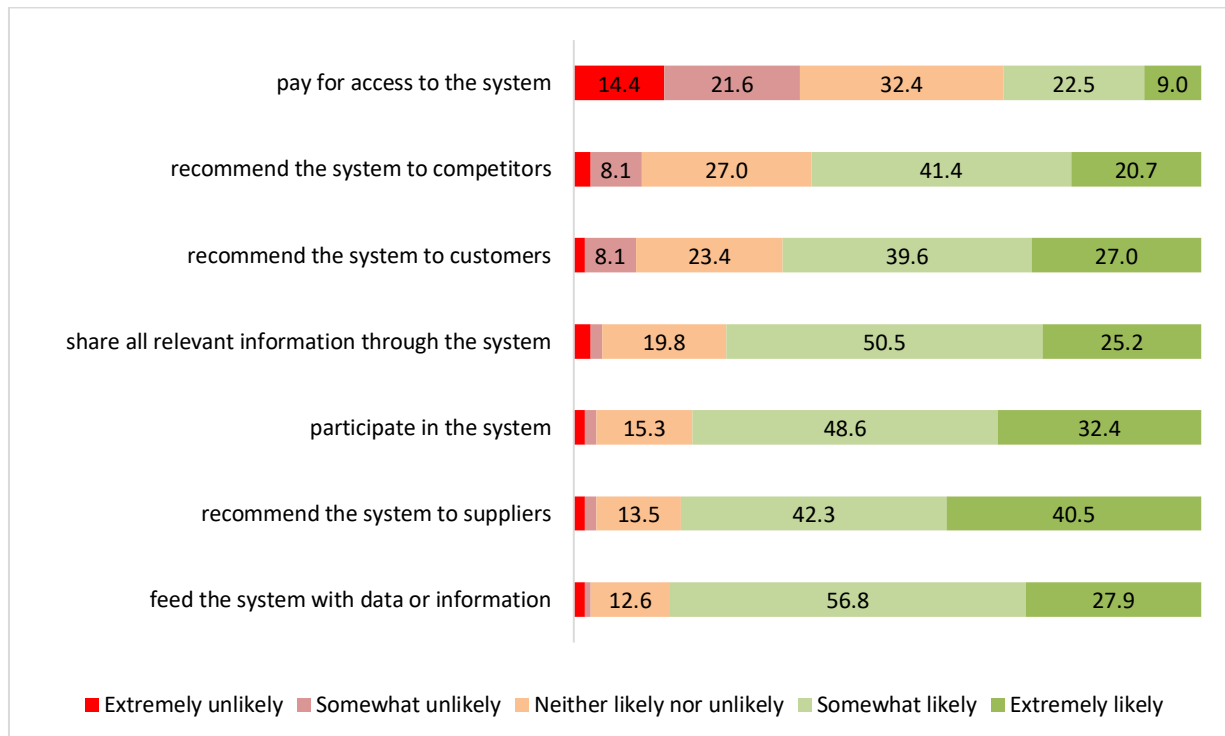


Figure 21: Participants likelihood of take-up a system for information sharing (n=111, %)

3.2. Round II

3.2.1. Description of the sample

A total of 61 stakeholders involved in the food supply chain participated in Round II, of which 36% also had participated in the first round (Table 10).

Table 10: Round II participants, participation in Round I (n=61)

Participation in Round I	n	%
New participant	39	64
Participated in Round I	22	36
Total	61	100

Round II was open to a broader range of stakeholders (2.4.1) to gain insights on different perspectives on the topic. Table 11 shows the type of actors that participated in Round II. During following analysis, the distinction is only made between food industry actors, including participants that identified themselves as food industry or service to the food industry, and other types of actors.

Table 11: Round II participants' self-identification (n=61)

Type of stakeholder	Number of participants (n)	Percentage of total sample (%)	Further details given by participants
Food industry	30	49.2	<i>Agro industrial</i> <i>Alcoholic spirits</i> <i>Chocolate</i> <i>Ingredient supplier and product formulator</i> <i>Manufacturer of alcoholic beverages</i> <i>Meat Industry</i> <i>Processor to retailers</i> <i>Producer of cake products</i>
Service to the food industry	9	14.8	<i>Aquaculture and seafood cluster</i> <i>Consultant</i> <i>External laboratory</i> <i>Food safety consultant</i> <i>Laboratory</i>
Researcher	10	16.4	<i>Nutrition</i> <i>PhD Student on Food Allergens and Risk Analysis associated to Food Allergens</i>
Law enforcement	3	4.9	
Consumer organisation	2	3.3	
Food authority	5	8.2	
Other	2	3.3	<i>Non-profit food information provider</i>

Similar to Round I, participants were also asked on which geographical level they were active, which is shown in Figure 22.

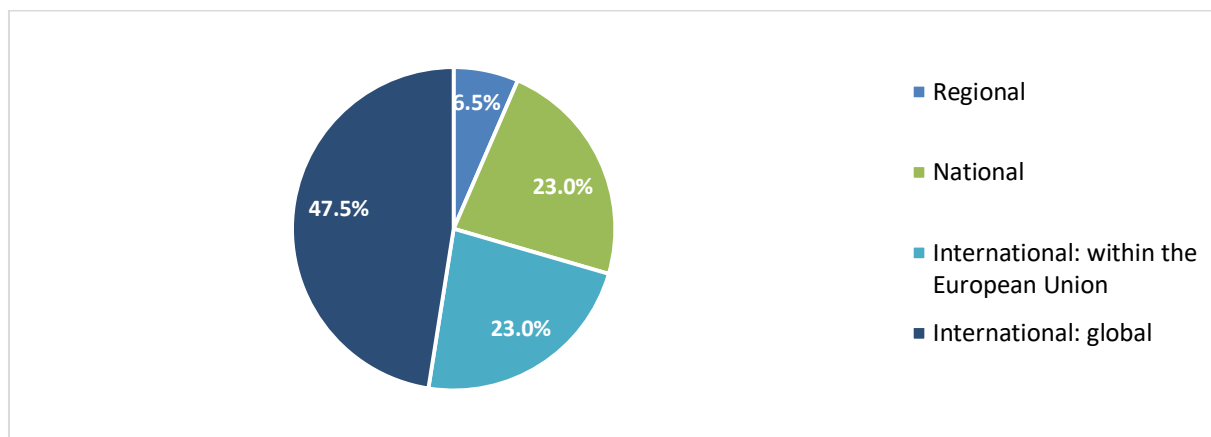


Figure 22: Geographical scope working field participants Round II (frequency, %)

3.2.2. Food integrity issues: occurrence and likelihood of detection

Stakeholders were shown Figure 11, which summarises Round I responses about the frequency of occurrence of food integrity issues and the likelihood of detection of food integrity issues and distinguishes three clusters:

- Cluster 1 (orange): high frequency of occurrence food integrity issues and high likelihood of detection
- Cluster 2 (green): low frequency of occurrence food integrity issues and high likelihood of detection
- Cluster 3 (red): low frequency of occurrence food integrity issues but unlikely to detect food integrity issues

Next, the 30 food industry actors in the sample, were asked to choose with which cluster they identify the situation of their company. The majority (n=17) consider themselves in the green group, with low frequency of detection and high likelihood of detection. The others consider their company in the red group (n=6) or the orange (n=5) or don't know (n=2).

All participating stakeholders were asked to analyse the response of industry actors in Round I and give their opinion on those results. The frequency of food integrity issues occurring, is considered as shown in Figure 23. The majority of stakeholders (58%) of the second round consider this estimation by industry actors an underestimation of the reality, which would imply they perceive the frequency higher. However, 5 % of the stakeholders, all being industry actors, think it is an overestimation. Through the open-ended question, stakeholders explained their perception in more detail. A reason given for believing the frequency is overestimated by industry, is the already intensive control of the food industry (n=1). Those who believe industry realistically estimates the frequency mentioned in particular their trust in the awareness of companies (n=2) and personal experience with efforts which have reduced the occurrence of issues (n=1). Reasons for believing the frequency of occurrence is

underestimated included the fact that frequency estimates are by nature based on detected cases, so impossible to measure exactly (n=7), the criticism that companies don't challenge integrity (n=5), the low frequency of detection (n=4), the fact that some issues are not reported (n=4).

In Round I, the likelihood of detecting issues was overall perceived rather high. During round II, stakeholders were asked if they think industry participants of Round I are realistic in their estimation.

Figure 24 shows the answers are divided, with over 40% of stakeholders considering an underestimation of the likelihood of detection. Further analysis of the open-ended question where stakeholders could further explain their choice, raises suspicion that some of the participants did not interpret the question correctly, giving reasons for overestimation, while selecting underestimation. Consequently, the results presented in Figure 24 need to be interpreted with caution. In Table 12, we present the arguments mentioned by stakeholders, as coded categories and highlight the contradictory combinations.

Table 12: Coded categories of statements made by stakeholders to clarify their answer on the question in Figure 24. Contradictory reasoning signalled in bold (n= 36)

	Industry actors overestimate likelihood of detection	Industry actors realistically estimate likelihood of detection	Industry actors underestimate likelihood of detection
Companies are aware	0	5	0
Companies conceal issues	1	0	1
Control is high	0	1	1
Detection measures are insufficient	3	2	3
Detection methods are expensive	1	0	1
Detection of actual incidents is low	5	0	9

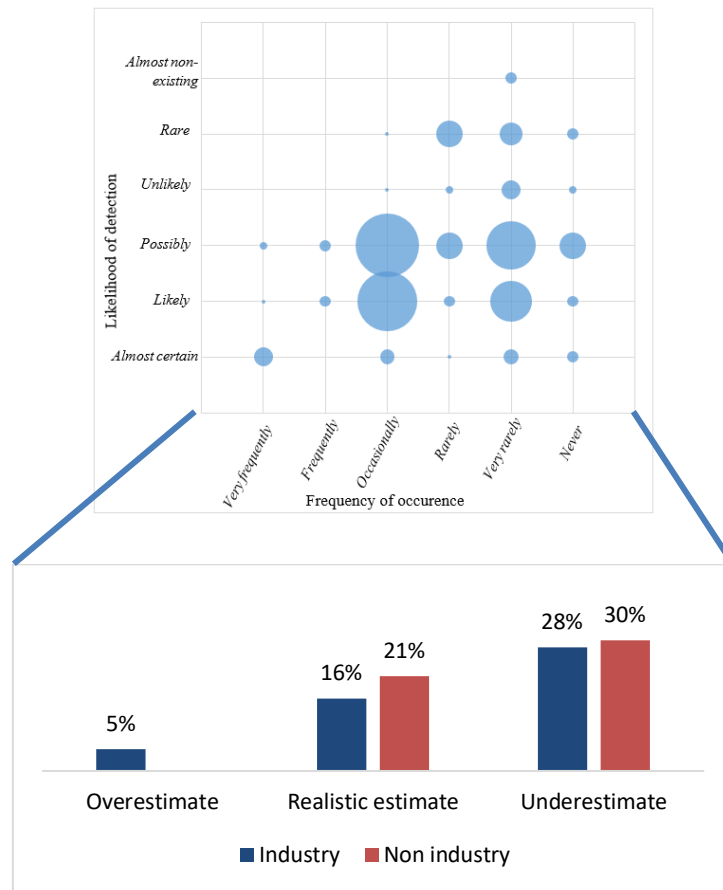


Figure 23: Round II stakeholders' perception on the estimation of industry stakeholders (Round I) regarding the frequency of occurrence of food integrity issues (n=61,%)

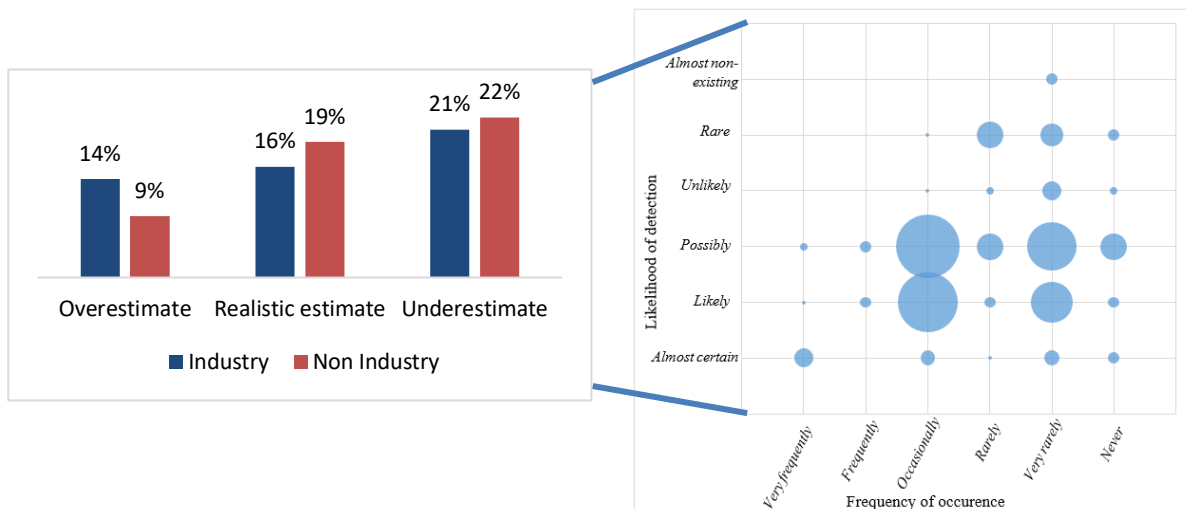


Figure 24: Round II stakeholders' perception on the estimation of industry stakeholders (Round I) regarding the likelihood of detecting food integrity issues (n=58, %)

3.2.3. Potential of a food integrity information sharing system to prevent and detect food integrity issues

The results of Round I show that the two main advantages of information sharing, perceived by food industry actors were the potential to improve prevention and facilitate detection of food integrity issues. During the second round, all stakeholders were asked to rate the same statements (Figure 25), and further clarify why they believe this in an open-ended survey question. Answers were coded with NVivo software, and the different positive statements that re-occurred are presented in Figure 26. However, some of the stakeholders also mentioned risks or barriers they perceive, inhibiting the potential of information sharing. For example, the risk that fraudsters might abuse the information (n=2), the doubt that the indicators to share are not strong enough because methods are not robust (n=2), the risk of a certain overconfidence when having a system in place (n=1).

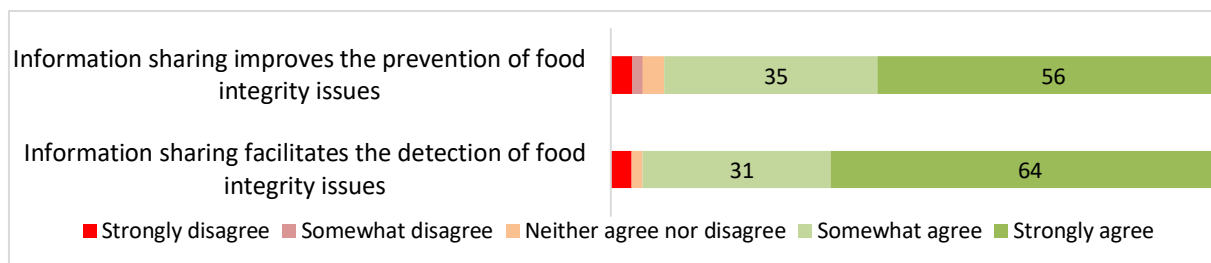


Figure 25: Round II stakeholders' perception on the potential of information sharing (n=58, %)

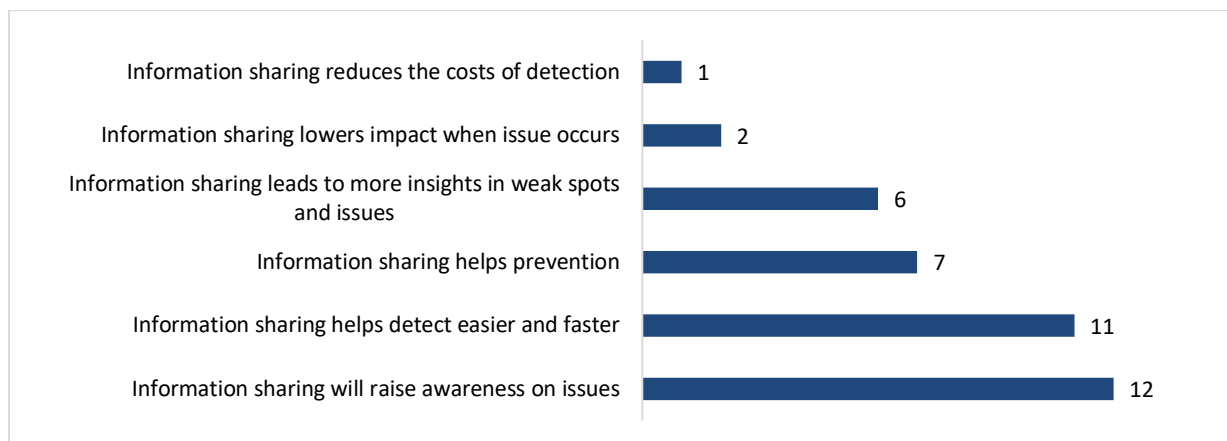


Figure 26: Round II stakeholders' reported advantages, coded categories (n=58, n)

3.2.4. Trusted third party

From Round I we concluded that, according to food industry actors, the two most suitable parties for organising a food integrity information sharing system are food safety authorities or a newly established organisation. As a part of Round II, the study explored the idea of a new organisation more in depth, by probing stakeholders' opinion about the criteria this new organisation would need to fulfil.

Overall, stakeholders in Round II agree that a newly established organisation is a suitable trusted third party (Figure 27).

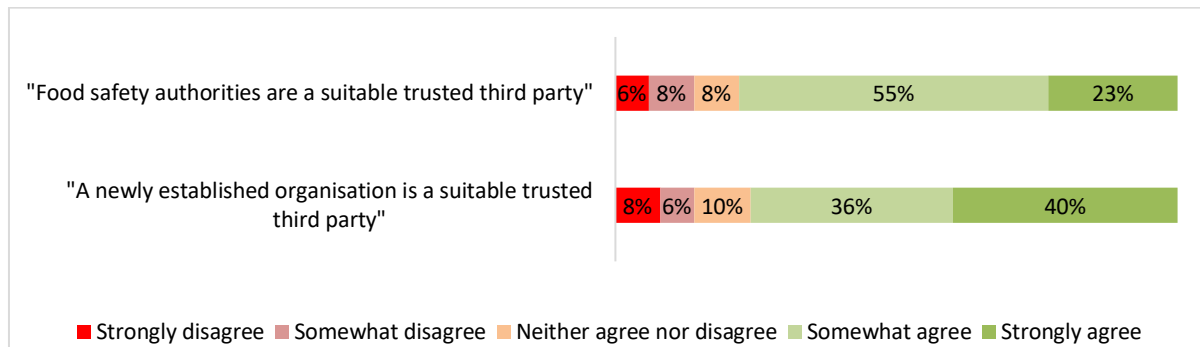


Figure 27: Round II stakeholders' agreement with two possible suitable trusted third parties most preferred in Round I (n=50, %)

Analysis of the open-ended survey questions shows that there are diverging opinions on the type of new organisation that should be in charge of a FI-ISS. The overview of the types of coded statements that were given by different types of stakeholders are presented in Figure 28 and Figure 29.

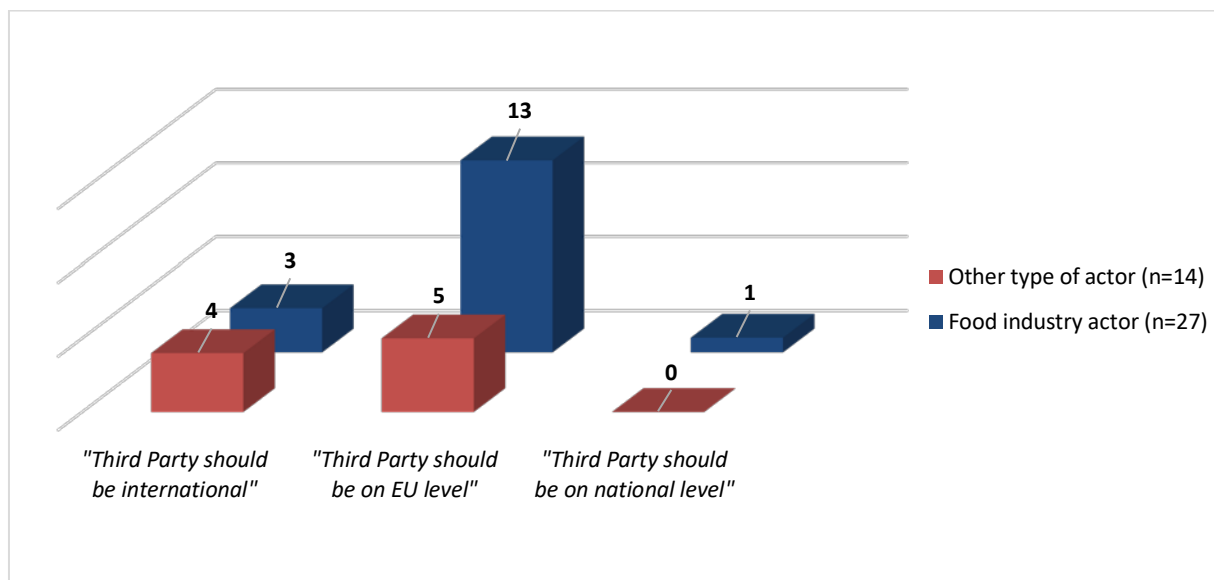


Figure 28: Round II stakeholders' qualitative statements on the establishment of a new organisation to manage a FI-ISS and the level on which level it should be active, coded into categories (n= 41, n)

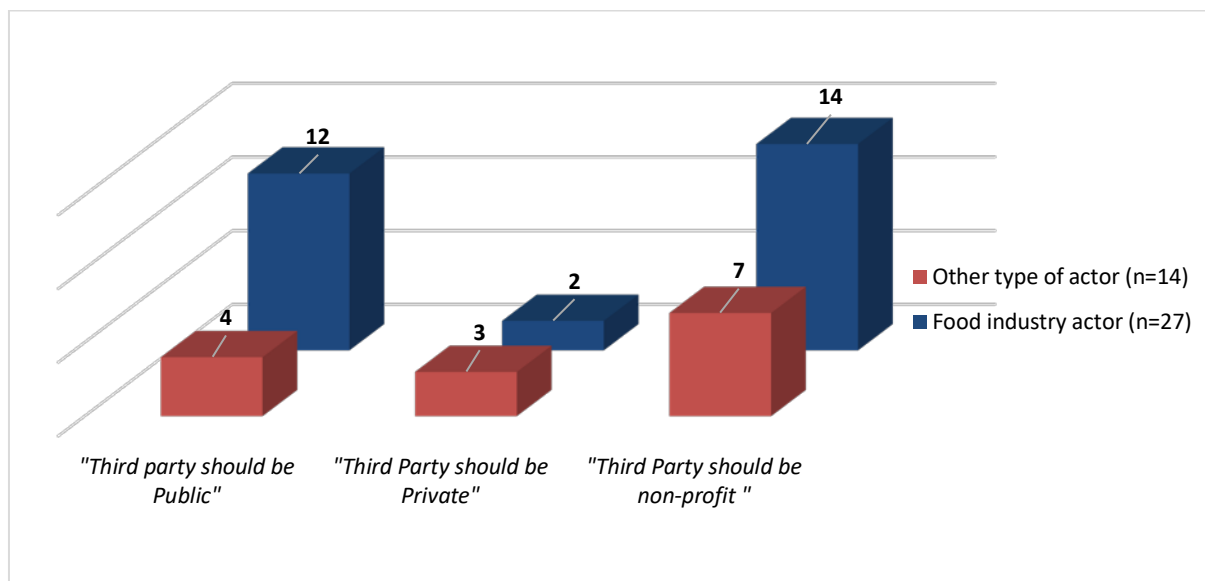


Figure 29: Round II stakeholders' qualitative statements on the establishment of a new organisation to manage a FI-ISS and the private public dilemma, coded into categories (n= 41, n)

Of the stakeholders (n=7) whom disagreed that a new organisation would be a suitable third party, two mentioned the complexity of adding another organisation as the reason for their reluctance. Stakeholders convinced that a new organisation would need to exist on an international level (n=7), mentioned their belief that food markets are global, have no borders as the main reason. Figure 28 illustrates that the majority of stakeholders prefer a new organisation at an EU-level (n=18), however they rarely clarified this preference. In Figure 29, more insights into the type of organisation the stakeholders would prefer are illustrated. A total of 21 participants clearly stated that they prefer a non-profit organisation, of which 3 mentioned a private non-profit initiative. One stakeholder that preferred a private organisation mentioned *'confidential information will be involved'* as a reason for this preference. On the contrary, another stakeholder used the same argument for his/her preference for a public organisation, stating *'usually these food integrity issues have sensitive data covered by data protection legislation'*. Several stakeholders mentioned why they think public funding should be used to finance a FI-ISS, for example *'if there is no charge to the companies using it then it would be more effective. Cost would be an issue to SMEs where margins are tight'*. Another argument stems from the primary purpose of a FI-ISS, where a participant mentioned *'it must be public and its primary purpose must be to protect the consumers'*. It is important to note that an additional four stakeholders expressed their preference for a public private partnership, without further argumentation as to why.

3.2.5. The role for food safety authorities within a FI-ISS

The majority of stakeholders participating in Round II (78%) also agreed that food safety authorities would be suitable as a trusted third party to manage a food integrity information sharing system (Figure 17). Food safety authorities exist on national level but as well on an international level, such as

EFSA (European Food Safety Authority). Stakeholders were asked for which of both they saw a role within a system. The majority of participants finds that this role can be for both (56%) as is shown in Figure 30.

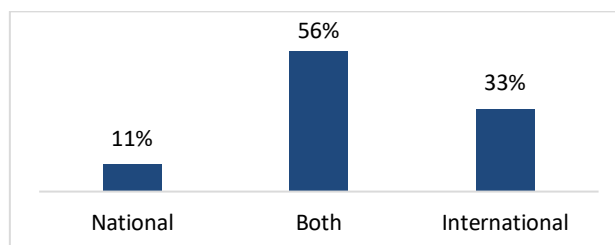


Figure 30: Round II stakeholders' comments on the involvement of national or international food safety authorities as trusted third parties to manage a FI-ISS (n= 46, %)

Analysis of the comments made by stakeholders in the open-ended survey question which asked to clarify their choice, showed that 8 stakeholders (consisting of 1 industry actor and 7 non-industry actors) clearly expressed their opinion that food safety authorities would be fit to manage an FI-ISS, and three reasons for this choice were mentioned. Firstly, their already existing structure, network and expertise were mentioned, leading to faster and less complex set-up of a system. Secondly, the already established trust by consumers was remarked. Thirdly, one stakeholder referred to the resources that food safety authorities have available. A total of 12 stakeholders also mentioned they see a role for FSA's and their expertise, but do not necessarily want them to be the third party which manages the FI-ISS, for example *'food safety authorities have an important role to play but are not equipped for this task. With the already existing systems they can play an important input role'*. Lastly, 13 stakeholders expressed the clear opinion that FSAs should not act as the third party managing a FI-ISS. A lack of trust by the industry was mentioned by four stakeholders, stating *'they are not reliable'*, *'also we doubt all issues are suitable to share with the FSA, businesses might want to deal with some issues themselves'* and *'right now, Belgian food authority gives fines when you have a recall and are able to trace back every kg sent. So some companies are asking themselves whether they will again warn food safety agency in case of recall'*. Furthermore, three stakeholders expressed their concern that food safety authorities should keep a certain distance from industry, for example *'food safety authorities often have to maintain distance from industry, for fear of being assumed to be complicit with the food industry. Its action as a third party may prevent it working appropriately'*. Another argument expressed by a few stakeholders is the difference between food safety issues and food integrity issues, and their worry that food safety authorities are not suited to deal with the economic aspect. For example, some stakeholders say *'The food safety is not concerned by all the food fraud. It is important to have information about economic food integrity issues'*, *'food integrity is far more than just food safety'* and *'a concern is that food integrity is not just food safety. Many impacts are purely economic, particularly*

for the industry being affected'. As stakeholders considered the role for food safety authorities, two of them raised concerns on the difference between the different national food safety authorities, saying 'it could be huge differences between countries. I think is more efficient an specialised organisation' and 'depending on their role and integration with the varied actors in the food supply chain some national food safety authorities may be better than others.'

3.2.6. The role for retail and consumer organisations within a FI-ISS

The results of Round I showed that retail and consumer organisation were considered the least suitable to organise a FI-ISS. To explore whether they could be involved in another way in such an information sharing system, Round II contained an open-ended survey question asking participants which role they think these can play in a FI-ISS. A number of stakeholders (n=10) stated they do not see a role for retail or consumer organisations, mentioning a few key arguments. Mostly, the commercial interest of retailers is of concern. Stakeholders also mentioned their lack of experience, bad reputation and the fear that they would overreact to issues, for both retailers and consumer organisations.

On the other hand, 27 other stakeholders mentioned a possible role for these organisations as an answer to the open-ended survey question. A number of participants believe their role would be to alert or report possible issues or concerns about issues. Going a step further, a few participants believe they can also share relevant data and information, as well as receive it. Two stakeholders mentioned retailers can provide samples to be tested. Furthermore, some stakeholders see a less active but rather advising role for consumer organisations and retailers, for example by being on the board of the new organisation. Lastly, two stakeholders also consider their role in terms of communication and awareness raising, by sharing alerts, showing the efforts of the food industry and building consumer trust.

3.2.7. Sharing data and information on volumes and transactions

Results from the first round showed there is reluctance to share data on volumes and transactions. During the second round stakeholders were asked for possible reasons for this reluctance. Analysis of the open-ended questions shows two reasons for the hesitance. Firstly, most stakeholders mention the commercial sensitivity and the fear of competitive advantage issues. When setting up an information sharing system which aims to use information on volumes and transaction, one needs to take these fears into account and foresee the necessary guarantees for anonymity and confidentiality of the information and data shared. Secondly, a few stakeholders also mention the fear of authorities having access to their business information, more specifically taxation authorities.

In a next question, participating stakeholders were asked which conditions should be fulfilled according to them, in order to improve industry actors' willingness to share information on volumes and

transactions. Figure 31 shows the seven criteria stakeholders could select, ordered from most chosen to least. Almost all stakeholders consider it necessary to anonymise data before they are seen by others. These results show again there is no consensus on how much access to data actors in a system should really have. An important group considers it not possible to give all actors access to raw data.

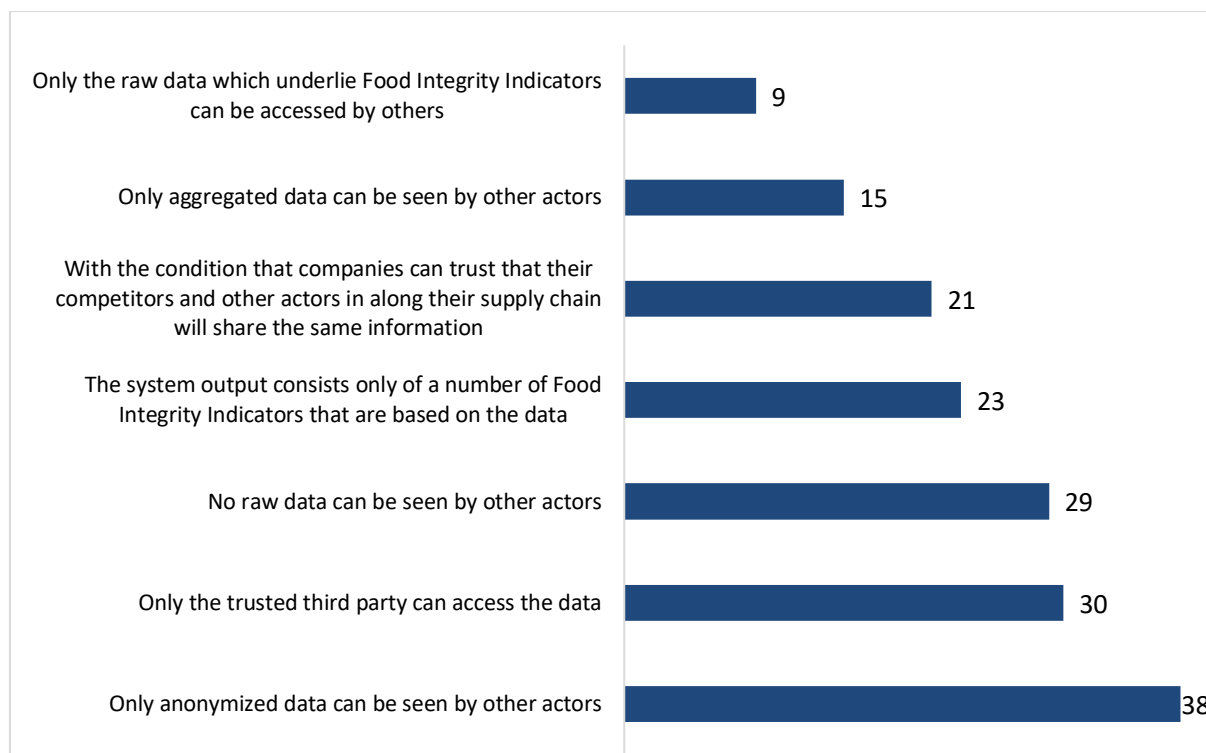


Figure 31: Criteria a FI-ISS has to meet for food industry actors to share sensitive information, according to stakeholders in Round II (n=49, n)

3.2.8. First steps to develop a food integrity information sharing system

During the second round, participants were shown the interest of food industry actors to join a FI-ISS, and their doubts. We challenged participants of Round II to think about the first steps that would need to be taken to develop a FI-ISS. For example, whom they seem suitable to take **the initiative to launch an information sharing system**. To this open-ended survey question, a variety of answers were submitted, by 23 industry stakeholders and 15 non-industry stakeholders.

Half of the stakeholders indicate that **authorities or governmental bodies** should take the initiative, more precisely 52% of food industry stakeholders and 40% of non-industry stakeholders. Several participants identify the European Commission and/or EFSA as the most suited actor, but initiative from EU member states are also encouraged by a few stakeholders. About a quarter of respondents believe the initiative should come from the **food industry, industry networks or services**, more precisely 17% of food industry actors and 40% of non-industry stakeholders. Some industry actors mention the industry initiative in combination with authorities or academic institutions, implying their

support for a joint effort or a consortium. Other stakeholders remarked a number of other organisations or initiatives, such as Codex Alimentarius (n=3), the Global Food Safety Initiative (GFSI) (n=2), World Trade Organisation (WTO) (n=1), World Health Organisation (WHO) (n=1) and Food Drink Europe (n=1).

One of first steps that could be taken in the development of a FI-ISS, is using a **pilot case to test the information sharing system**. Stakeholders in Round II were asked in an open-ended question if they think a pilot-case would be useful as a starting point and which case would be fit for purpose. Most stakeholders expressed their agreement that a pilot case would be useful (n=29). However, some expressed their doubts (n=2), warning the possible cost of a pilot case and the risk it might not be implemented afterwards because too many different opinions exist in the food sector. A number of potential pilot cases were mentioned by stakeholders, which can be categorised into three types. Firstly, many stakeholders suggest starting from a certain food commodity and preferably one of the commodities which are vulnerable for food integrity issues such as meat sector, spices, seafood and olive oil, all mentioned several times in the answers. One food industry stakeholder explained that the meat sector would be an interesting pilot case because they already share a lot of information, however nothing is tracked down to the level of entities. A stakeholder from a food safety authority indicates that the olive oil industry would be a good starting point as it has a rather small variety of products, a high number of businesses and is considered vulnerable to food integrity issues.

Secondly, a few stakeholders also mention to use previous cases of food integrity issues as a starting point to develop a pilot case, such as the fipronil case or the horse meat scandal. Lastly, a stakeholder also suggested a pilot case should be started on a country level for the whole food sector within that country.

Lastly, food industry stakeholders (including services to food industry) were asked to indicate at which point they would join a FI-ISS (Table 13). The five possible options are based on the innovation adoption lifecycle (Rogers, 2010), ranging from immediate adoption of a new innovation to joining after over half of the other actors has joined. The question was accompanied with the illustration of the innovation adoption cycle (Figure 32).

Table 13: Food industry stakeholders' perception on when they would join a FI-ISS (n=30)

Moment of joining a food integrity information sharing system	n
Immediately (Innovator)	12
Not immediately, but after a few actors in my sector have joined (Early adopter)	12
When over 15% of actors in my sector have joined (Early majority)	4
When over 74% of actors in my sector have joined (Laggard)	1

When over half of actors in my sector have joined (Late majority)

1

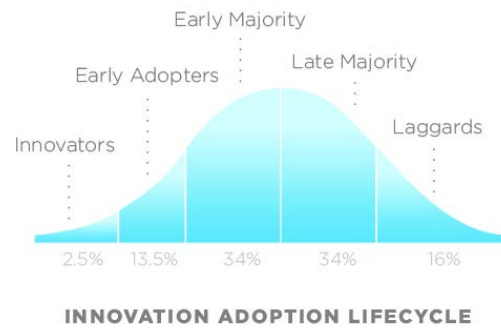


Figure 32: Innovation Adoption Lifecycle

3.3. Round III

The workshop ‘Key success factors for a food integrity information sharing system’ took place on May 28th 2018 in Belfast, UK and was the last round of this stakeholder study. The workshop report can be found in Deliverable 11.5, including a participant list, photo material and logistic information. In this deliverable, we summarise the results from the interactive part of the workshop. During the workshop, stakeholders were presented an overview of the main results of Round I and Round II, as well as the results of a study on key indicators for a FI-IS, reported in Deliverable 17.4. The slides of the presentations by TNO Netherlands and Ghent University are attached in Appendix VI. Following the presentations, stakeholders debated a number of results and questions during break-out sessions which were moderated using a general discussion guide. Notes from the four different break-out sessions as well as the transcript of the reporting back sessions are available in Appendix VII and Appendix VIII.

3.3.1. Development of a discussion guide

The discussion guide was developed to provide structure to the 45 minute break-out sessions, encompassing four possible key success factors for a FI-ISS and a number of related discussion points. Reflection with the four moderators after the break-out session showed that the four different groups used the guide in various way, from very directly following the questions to a more loose approach where the stakeholders diverged from the suggested topics.

The discussion guide is based on the results of Round I and Round II, and is summarised in a visual overview (Figure 33) of the four success factors and the related points of discussion.

- Foundation: A food integrity information sharing system will help prevent and detect food-integrity issues
- Success factor 1: A new organisation should manage a FI-ISS
- Success factor 2: Data and information confidentiality needs to be well guaranteed
- Success factor 3: All actors in the supply chain need to be in the system
- Success factor 4: Food safety authorities need to be involved in a FI-ISS

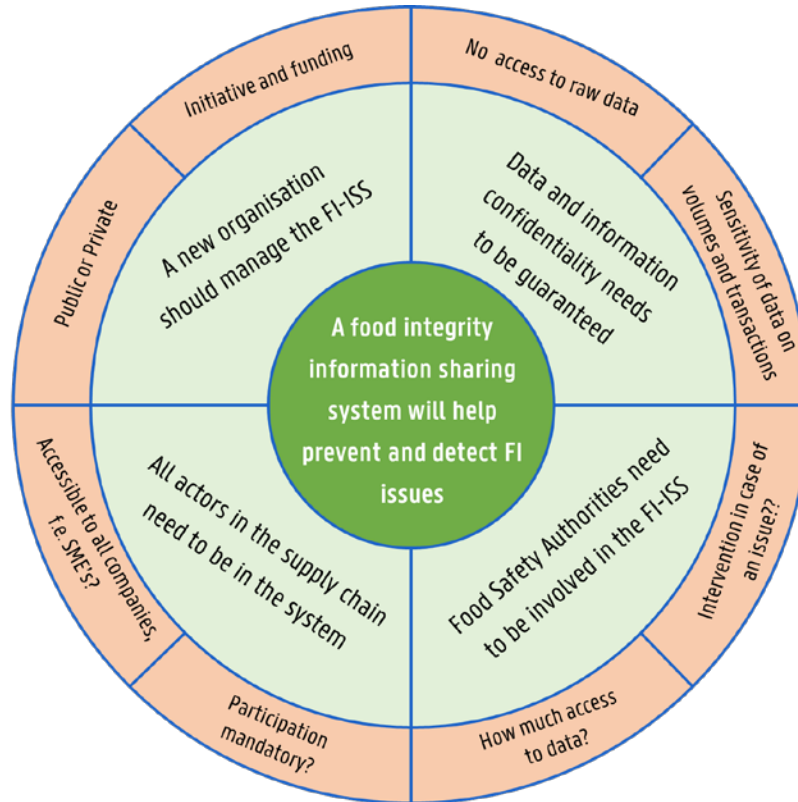


Figure 33: Key success factors and discussion points for a food integrity information sharing system

The discussion grid is based on this structure, and aims to let stakeholders discuss their agreement with the different statements and the feasibility.

3.3.2. Break-out sessions

Each moderator used the grid to guide the discussion during the 45 minutes break-out session. In each of the four groups a reporter took notes. In this section, the comments and statements from the different groups are integrated in the same structured grid (Table 14). The left side presents the four key success factors for a FI-ISS and the comments stakeholders made with regards to each of them. The right side presents the discussion point, or points of contention on which the stakeholders gave their opinion.

After the discussions, the reporters of each group reported back in a plenary session on the conclusions from their break-out sessions.

Table 14: Discussion grid and different comments made by stakeholders during the break-out sessions of Round III (G1= group 1, G2= group 2, G3= group 3, G4= group 4)

FOUNDATION
<p>A food integrity information sharing system will help prevent and detect food-integrity issues</p> <ul style="list-style-type: none"> ➤ Several data systems exist but links between the systems are lacking (G4) ➤ We need one general system where all relevant data can be integrated (G4) ➤ Opportunity for different actors to learn from each other (G4) ➤ Goal of the system should be for industry actors to protect themselves and their product better (G3) ➤ Consider building further on existing systems, creating an overarching system. Start with creating inventory of existing systems (G1) ➤ Learn from issues of the existing systems, such as conflicting interests (G1) ➤ Consider to broaden the focus to both food safety and food integrity (G1) ➤ Doubts whether information shared will uncover issues at all (G1) ➤ One of the key issues today is that everyone shares data one-up and one-down (G2)

KEY SUCCESS FACTORS	DISCUSSION POINTS
<p>Success factor 1: A new organisation should manage a FI-ISS</p> <p>Consensus in the group for giving the task to a new organisation (G1, G4)</p> <p>Consider a new organisation but not a new system, rather a system of systems, in a skeleton architecture, umbrella (G1)</p> <p>A technology company with the expertise and the know-how under a service contract could execute the technology component, with on top of that a public-private partnership for governance (G2)</p>	<p>Should a new organisation be private or public?</p> <p>Consensus in G4 that coordination and communication must be done by a public organisation at EU level – funded by EU Commission – but technical partner should be in charge of data management and data architecture (G4)</p> <p>Higher consumer trust in public organisation compared to a private organisation (G4)</p> <p>Communication and collaboration between different (national, EU and global) organisations will be crucial (G4)</p> <p>Take into account both consumer trust AND industry trust, when setting up a system (G3)</p>

	<p>Impartiality and conflict of interest are important when choosing a trusted third party (G3)</p> <hr/> <p>Who should take the initiative? Who should fund the system?</p> <p>Funded by EU commission (G4)</p> <p>Not clear who should fund the new organisation (G1)</p> <p>Majority group agrees that initiative should be authority-driven (G3)</p>
<p>Success factor 2: Data and information confidentiality needs to be guaranteed</p> <p>Industrial actors can be in favour of sharing data only anonymously, they are concerned for the possible economic loss (G4)</p> <p>Industry actors concerned about trust from the general population (G4)</p> <p>Suggestion to share data on different levels, and adjust anonymity to the type of data (early indicator vs outcome indicators) (G4)</p>	<p>Is it feasible to share to create a system guaranteeing that nobody has access to the raw data that is shared?</p> <p>Focus should be on sharing of meaningful data (G4)</p> <p>Full anonymity is not possible: in case of an issue, the involved actors need to be able to be identified (G4)</p> <p>There is a need to share metadata (G3)</p> <hr/> <p>Is the sensitivity of data on volumes and transactions a problem?</p> <p>Very low trust between industry actors, according to non-industry actors (G1)</p> <p>Food fraud should be non-competitive, to try to take away some of the pressures of sharing data (G2)</p> <hr/> <p>Other</p> <p>At which point do authorities need to be informed of a food integrity issue? (G4)</p> <p>Many data still on paper – need for a shift to machine readable data (G3)</p> <p>By only sharing one-up and one-down, stove pipes are created. This is too restrictive (G2)</p>
<p>Success factor 3: Food Safety Authorities need to be involved in the FI-ISS</p> <p>Part of the issue is that FSA lack the skill set, for example investigation skills (G2)</p>	<p>Should FSAs have access to data and information?</p> <p>Currently game of hide and seek between industry and authorities – industry is not willing to share all data with authorities (G3)</p>

	<p>Authorities are bound legally (G1)</p>
<p>Success factor 4: All actors in the supply chain need to be in the system All European countries need to be involved (G4)</p> <p>Including regulatory bodies, retail, NGOs ... (G1)</p> <p>Will actors with bad intentions join? (G1)</p>	<p>Uncertainty about reaction FSAs in case of issues</p> <p>Worry confirmed: when will authorities be informed and which information will they receive? (G4)</p> <p>Should participation be mandatory?</p> <p>Ideally the system should be mandatory but stakeholders doubt that is feasible (G1)</p> <p>A mandatory system is not possible</p> <p>Accessible for SME's?</p> <p>Small companies might be frightened to share data (G4)</p> <p>Need for an incentive to convince all partners of the benefits of sharing data (G4)</p> <p>Resource issue for very small companies – involve cooperatives or sector organisations to support SME's (G4)</p>

4. Conclusions

The stakeholder study gives insights into the opinions of different types of stakeholders in the food supply chain regarding information sharing. It allows us to formulate recommendations for the development of a food integrity information sharing system. Both qualitative and quantitative data were collected and several topics were discussed.

The study shows that the large majority of stakeholders support the idea of a food integrity information sharing system (FI-ISS). Their support can be seen as a combination of their concern about food integrity issues and their belief that information sharing has the potential to help prevent and detect food integrity issues. However, in spite of this enthusiasm, most stakeholders are sceptical about the ways in which information could be shared, for example through an information sharing system. The doubts often stem from a lack of trust and uncertainty about the three dimensions of a FI-ISS: the input by other actors, the technology used for data sharing and the output of a system.

The study shows the majority of stakeholders consider a FI-ISS only promising if the data confidentiality is guaranteed by the data infrastructure. Although new data technology could provide this guarantee, many stakeholders suggest to set up a system with indicators or metadata, so food industry actors would not be sharing the raw data. Another fear of industry stakeholders is the added administrative layer that this information sharing could create. They are mainly worried about the work load and the cost of joining a FI-ISS. These worries need to be taken into account when designing a FI-ISS, making sure the system replaces older systems, or reuses them, rather than additional burden on food businesses. Additionally, improving stakeholders' knowledge of the potential of new data technologies might improve their trust.

A data and information sharing system would be fed by data from a large number of actors, which do not necessarily know and trust each other. In addition to worries on which type of data to share, stakeholders also repeatedly mentioned their distrust in the information others would share. On the one hand, several stakeholders expressed doubts regarding the quality of the information that would be shared, fearing that incorrect or poor-quality input can lead to bad or no meaningful output. If accidental or deliberate mistakes are made before data entry, an information sharing system could fail to fulfil its purpose. Moreover, the safety of a FI-ISS itself was also questioned and stakeholders wonder if those with bad intentions could use it to their advantage. In order to address these doubts, the development of a FI-ISS needs to include procedures on how actors will be reviewed and the quality of data will be verified.

The first round of the study included the topic of the output of a FI-ISS, specifically which kind of output the industry actors would prefer to receive themselves. The results showed their indifference towards

the format of how they would receive output. Nonetheless, during the study it became apparent that stakeholders are more concerned about the output or communication other actors might receive, such as food safety authorities, consumers and retailers. There is no consensus among stakeholders whether retail should be involved in a FI-ISS and a number of industry stakeholders expressed their distrust. Throughout the study, the notion that food integrity should be considered a non-competitive advantage was mentioned, similar to food safety. Most stakeholders agree with this notion but several distrust that retailers would join a FI-ISS from a non-competitive intention. On the contrary, other stakeholders consider retail as a possible driving force behind a FI-ISS, because their position at the end of the food supply chain gives them the power to demand their suppliers to join. The output of a FI-ISS, such as alerts or weak points can also be accessed by food safety authorities, which could decide to take action. A number of stakeholders considered anonymity of actors in the system an important condition, protecting them against actions in case an issue occurs. A reoccurring question from stakeholders regards the moment that food safety authorities would be informed and the level of access they would have to the data.

The role of food safety authorities is discussed multiple times throughout the different rounds of the study. Although food safety authorities are considered a suitable trusted third party to manage a FI-ISS, there was more consensus about the need for a new organisation on a European level or international level. Several opinions regarding this new organisation, its funding, its reach and responsibilities exist. There is consensus that the new organisation should be a public-private collaboration with a large role for food industry. A frequently reoccurring opinion is that the initiative and funding should come from the European Commission, which should create a new organisation.

Although doubts exist, the overall consensus is that a FI-ISS could play an important role in the larger strategy against food integrity issues. The purpose of a FI-ISS should be to protect both consumers and food businesses against food integrity issues. The complexity of information sharing and the possible implications of joining a FI-ISS are still uncertain for many stakeholders and could cause lack of trust. Responding to these worries and doubts will be key to create trust and interest in joining a system.

The stakeholder study faces limitations owing to relatively small and self-selected samples of stakeholders. Generalizations beyond the study sample should be interpreted with caution. Nevertheless, stakeholders' positive attitudes are encouraging for the development of a FI-ISS. Insights on the barriers that might be encountered can be helpful for industry and authorities in their efforts to ensure future food integrity, and eventually develop an effective FI-ISS.

References

- Brooks, S., Elliott, C. T., Spence, M., Walsh, C., & Dean, M. (2017). Four years post-horsegate: an update of measures and actions put in place following the horsemeat incident of 2013. *npj Science of Food*, 1(1), 5. doi:10.1038/s41538-017-0007-z
- Elliott, C. T. (2014). *Elliott review into the integrity and assurance of food supply networks - Final report - A National Food Crime Prevention Framework*. Retrieved from London: <https://www.gov.uk/government/publications/elliott-review-into-the-integrity-and-assurance-of-food-supply-networks-final-report>
- Ellis, D. I., Muhamadali, H., Haughey, S. A., Elliott, C. T., & Goodacre, R. (2015). Point-and-shoot: rapid quantitative detection methods for on-site food fraud analysis - moving out of the laboratory and into the food supply chain. *Analytical Methods*, 7(22), 9401-9414. doi:10.1039/c5ay02048d
- European Parliament. (2014). *Report – on the food crisis, fraud in the food chain and the control thereof*. Retrieved from Rapporteur (Chair): Esther de Lange, Committee on the Environment, Public Health and Food Safety
- Fritsche, J. (2018). Recent Developments and Digital Perspectives in Food Safety and Authenticity. *Journal of Agricultural and Food Chemistry*, 66(29), 7562-7567. doi:10.1021/acs.jafc.8b00843
- Rogers, E. M. (2010). *Diffusion of innovations*: Simon and Schuster.
- Rychlik, M., Zappa, G., Añorga, L., Belc, N., Castanheira, I., Donard, O. F. X., . . . Zoani, C. (2018). Ensuring Food Integrity by Metrology and FAIR Data Principles. *Frontiers in Chemistry*, 6(49). doi:10.3389/fchem.2018.00049
- Spink, J., Moyer, D. C., & Whelan, P. (2016). The role of the public private partnership in Food Fraud prevention—includes implementing the strategy. *Current Opinion in Food Science*, 10, 68-75. doi:<https://doi.org/10.1016/j.cofs.2016.10.002>

Appendices

Appendix I: Explanation script

Text	On-screen actions
One of the biggest challenges currently faced by the food industry is assuring the integrity of our food.	'Food integrity pops up'
Food fraud is a complex issue and the solution requires a multi-dimensional approach.	'Food fraud' pops up
Preventive actions and early reactive responses are key for the whole food supply chain.	'Preventive actions' and 'early reactive responses' pop up
Information sharing between all actors could help the identification and the prevention of food integrity issues.	'Information sharing' pops up
But what would this look like?	
Different actors in the food supply chain already exchange information, between each other and with external actors.	
Could the integration of all this information be valuable to help predict and prevent irregularities?	
The actors in the food chain could filter and encrypt certain types of information and share them with a trusted third party .	
This trusted third party would integrate, analyse, interpret and manage the received data.	'Integration', 'analysis', 'interpretation' and 'management' pop up
Useful information such as alerts or detected issues would be communicated back to all the actors in the network.	Arrow goes down on the right of the screen
On top of the data from private companies, external data from scientific studies, ngo's and authorities such as food safety agencies can be added	Top screen 'Other data' are shown
This Food integrity information sharing system could work in the identification and prevention of food integrity issues...	No action
... but many questions remain...	No action
Which types of information can be shared and by whom?	Question mark pops up
How to encourage the actors to participate? And what are the benefits for them?	Question mark pops up
Who can act as trusted third party?	Question mark pops up
What information output would the different actors expect to receive back?	Question mark pops up
What happens when the system identifies a food integrity issue?	Question mark pops up
On which level could we organise such a system?	Question mark pops up
To gather answers to these questions from food industry actors across Europe, this large-scale study is being conducted.	Some extra question marks pops up
As a food industry actor, you can fill in the online survey in the first round	First circle
Secondly, the results of the survey will be shared and you can give feedback in more detail	Second circle
Finally, a stakeholder workshop is organised in May 2018 in Belfast to discuss the feasibility of the proposed system	Third circle
Join the discussion at www.foodintegrity.eu	Last screen

Appendix II: Round I Questionnaire



Early detection of food fraud: How feasible is a system for information sharing within the food supply chain?

To find an answer to this question, we are consulting stakeholders in the food industry through three different rounds:

- This online survey
- An online feedback consultation about the results of this survey
- A stakeholder workshop in Belfast on 28th of May 2018 in Belfast

We ask your opinion on information sharing to prevent food integrity issues. The survey takes about 15 minutes to complete and you can follow your progress at the top of the page. All answers will be recorded, analyzed and reported anonymously.

This study is part of the European (EU-funded) Research Project FOOD INTEGRITY which involves various universities and institutes throughout Europe, funded by the European Commission. The study is carried out by Ghent University (Belgium) and TNO (Netherlands).

If you have a question, do not hesitate to [contact us](mailto:fien.minnens@ugent.be) (fien.minnens@ugent.be)

>>



Are you currently employed by a company or organization that is involved in the European food supply chain?

Please answer the survey considering the current situation of the company you represent.

- Yes
- No

The concept of information sharing will be explained in this video. It is important that you watch the video to understand the questions in the survey

Please **turn up your volume** and watch the video from start to end (2.5 minutes)



Please select

- I would like to read the text of the video
- I understood the video, continue to the survey



Food integrity refers to the “*state of being whole, entire, or undiminished or in perfect condition*”.

Thus, assuring food integrity is providing assurance to consumers and other stakeholders about the safety, authenticity and quality of food.

A food integrity issue therefore is any breach of that. These issues include food fraud, economically motivated adulteration, dilution, substitution, mislabeling, ... of food

During the past five years, give an estimation of how often your company or organisation has been confronted with food integrity issues

- Very frequently
- Frequently
- Occasionally
- Rarely
- Very rarely
- Never
- I am not aware how often

Considering the measures currently in place in your company or organisation, what is your estimate of the likelihood of detection of a food integrity issue when it occurs?

- Almost certain (Incidences will almost for sure be detected)
- Likely (Incidences will most likely be detected)
- Possibly (Incidences might possibly be detected)
- Unlikely (I don't expect incidences to be detected. It is possible, but unlikely they might be)
- Rare (Incidences will probably not be detected)
- Almost non-existing (Incidences will almost for sure not be detected)
- We do not have any measures currently in place to detect food integrity issues





To which extent do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
My company is very concerned about becoming a victim of food fraud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food integrity issues are a growing problem in our sector	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food integrity issues are one of the main risks our company faces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To which extent do you believe the following food products are **susceptible to fraud**?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Food products with high added value	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food products that had an integrity issue in the past	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food products with long supply chains	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food products without proper paper work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All food product categories	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food products with high profit margins	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food products produced in certain geographic regions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food products with complex supply chains	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To which extent do you believe the following food products categories are **susceptible to fraud**?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Herbs and spices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fish and seafood products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Olive oil	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meat and meat products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Milk and milk powder	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Honey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nuts and nut products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fruit juices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



To which extent do you believe that **information sharing** for the prevention of food integrity issues is...

Unnecessary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Necessary
Irrelevant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Relevant
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive
Unimportant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Important
Useless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Useful
Uninteresting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Interesting

To which extent do you agree with the following statements about the potential **advantages of information sharing**?

Information sharing...

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
reduces the loss of image of the sector (in case an issue is detected)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
magnifies the separate efforts of individual actors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
facilitates the detection of food integrity issues (e.g. easier, faster, cheaper detection)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
increases our control over food integrity issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduces the impact of food integrity issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
improves the prevention of food integrity issues (e.g. pro-active measures)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
lowers incentives to commit fraud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
increases the trust between actors (e.g. more transparency)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To which extent do you agree that the following factors are potential **disadvantages of information sharing**?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Sharing information might not have any measurable benefits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information sharing could have a negative impact on our competitive position	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information sharing on food integrity issues might be too complex	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The information shared by others could be wrong	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The information shared by us could be misused	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharing information could increase the workload of our staff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Optional: In addition to the advantages and disadvantages of information sharing that were displayed, are there any others you can think of?

Advantages	
Disadvantages	

Imagine that a system for information sharing is being developed, taking into account your conditions and ideas.

To which extent do you agree that the following **conditions** should be met for you to join this system for information sharing?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Data confidentiality needs to be well established	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clear protocols for alert notifications and actions from participants need to be established	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alerts are only shared with members in the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Participation without sharing is limited to some members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The format to submit data must conform to current formats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data cannot be seen by all members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data are protected or encrypted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Members can decide which information they share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data from authorities, science and NGOs need to be incorporated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The identity of companies is protected	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Only selected data can be seen by all members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data can be decrypted by the system's manager only for analysis and interpretation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality control and feedback mechanisms to prevent false signals and unnecessary measures need to be established	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sufficient actors in the sector need to participate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Role and permissions of trusted third party need to be well established	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Benefits of participation need to be well described	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To which extent do you believe that the following **third parties** are suitable to manage such a food integrity information sharing system?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Food safety authority	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Academic institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Governmental institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Retail organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consumer organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Industry organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Certifying organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organisation established for this specific purpose	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contract research organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To which extent would you agree to share your information within a system with the following actors?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Other food business operators	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Government agencies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Participants of the information sharing system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Research organisations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trusted third parties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All actors in the food chain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My own business partners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Optional: In addition to the conditions, proposed third parties and actors that were displayed in the last tree questions, are there any others you can think of?

Conditions for joining an information sharing system

Suitable trusted third party

Actors you are willing to share information with

To which extent do you believe the following **types of data** can be shared within a food integrity information sharing system?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Data on trustworthiness of companies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Import or trade data at company level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analytical data on product content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transactional data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data on shipments at batch level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Certifications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data on sourcing of the products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring or surveillance data (not necessarily analytical)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data on volumes at company level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To which extent do you believe that a food integrity information sharing system should minimally produce following **outputs**?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Timely reports with filtered and analysed information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alerts to all participants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Newsletter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Database searchable through keywords	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Targeted alerts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best practices on follow-up of signals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online (real time) access to data and reports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Optional: In addition to the data and outputs that were displayed in the last two questions, are there any others you can think of?

Data that can be shared in a food integrity information sharing system

Outputs of an information sharing system

Assuming that your conditions related to an information sharing system are fulfilled, how likely is it that you would...

	Extremely unlikely	Somewhat unlikely	Neither likely nor unlikely	Somewhat likely	Extremely likely
recommend the system to suppliers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
feed the system with data or information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
recommend the system to competitors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
recommend the system to customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
participate in the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
share all relevant information through the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pay for access to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Please select on which level of the food supply chain your company or organisation is active. Multiple answers are possible

- Primary production
- Transport
- Storage
- Processing
- Retail
- Export
- Import
- Non-food service to the food sector

Please select whether your company or organisation is active in one of the following 10 food commodities which are considered most at risk of food integrity issues.

- Olive oil
 - Fish
 - Organic food
 - Milk
 - Grains
 - Honey and syrup
 - Coffee and tea
 - Spices
 - Wine
 - Fruit juices
 - Other
-

Please select on which geographical level your company is active.

- Regional
- National
- International: within the European Union
- International: global

Please select the size of the company you work for.

- Micro (<10 employees)
 - Small (<50 employees)
 - Medium-sized (<250 employees)
 - Large (>250 employees)
-

What responsibility do you have within your company with regards to food integrity?

- Research and development
- Marketing
- Quality management
- Sourcing
- Other



Thank you very much for your participation in this study.

Are you interested in the opinion of other stakeholders and experts?

By clicking this [external link](#) you can provide your email address and receive the report with the results of this survey. Your email address will not be linked to your answers in this survey.

This survey is the first of three rounds in which we consult food industry stakeholders (using the Delphi method).

By providing your email address, you will receive **access to findings** and an invitation to provide detailed **feedback on the topic** as well as an **invitation to the stakeholder workshop** that FoodIntegrity (www.foodintegrity.eu) will organize in Belfast on May 28th 2018.

Please contact our researchers with any questions about the topic, by sending an email to fiem.minnens@ugent.be

Appendix III: Round II Questionnaire

Welcome!

One of the biggest challenges currently facing the food industry is assuring **food integrity**. **Information sharing** could facilitate the prevention and detection of food integrity issues. Ghent University and TNO are investigating the feasibility of a **food integrity information sharing system (FISS)** where information of different actors in the food supply chain could be gathered.

To study attitudes among stakeholders in the food supply chain, we are conducting a Delphi study that consists of three rounds.

This is the **second round** and is open to **all interested stakeholders**, regardless of having participated in the first round.



- In the **first round**, a total of 119 food industry stakeholders participated in an online survey between November 2017 and February 2018, being the first phase of a Delphi study.
- In **this second round**, the findings of the first round are presented to you. By consulting different stakeholders (industry, policy makers, authorities, researchers) about their opinion on the results, we are hoping to gain more understanding into some of the findings. You will have the chance to voice your opinion or raise more questions.
- The **third round** will be organized as a workshop where the results of the previous rounds will be presented followed by an interactive discussion. At the end of this survey you have the chance to register for this **workshop taking place in Belfast on 28th of May 2018 (satellite workshop of the ASSET 2018 conference)**

This study is part of the EU FP7 Project FOOD INTEGRITY (www.foodintegrity.eu)

All your answers will be treated anonymously. If you have further questions regarding this study, do not hesitate to contact fienn.minnens@ugent.be

Did you participate in the first round, a survey distributed between November 2017 and January 2018? (not a requirement for joining this round)

- No
- Yes, I completed that survey
- Yes, but I didn't fill it in completely

During the first round, industry stakeholders were shown a **video** (2.5 minutes) to explain the concept of information sharing. If you are interested in watching the video before starting the second round, choose that option below.

- I would like to watch the video before starting this round
- I would like to start



Results of the survey with food industry stakeholders

A total of 119 food industry stakeholders (46% SMEs) – covering all major food sectors susceptible to FI- issues – participated in the online quantitative survey. Within their companies, participants were predominantly responsible for quality management or research and development.

The food industry companies had mostly an international scope, with 23% active within the European Union and 67% on a global scale. About 10% of companies were only active on national or regional levels.

This second round is open to all possible stakeholders and experts.

What type of actor in the food supply chain are you? If you would like you can specify further, but it is not obligatory

- Food industry
- Service to the food industry
- Policy maker
- Researcher
- Law enforcement
- Consumer organisation
- Food authority
- Branch representative
- Lobby organisation
- Other

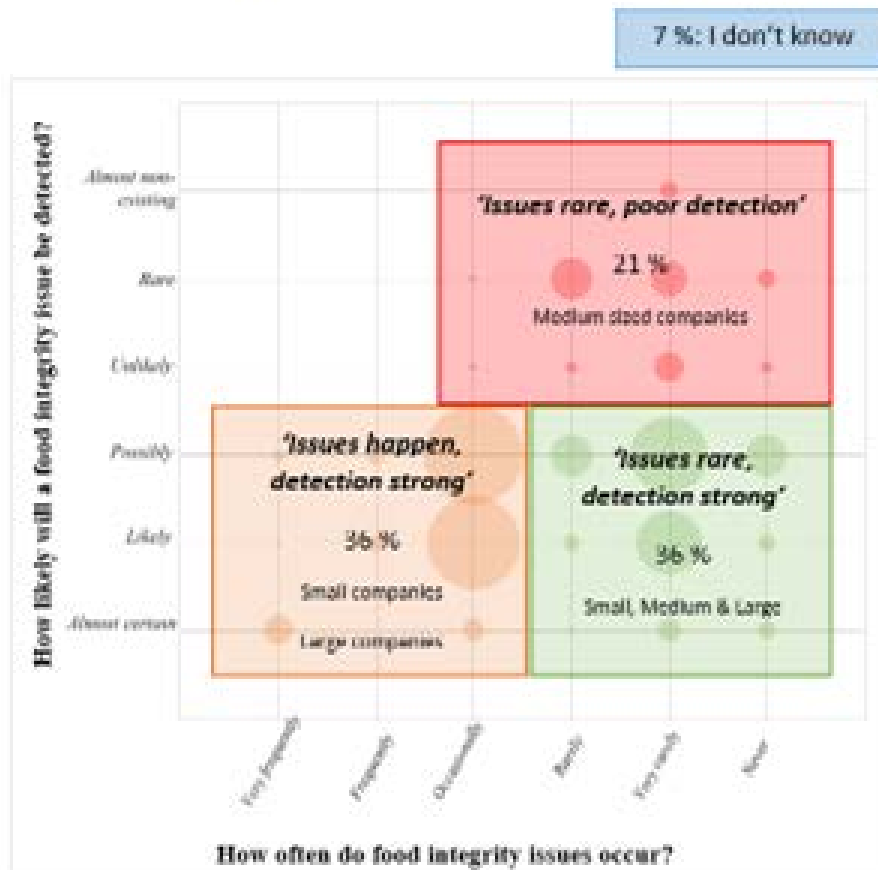
Please select on which geographical level you are professionally active

- Regional
- National
- International: within the European Union
- International: global

Perception about current food integrity issues

The figure below represents the answers the study participants gave regarding

- How often did food integrity issues occur in their company or organisation during the past five years? -> x-axis
- How likely is it that the food integrity issue would be detected considering the measures the company or organisation currently takes? -> y-axis



The sizes of the bubbles represent the amount of participants with a certain combination of answers. The participants can be categorized into three major groups:

- **Green:** Issues occur rarely and detection is probable
- **Orange:** Issues occur more than rarely and detection is probable
- **Red:** Issues occur occasionally or less and detection is unlikely

Please look at the figure and note that:

- Blanc spot in the left top corner: none of the participants perceive both the frequency of occurrence high and likelihood of detection low
- Red group consists mostly of medium- sized companies
- Orange group is overrepresented by small companies and large companies

Facing these results of industry stakeholders' perception of frequency and detection of food integrity issues, please select your opinion:

To my opinion, food industry stakeholders _____ the frequency of food integrity issues occurring

Overestimate

Realistically estimate

Underestimate

Please explain why you chose this answer

To my opinion, food industry stakeholders _____ the likelihood of detecting food integrity issues.

Overestimate

Realistically estimate

Underestimate

Please explain why you chose this answer

The bubble graph has a blank spot in the upper left corner, showing there are no respondents signalling a high frequency of occurrence of issues combined with a low likelihood of detection.

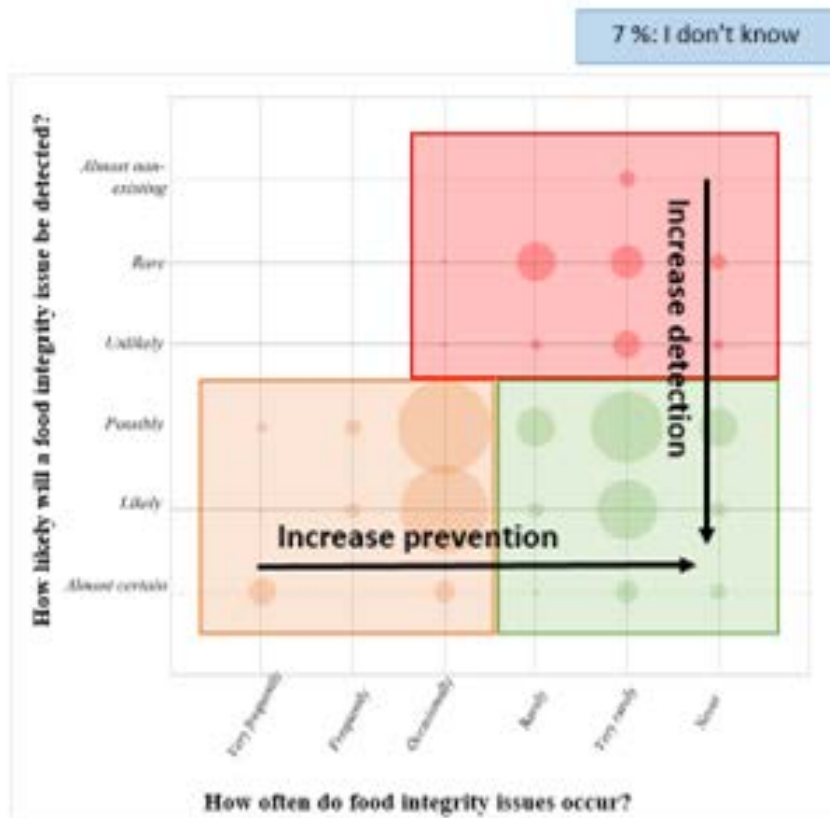
To your opinion, is this blank spot realistic? Please explain your answer.

Yes, it is realistic

No, it is not realistic

Potential of information sharing among the different actors in the food supply chain

The bubble graph shows a potential for improvement. An ideal situation would be that food integrity issues occur very rarely or never and when they do occur, that they are certainly detected.



The study further inquired whether stakeholders believed information sharing between actors could help the prevention and detection of food integrity issues.

- 84% of consulted stakeholders agreed that information sharing improves the prevention of food integrity issues.
- 84% of consulted stakeholders agreed that information sharing facilitates the detection of food integrity issues



Furthermore, industry stakeholders have a positive attitude towards information sharing with a mean score of 4.49 on a 5-point scale.



To what extent do you agree with the same statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
information sharing facilitates the detection of food integrity issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
information sharing improves the prevention of food integrity issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

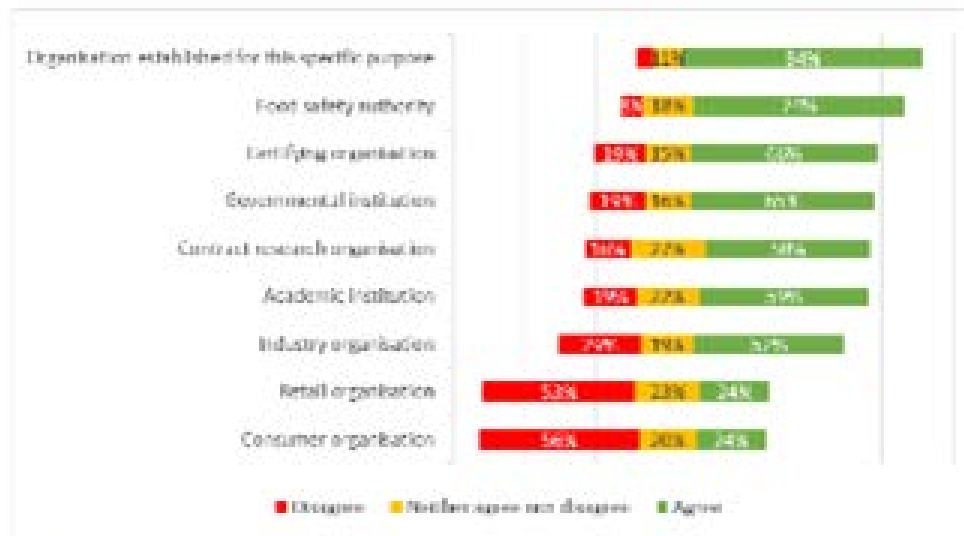
Please explain your answer about the role information sharing can play to prevent food integrity issues

Please explain your answer about the role information sharing can play to detect food integrity issues

A food integrity information sharing system: which trusted third party is most suitable?

One of the main questions about organizing a food integrity information sharing system is the choice of the trusted third party that will manage such a system and to manage the data in the system.

Participants in the survey answered the question which third party is most suitable to organize a food integrity information sharing system.



Note that:

- A food safety authority (74%) or a newly established organisation (84%) were believed to be the most suitable parties
- Consumer organisations (24%) and retailers (24%) are perceived least suitable

'A new organisation established for this specific purpose' was perceived the most suitable.

To which extent do you agree that a new organisation is a suitable trusted third party?



What type of organisation could this be? (Private/public? ; European/national ; Non-profit?)

Which criteria should this new organisation fulfil?

'Food safety authorities' are also perceived suitable by 74% of participants.
To which extent do you agree that food safety authorities are a suitable trusted third party?

Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree

Please explain why you chose this answer

Do you see this role for national or international food safety authorities? Why?

- National
- International
- Both

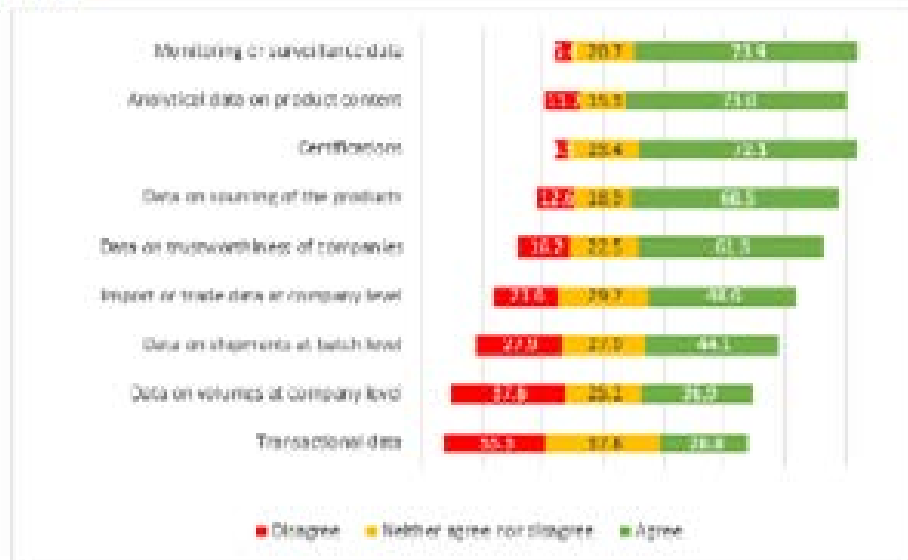
Retail and consumer organisation are perceived least suitable to organize a trusted third party.

In your opinion, might these have another role within such a system?

Please provide any other feedback you would like to give about the results on trusted third party?

A food integrity information sharing system: what types of data are actors in the food industry willing to share?

The figure shows to which extent food industry actors would be willing to share different types of data.



Note that:

- Over 70% of the participants agree to share monitoring data, analytical data and certificate information
- Over 20% disagree with sharing data on import or trade, data on shipments, data on volumes or transactional data

In your opinion, what is the reason behind the reluctance to share data on volumes and transactions?

Please tick the conditions you think should be met to increase industry stakeholders willingness to share data on volumes and transactions

- Only anonymized data can be seen by other actors
- With the condition that companies can trust that their competitors and other actors in along their supply chain will share the same information
- The system output consists only of a number of Food Integrity Indicators that are based on the data
- No raw data can be seen by other actors
- Only aggregated data can be seen by other actors
- Only the trusted third party can access the data
- Only the raw data which underlie Food Integrity Indicators can be accessed by others

Please provide any other feedback you would like to give about the results on the types of information?

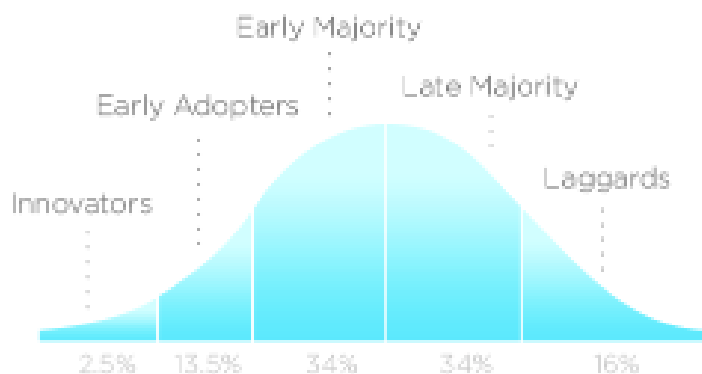
Which first steps can be taken towards a food integrity information sharing system?

The results presented on the previous pages show food industry stakeholders support the concept of a food integrity information sharing system and give more details about their conditions to join.

Who should take the initiative to launch a food integrity information sharing system?

According to you, would a pilot case be useful to start up a FI-ISS? Which case could be fit to start?

Imagine a food integrity information sharing system would be set up, when would you join?



INNOVATION ADOPTION LIFECYCLE

- Immediately (Innovator)
- Not immediately, but after a few actors in my sector have joined (Early adopter)
- When over 15% of actors in my sector have joined (Early majority)
- When over half of actors in my sector have joined (Late majority)
- When over 74% of actors in my sector have joined (Laggard)

Thank you for sharing your opinion on the results of the first round.

Please share any further comments or questions you have regarding the topic.

Thank you for your participation in this second round. Join the final round in Belfast!

Would you like to receive the invitation and the program of the workshop through email, provide your email address [here](#)

Appendix IV: Round III Discussion guide

	CONSENSUS ON KEY SUCCESS FACTORS		DISCUSSION POINT	
	<p>“A food integrity information sharing system will help prevent and detect FI issues”</p> <p>Agreement? Relevance?</p> <ul style="list-style-type: none"> Is it indeed a priority to invest in such a data sharing system? Is it more relevant to invest in good and fast analytical methods? 	<p>“A new organisation should manage the FI-ISS”</p>	<p>Agreement? Feasibility?</p>	<p>Private/Public</p>
<p>Initiative and funding</p>				<ul style="list-style-type: none"> Who should take the initiative to set up the organisation? How should it be funded?
<p>“Data and information confidentiality needs to be guaranteed”</p>		<p>Agreement? Feasibility?</p>	<p>No access to raw data</p>	<ul style="list-style-type: none"> Can the system be effective if the participants don't have access to raw data?
			<p>Sensitivity of data on volumes and transactions</p>	<ul style="list-style-type: none"> Which criteria need to be taken into account Does a system really need this information to be effective?
<p>“Food Safety Authorities need to be involved in the FI-ISS”</p>		<p>Agreement? Feasibility?</p>	<p>Access for FSA</p>	<ul style="list-style-type: none"> How much access to data would the FSA be allowed to have?
			<p>Uncertainty about reaction FSAs in case of issues</p>	<ul style="list-style-type: none"> How will FSA's react to alerts in the system
<p>“All actors in the supply chain need to be in the system”</p>		<p>Agreement? Feasibility?</p>	<p>Participation mandatory?</p>	<ul style="list-style-type: none"> How to ensure that all necessary actors in the food chain (can) take part? Is regulation needed?
			<p>Available for SME's?</p>	<ul style="list-style-type: none"> How likely is it that SMEs can take part in data sharing initiatives – and if they cannot, how will this influence the success of such a system

Appendix V: Round III Workshop invitation



Key success factors for a food integrity information sharing system

Insights from a stakeholder study and interactive discussion

Satellite workshop of ASSET 2018 SUMMIT – May 28th 2018

One of the biggest challenges facing the food industry is assuring food integrity. Information sharing could facilitate the prevention and detection of food integrity issues. Are food industry actors interested to participate and what are their conditions for a food integrity information sharing system?

Program

- 15.30 Results of a large stakeholder consultation (Ghent University)
Insights on attitudes towards information sharing, advantages and disadvantages, conditions, suitable third party, data sharing and transparency.
Key functions of a future information system to pro-actively support food integrity (TNO)
Early indicators for food non-integrity and the challenges to collect and analyse the data
- 16.15 Break-out sessions for further discussion on most diverging topics
Which types of data can be shared? Which third party could organize a system? Which first steps can be taken?
- 17.00 Reporting back and conclusions
- 17.30 Network reception

Date & Venue

May 28th 2018 (15.30 – 18.00)

Riddel Hall - Queen's University Belfast (185 Stranmillis Road, Belfast)

Interesting for ...

- Food industry stakeholders
- Researchers
- Policy makers
- NGO's

Registration

- [Register here](#)

Organisation and contact details

This workshop is organised as a part of the European Research Project FOOD INTEGRITY. The organisers are Ghent University (Belgium) and TNO (The Netherlands). For more information, please contact Fien Minnens (fienn.minnens@ugent.be)

Appendix VI: Round III Presentation slides used during interactive workshop



Key success factors for a food integrity information sharing system

Insights from a stakeholder study and interactive discussion
Satellite workshop of ASSET 2018 SUMMIT – May 28th 2018 - QUB Belfast

EU FOOD INTEGRITY – Ghent University (Belgium) – TNO (The Netherlands)





Food Integrity



Assuring quality and authenticity in the food chain

Comprising 60 participants from 18 European countries and one from China and one from Argentina, Food Integrity's key focus is to consolidate, harmonise and mobilise the European capability on food authentication to ensure consumer confidence and protect European added value.

21 Work Packages

www.foodintegrity.eu

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 613688 

WP17 Feasibility study on information sharing and analysis along the food chain to identify emerging food integrity issues

Work Package 17

Partners: TNO, Ghent University




1. To demonstrate the technical possibilities of sharing information without competition issues and the potential of information analytics to identify food integrity issues at an early stage
2. To research the actual feasibility (and willingness) in the food chain of setting up, managing and using a system for the early identification of food integrity issues among food chain stakeholders

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 613688 

Workshop Organisation

Ghent University

TNO

Prof. Wim Verbeke

Nels Lucas Luijckx

Dr. Isabelle Soen

Fred van de Brug

Fien Mnnens



Program

15:30 Introduction

Key functions of a future information system to pro-actively support food integrity (TNO)
Early indicators for food non-integrity and the challenges to collect and analyse the data

Results of a large stakeholder consultation (Ghent University)
Insights on attitudes towards information sharing, advantages and disadvantages, conditions, suitable third party, data sharing and transparency.

16:15 Break-out sessions for further discussion on most diverging topics
Which types of data can be shared? Which third party could organize a system? Which first steps can be taken?

17:00 Reporting back and conclusions

17:30 Network reception



Food Integrity Information Sharing System?





WP17

Early indicators for food non-integrity and the challenges to collect and analyse the data

Fred van de Brug, Niels Lucas Luijckx, Christopher Brewster

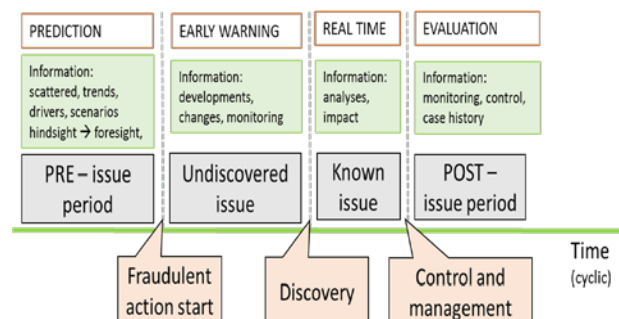


Contents

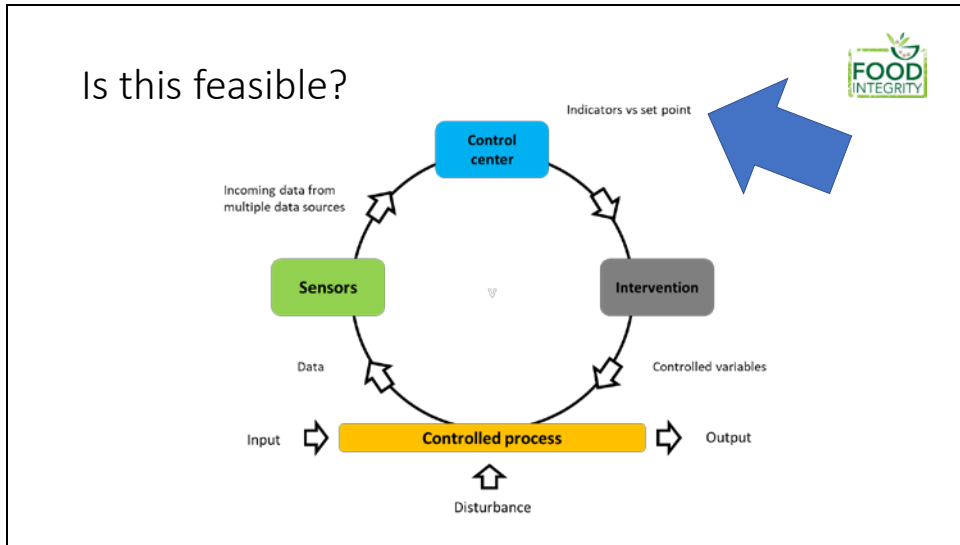
- Introduction
- In hindsight
- Indicators
- Conclusions
- Recommendations



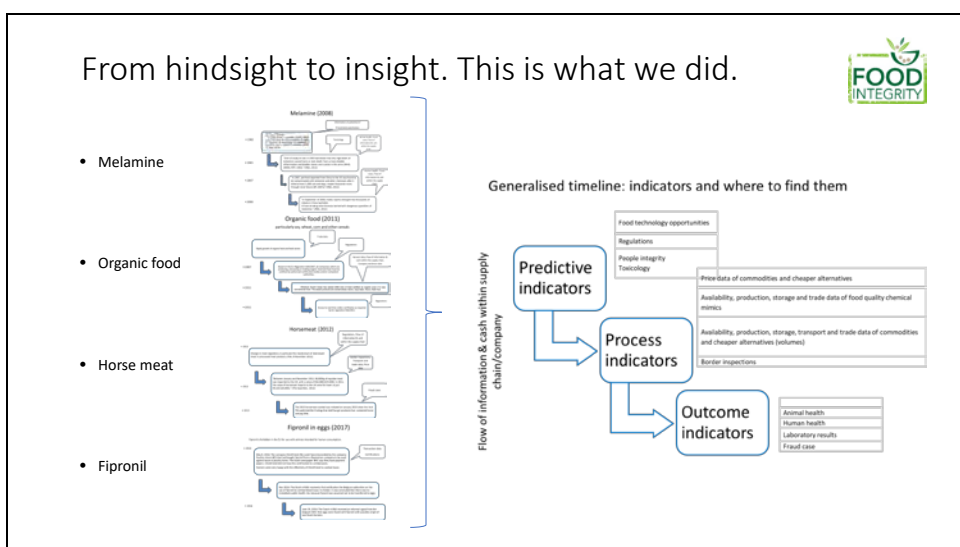
Introduction

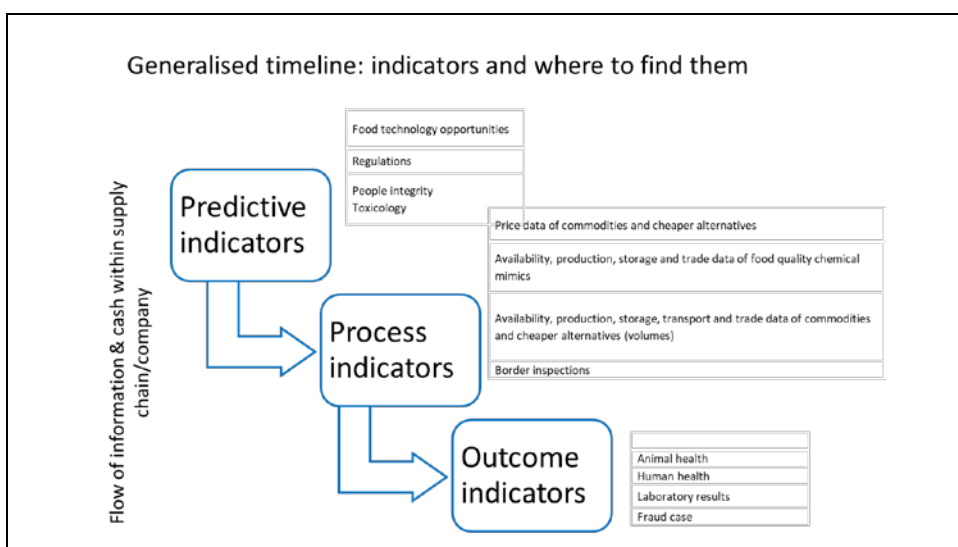
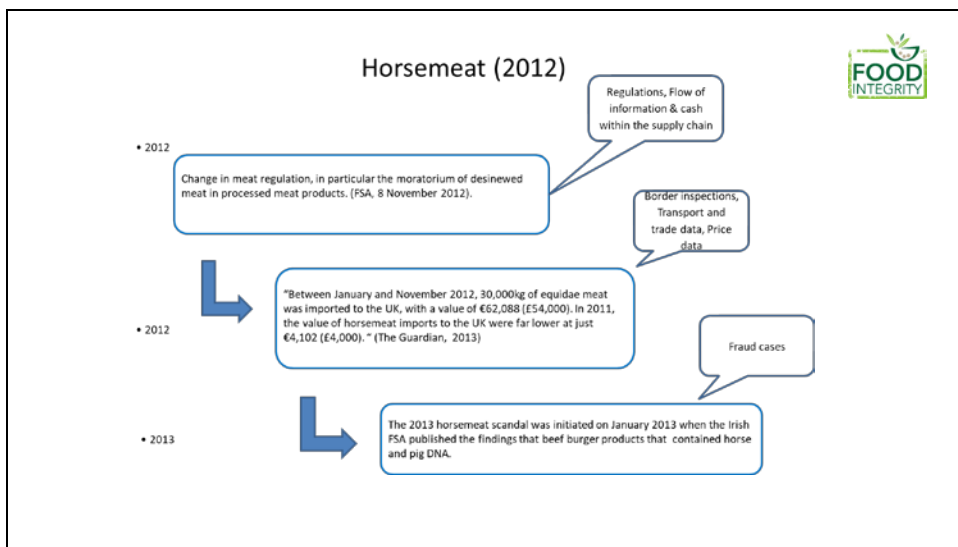
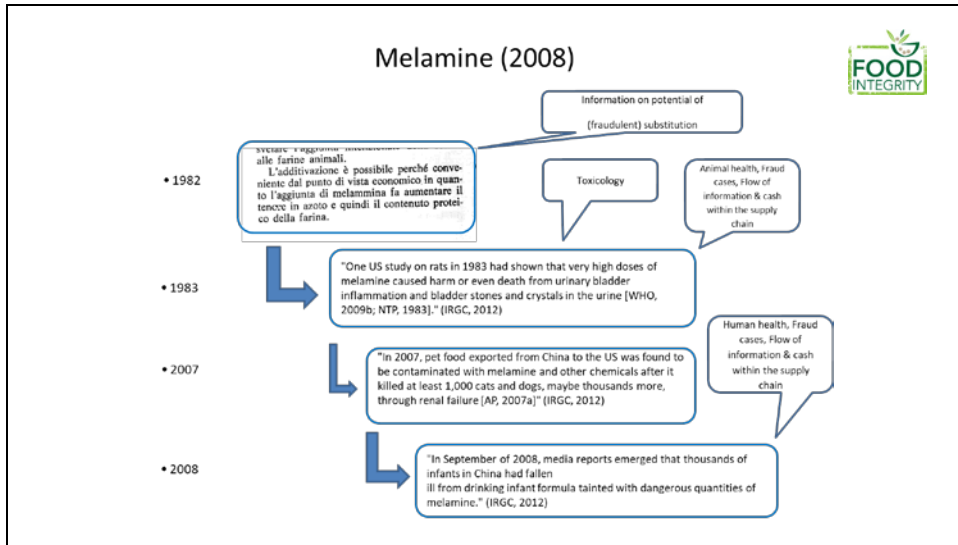


Issue cycle applied for fraudulent actions in the food chain



- ### Indicators (analogy to the medical domain; Mainz, 2003)
- **Predictive indicators** attempt to be early signals of an event what may be happening in the future.
 - **Process indicators** denote what is actually happening while an event is developing and which lead to the actual outcome (e.g. detection) of the event.
 - **Outcome indicators** attempt to describe the final effect of an event, by which the event is diagnosed and which triggers mitigation or treatment.





Predictive indicators

Nr	Indicator	Indicator description	Usefulness (authors opinion)	Possible data sources
1	Predictive	"Risk profile" is composed of multiple parameters. (e.g. risk countries, history of product/company integrity issues, low profitable sector, products with low or lowered price level, products with high added value, anomalies in business finance).	High, public data available	Information on products (public recalls), suppliers & countries (public recalls). Business news
2	Predictive	Mass disbalances	High, but company private data	Private company data
3	Predictive	(Unexplained) anomalies (e.g. credit card fraud, unusual transactions).	High, but private data	Financial data, private
4	Predictive	Products produced before a relevant change in regulations AND a change to 'risk' supplier or country	Low, partly private company data	EU, US (and others) regulations & company data
5	Predictive	(Expected) volatile products prices products in combination to possible illegitimate profit that can be made.	Low, public data	Market & economic data in newspapers, specialized websites
6	Predictive	(Expected) shortage of products in combination to possible illegitimate profit that can be made.	Low, public data	Market & economic data in newspapers, specialized websites
7	Predictive	(Expected) surplus of products that can be used as alternative for higher priced product.	Low, public data	Market & economic data in newspapers, specialized websites
8	Predictive	(Expected) surplus of potential chemical adulterants.	Low, public data	Surplus chemicals websites

Process and outcome indicators

Nr	Indicator	Indicator description	Usefulness (authors opinion)	Possible data sources
9	Process	Imbalance between costs vs quality/effectivity/potential supply capacity ("too good to be true") AND suppliers with a risk profile.	Low, partly private company data	Product information sheets & Market & economic data in newspapers, specialized websites
10	Process	Missing or otherwise non-integer paperwork.	High, but private data	Private company data
11	Outcome	Acute effects in humans with (possible) link to feed/food	High, partly public data	Medical reports, social media and scientific literature, NTP, FDA, EFSA, IARC (WHO) and others
12	Process	Acute effects in animals with (possible) link to feed	High, partly public data	Veterinary medical records, pet food complaint reports, consumer complaints.
13	Outcome	(Unexplained) anomalies in chemical analysis	High, partly private company data	Analytical data
14	Outcome	Historical cases may repeat themselves somehow	High, public data	Description of historical cases in e.g. science literature, RASFF data.

Indicators shortlist (most useful, most feasible)



Indicator	Indicator description
Predictive	"Risk profile". Transactions made with companies with a risk profile (e.g. risk countries, history of product/company integrity issues, low profitable sector, products with low or lowered price level, products with high added value, anomalies in business finance). This indicator is a panel of multiple parameters.
Predictive	Mass disbalances
Predictive	(Unexplained) anomalies (e.g. credit card fraud, unusual transactions)
Process	Missing or otherwise non-integer paperwork.
Outcome	Acute effects in humans with (possible) link to feed/food
Process	Acute effects in animals with (possible) link to feed
Outcome	(Unexplained) anomalies in chemical analysis
Outcome	Historical cases may repeat themselves somehow

Conclusions



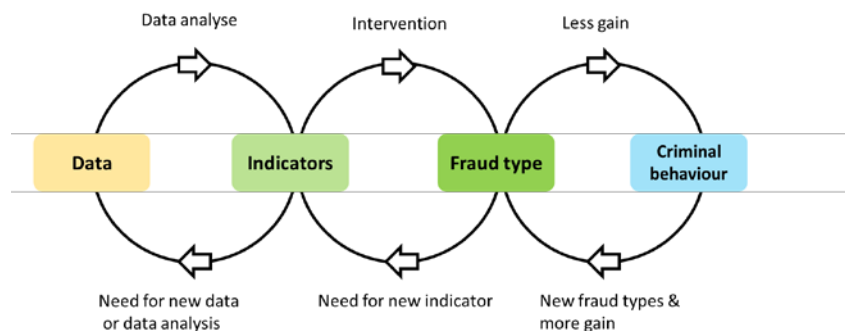
- Indicator shortlist must be dynamic
- What to share: data – information - indicators
- Public vs private data
- Data analysis:
 - The food sector lags behind other sectors: risk of shift of criminal activity
 - Very few use cases published in science (Bayesian network, text mining)

Recommendations



- Data architecture must protect company data / privacy
- Data analysis:
 - Implement above reasoned indicators
 - Learn new indicators from historical/knowns data set
 - Build further on existing methods, e.g.
 - predictive Bayesian networks
 - text mining for early signals
 - More research on predictive models is needed
- Future project: use case, set up architecture, data, test the indicators

Future





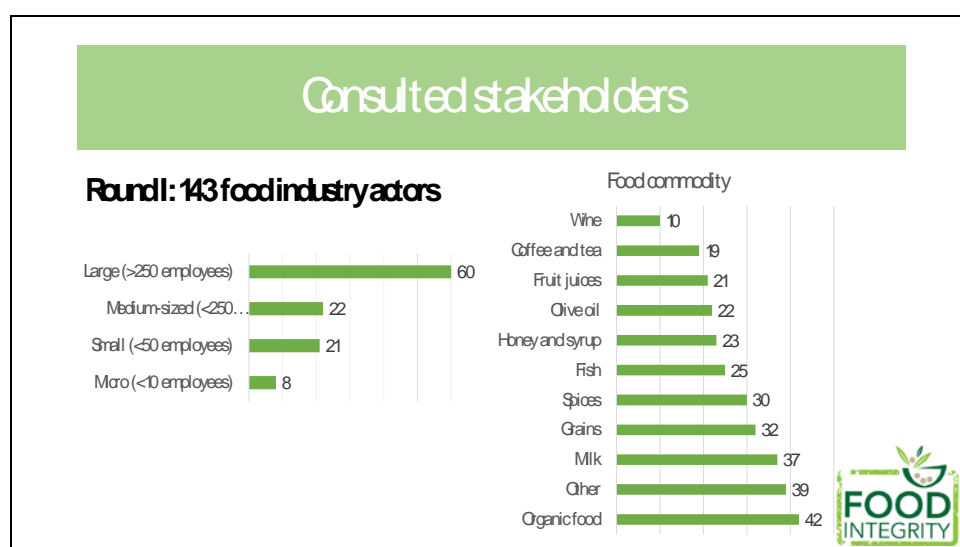
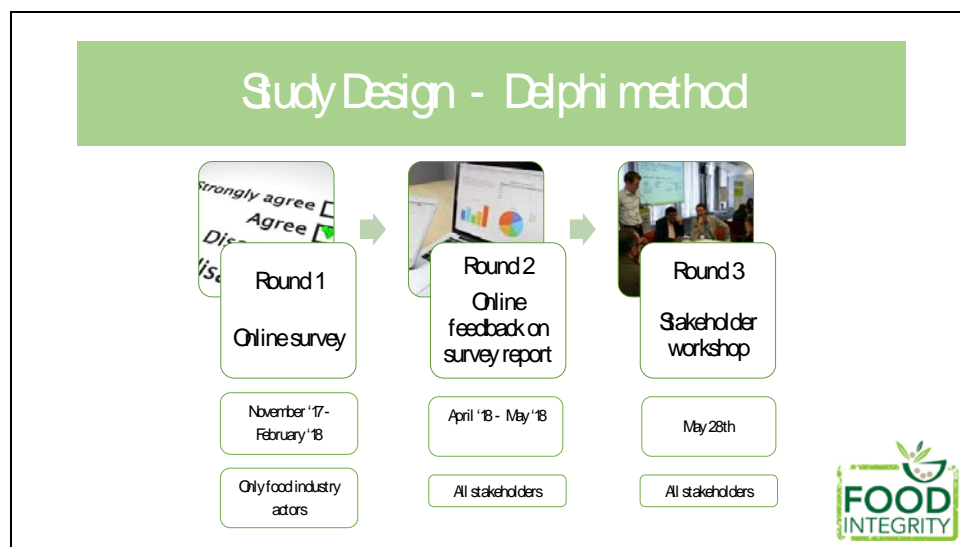
Key success factors for a
food integrity information sharing system

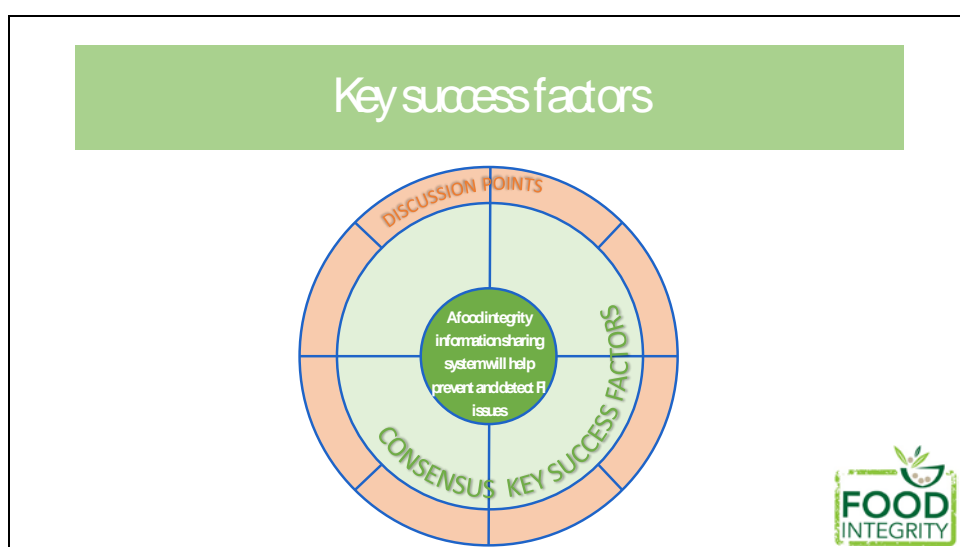
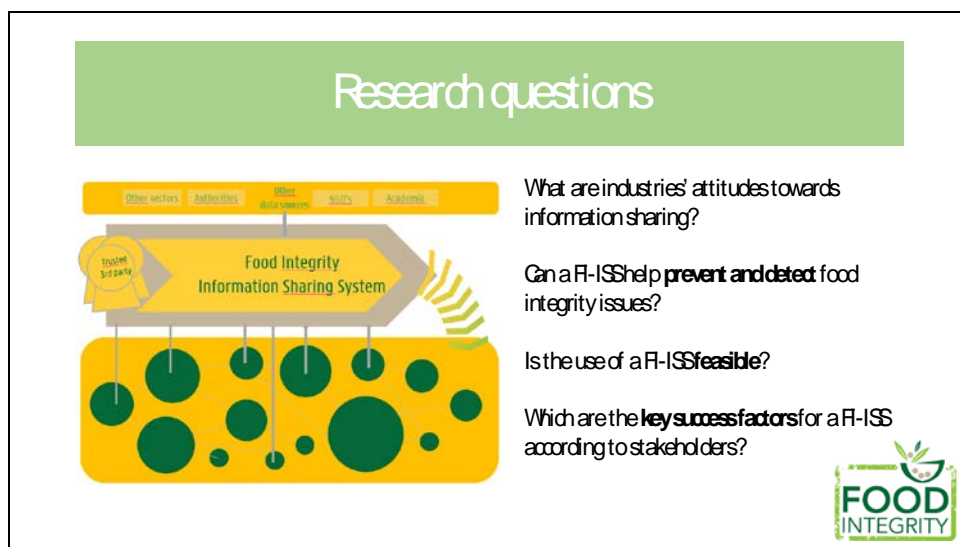
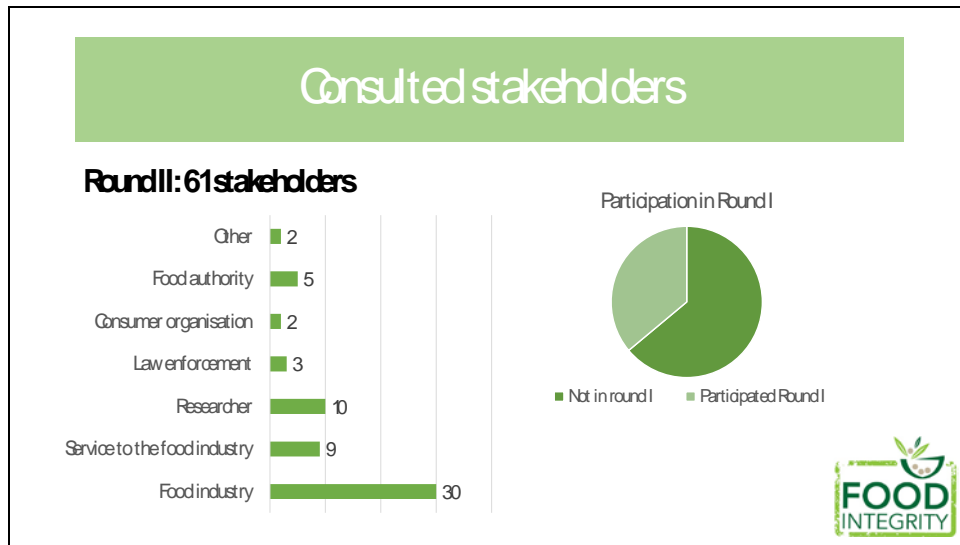
**Food industry stakeholders' perspectives
on sharing information
to prevent and detect food integrity issues**

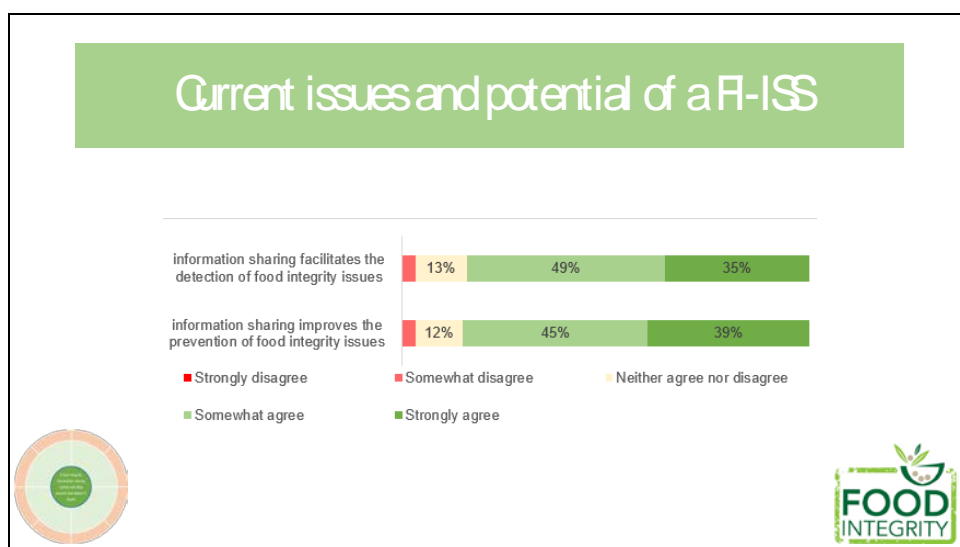
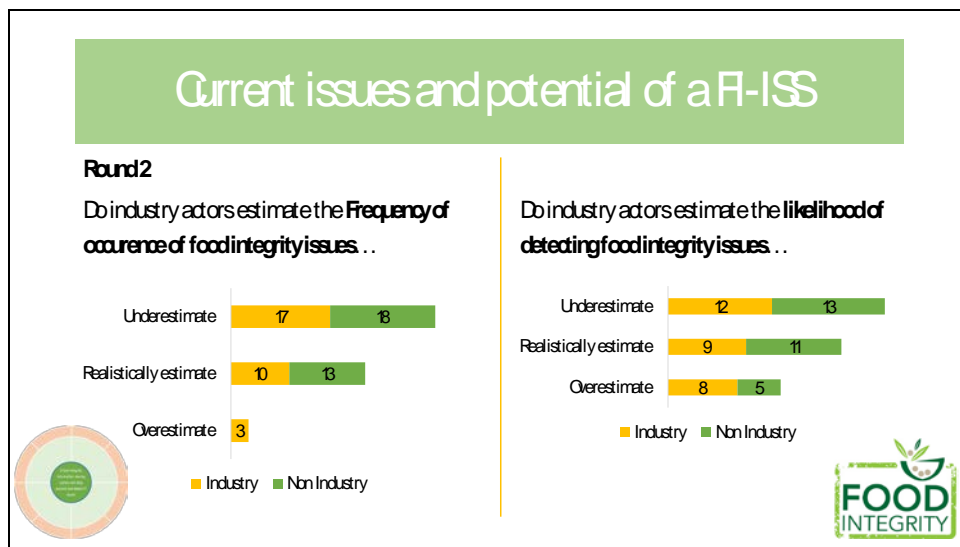
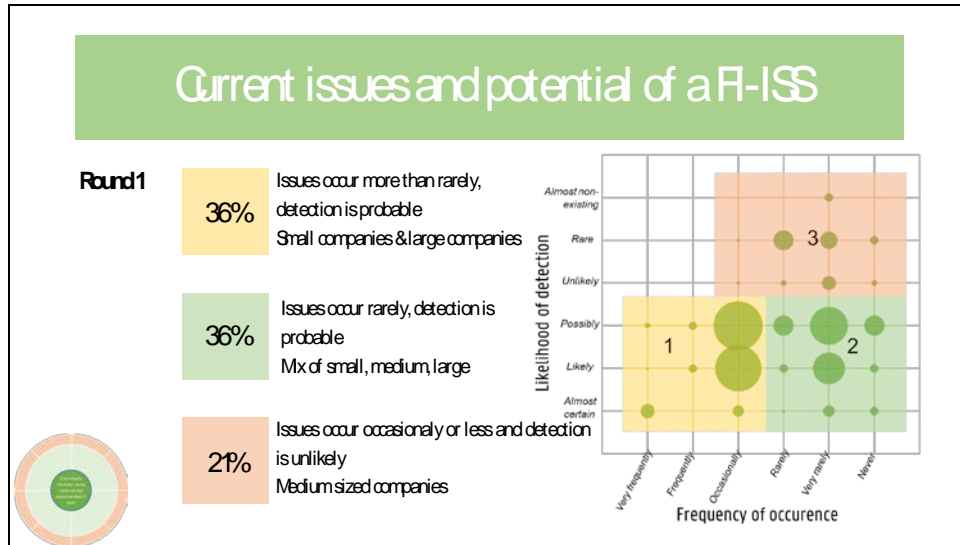
Fien Minnen, Isabelle Soen, Nels Lucas Luijckx, Fred van de Brug, Wim Verbeke





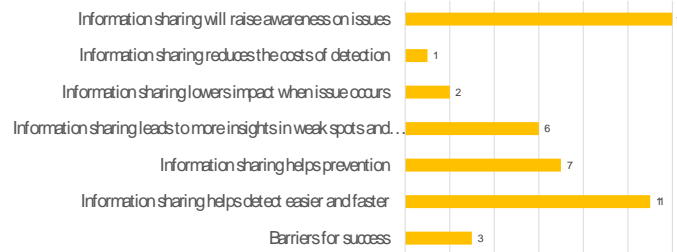




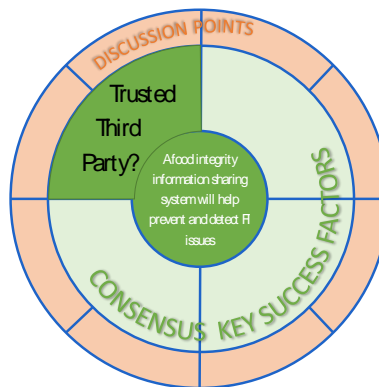


Current issues and potential of a FI-ISS

Number of times following statements were made in Round II (n=61)

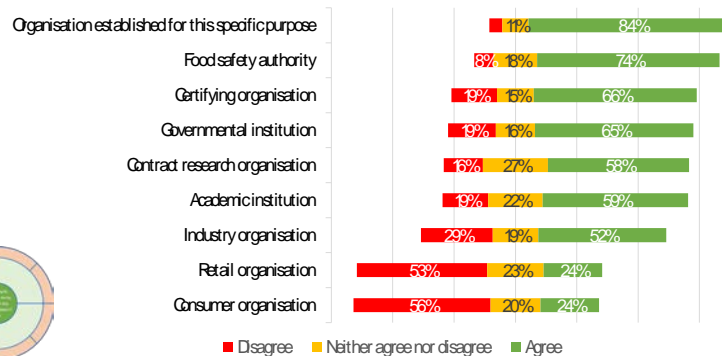


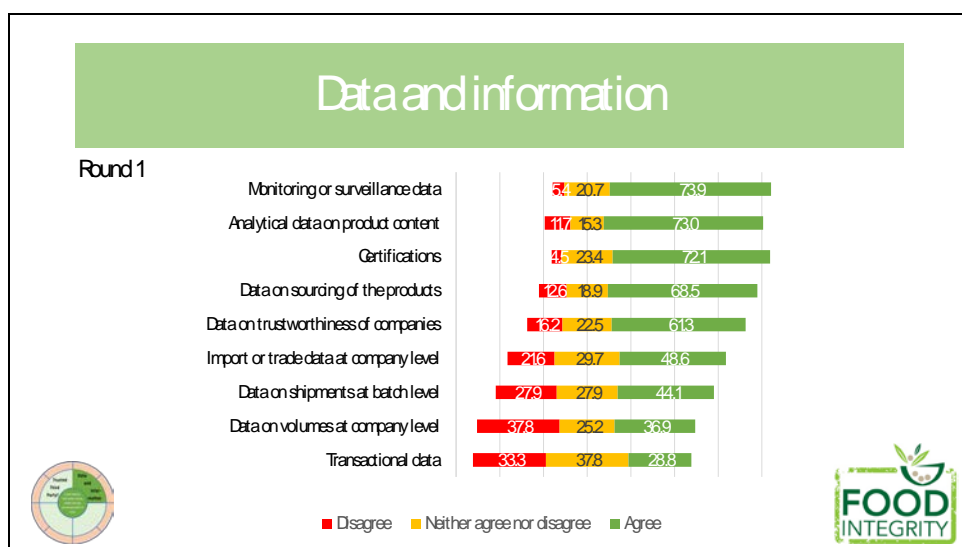
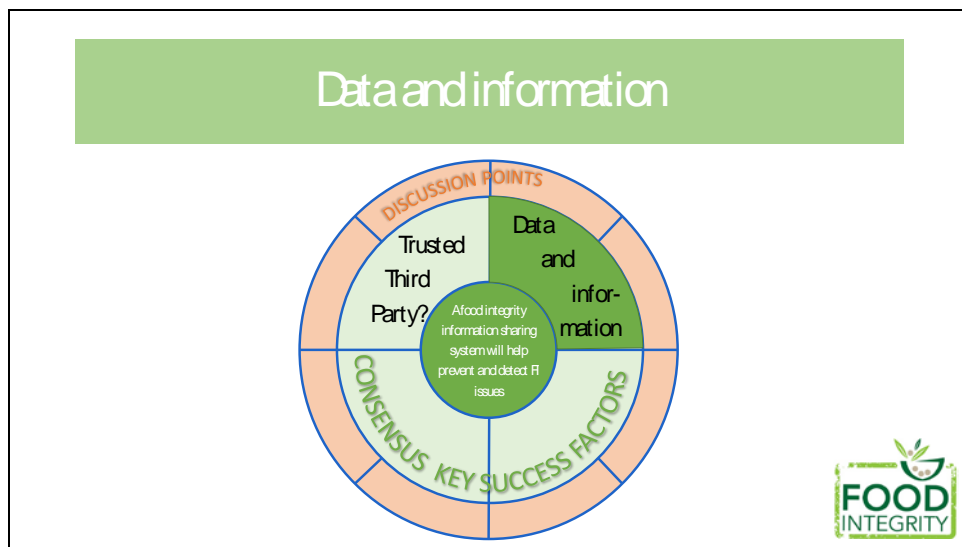
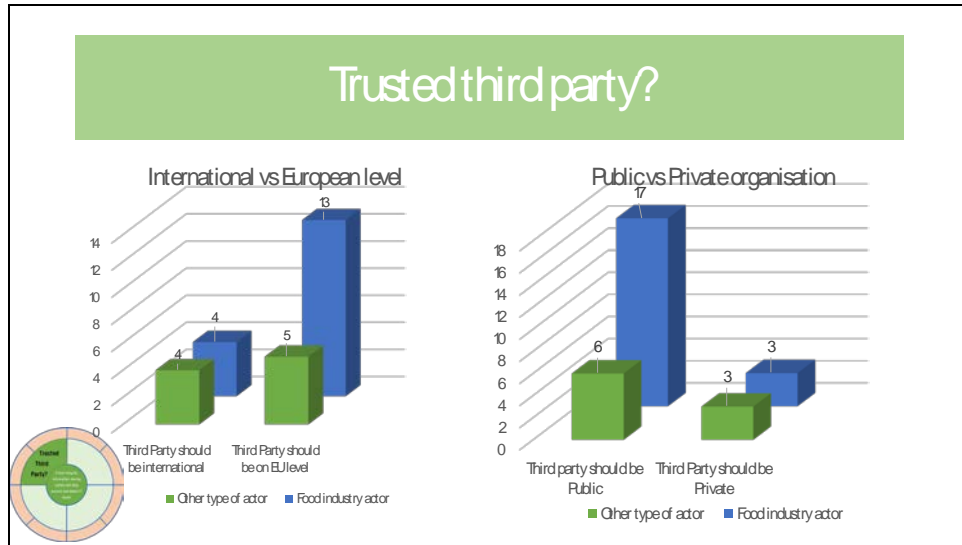
Trusted third party

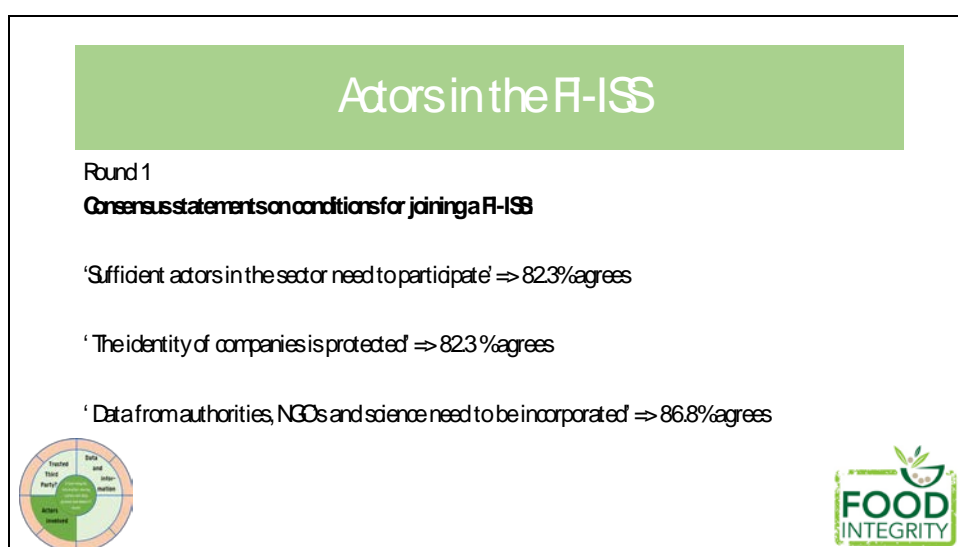
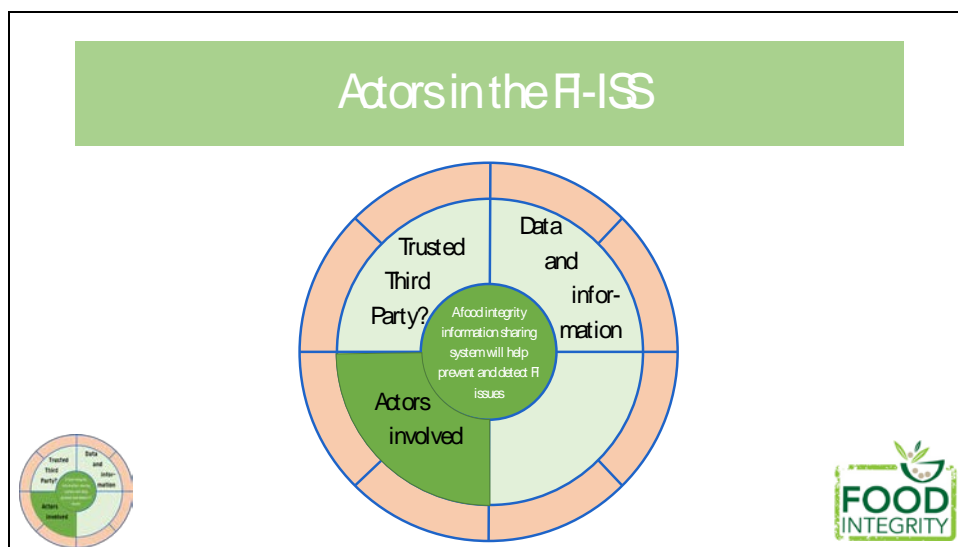
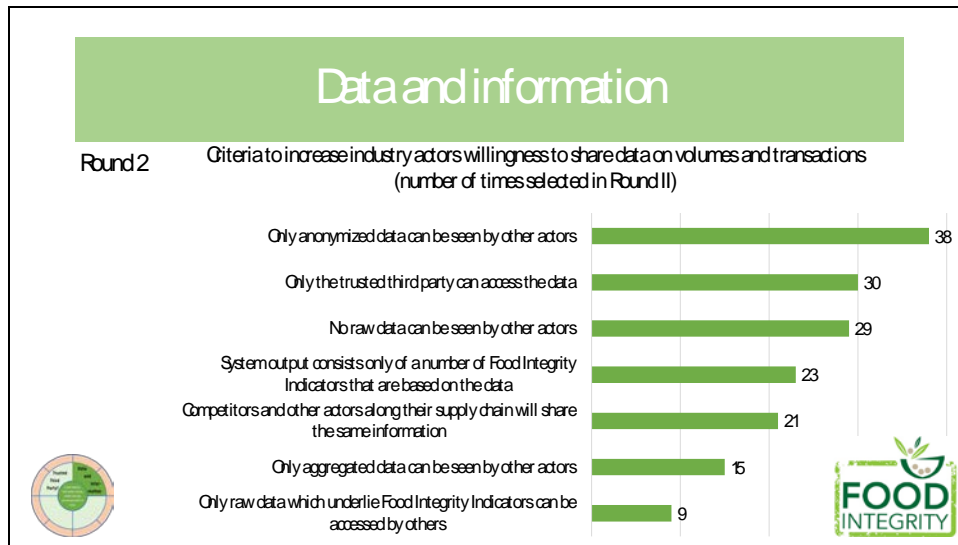


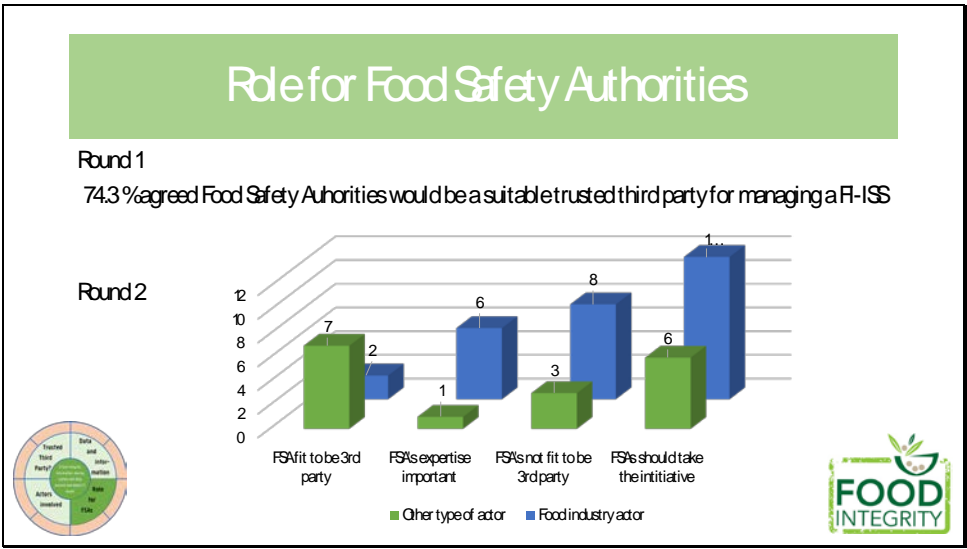
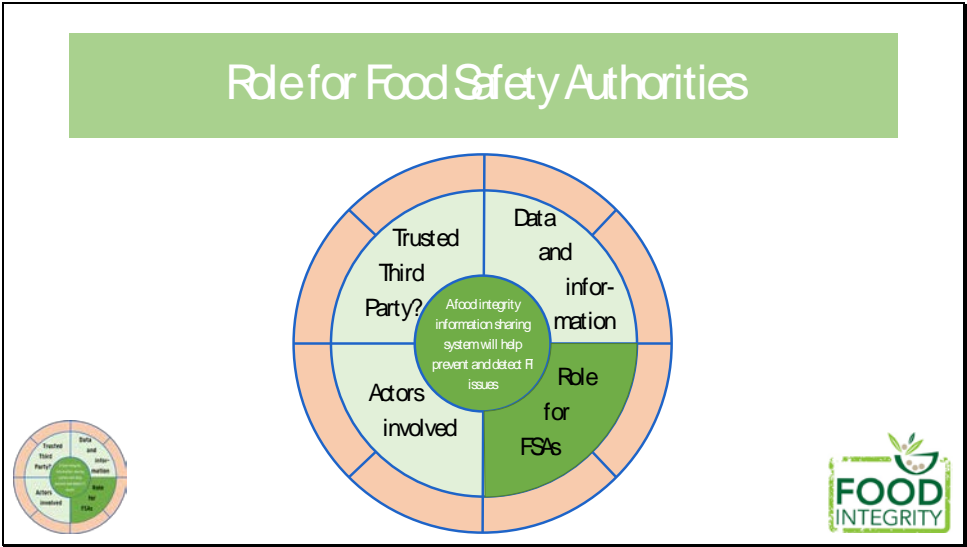
Trusted third party?

Round 1









- ## Break out Session
- 4 groups
 - 45 minutes
 - Moderator
 - Discuss your opinion on the key success factors and their feasibility
 - Debate on the discussion points
 - Reporting back at 17:00

Break out Sessions

A food integrity information sharing system will help prevent and detect FI issues

A new organisation should manage the FI-ISS

Data and information confidentiality needs to be guaranteed

All actors in the supply chain need to be in the system

Food Safety Authorities need to be involved in the FI-ISS

Initiative and funding

No access to raw data

Security of data on consumer and production

Intervention to ease of an issue?

How much access to data?

Participation mandatory?

Applicable to all countries (e.g. UK, EU)

Public or private

Key success factors for a food integrity information sharing system

Thank you for your participation

www.foodintegrity.eu
 fien.minnens@ugent.be

Appendix VII: Notes from the working groups during Round III

Group 1 (Moderator: Niels Lucas Luijckx - TNO)

“A food integrity information sharing system will help prevent and detect FI issues”

“all actors in the supply chain need to be in the system”

- In general 100% agreement → including regulatory bodies, retail!!, NGOs (! ?)...
- But, systems already exist, e.g. in organic chain and other specified chains or networks, build on joining systems (inventory), overarching system;
- However, crises in past (e.g. Norway, E. Coli, 2007) did demonstrate that existing systems do not (always) work properly, conflicting interests and perspectives;
- People/businesses with bad intentions won't share (join), this is however also a benefit as it also indicates the bad guys if everyone else joins;
- Regulatory bodies have a legal reason, however this is contrary to anonymity of data/information....
- What is the benefit for participants, the reward?
- Broaden focus (fraud and safety)

“data and information confidentiality needs to be guaranteed”

- YES
- Also TRUSTED data, and COMPLETE
- There is doubt on whether participants in the system will share all or enough to be able to analyze integrity issues
- There is a doubt whether information shared will be uncovering issues at all.

“food safety authorities need to be involved”

- YES, mandatory AND retailers !!

“a new organization should manage the system?”

- YES

Group 2 (Moderator: Prof. Wim Verbeke – Ghent University)***'A food integrity information sharing system will help prevent and detect FI issues'***

- Fraud or integrity should not be a means to differentiate from competitors (=the idea that food integrity should be pre-competitive, similar as food safety)
- As an argument for the request to consider food integrity as pre-competitive: the negative publicity often refers to a country rather than an individual company, and the bad reputation is often longer remember in terms of the country where the event happened than the company that was involved. As an example: Manuka-honey, which is clearly associated with New-Zealand, and where food integrity issues impact the image of NZ as a country rather than individual companies.

"a new organization should manage the system?"

- Arguments for public organization: more sustainable in the long run, authority to supervise, monitor and control, can easily subcontract specific tasks to e.g. technology providers, e.g. EC institutions that monitor the FI-ISS
- Private organization: most suitable might be technology company, since the key of a FI-ISS will be technology-related. Drawbacks in case of a private organization: data might be too sensitive to be shared and handled by a private organization; differences in food product categories might be too complex to be handled by a single private organization
- Other remarks: must be for profit – might otherwise not function well; beware of issues with so-called anonymized data – some cases of anomalies have already been detected; there is no match between a system aimed for controls on one hand, and the use of open source data on the other hand

"data and information confidentiality needs to be guaranteed"

- Only information should be shared, not raw data
- Questions about the possibility to pay for data
- Suggestions to rely on / integrate open source data
- Objectives of different stakeholders are too different to share data

"food safety authorities need to be involved"

- Ideally, FSAs should have a role in monitoring and overviewing the system, and assessing the protocols;
- Access for FSAs should be limited to information, not to data since data should stay inside companies
- Reaction in case of an issue: it will be important not to react too early and gather further evidence first, e.g. to detect the source of the incident. This requires specific investigative skills, reference to police work. This is not the job of FSAs; they act now as risk assessors, not as risk managers. A specific and new skills set might be needed.

"all actors in the supply chain need to be in the system"

- Mandatory participation: most probably not realistic
- SMEs: might lack the resources to upload data
- Other: beware of regulation that is based on mistrust; ideally and feasibly: one up, one down; only sharing what is strictly required to stay in business

Group 3 (Moderator: Fien Minnens – Ghent University)

“A food integrity information sharing system will help prevent and detect FI issues”

- Just sharing is ok, it depends on granularity of data and what you do with the data
- Important that stakeholders get a clear message
- You have to start somewhere
- Is it just sharing system or also collecting data?
 - first importance is the data
 - from historical data we can understand how fraud is committed
 - if data is available we can do more in detection
 - authorities are not sharing data, all such data is confidential
 - You need to have clear end point/purpose of data
 - e.g. prediction of fraud on border wines
 - need to be clear purpose
 - and how that data will be made available
 - Clarity on degree or what is shared - TRANSLUCENCE
 - important to have rules and protocols

“a new organization should manage the system?”

- cf. FIIN - trusted third party set up by industry
- we need the third party chosen by the industry to have confidence in it
- not important but impartiality and conflict of interest is important
- big companies tend to monopolise
- deal with conflict of interest
- What about a hybrid? Government + industry, a joint effort
- Most answer were it should authority driven
- We need to protect both industry as well as consumer
- In terms of food safety we do not have a transparent system. You will never find a label that food is safe!
 - Defined by law that it will be safe
 - Food fraud is different - no longer know what is "authentic"
 - Transparency is not the real issue
 - Most of food fraud is b2b - driven to make money
 - Goal of such a system should be to allow people to protect themselves
 - Driver is often to protect the product

“data and information confidentiality needs to be guaranteed”

- Raw data -- would it be possible to collect completely?
- Would a system be efficient only with indicators of aggregate data?
- You need metadata!
- If an issue occurs should the data be made available?
 - Not for everyone
 - Anonymizing or sharing aggregate data - not identifiable?
 - Authority have monitoring data

- There is a game of hide and seek between industry and public authority
 - Industry not prepared to share all data
 - Most data on paper
 - Shifting to machine readable data would change the name of the game
 - We need to be very careful what the consequences are
 - We need to start small.
- Is this feasible?
- If we apply ML then people can decide after
 - level of sharing needs to vary
 - How do we motivate farmers? E.g. from persuading them by giving them a service
- Unintentional food safety issues
 - if traced to you can do a lot of harm
 - you should not be afraid
- Are we talking about data sharing or intelligence sharing?
 - easier to share intelligence than data

Group 4 (Moderator: Isabelle Sioen – Ghent University)

'A food integrity information sharing system will help prevent and detect FI issues'

- Everyone agrees on that statement, there is a clear consensus within this group
- Why?
 - o Already so many different data collection systems exists (managed by many different organizations, at different sector levels) -> however, there is a need for one general system where all relevant data can be brought together; currently links between the different systems are lacking
 - o By bringing different data systems together, we can learn from each other
 - o Combination of many different analytical datasets would be highly relevant
 - o Besides analytical data, it would also be very interesting to analyses social media data -> analytics of social media data can be used as 'early indicators' for a food integrity problem ("*indications that something is going on*")
 - o It would be relevant to have a system containing and linking all kind of data (qualitative as well as quantitative)

Some more general aspects that were discussed as well:

- Consumers do not distinguish between food integrity issues with a health risk (e.g. dioxins in food) and without a health risk (e.g. sugar in honey); in general, every food integrity problem is related to a very negative perception on the level of the consumer

'All actors in the supply chain need to be in the system'

- There is an agreement that all (European?) countries need to be involved
- Subtopic - Participation mandatory?
 - o Small companies may be frightened to share data – there will maybe be a need to have a kind of incentive to convince all partners (not only SMEs) of the fact that sharing data will be on the long term beneficial for all actors involved
 - o More in general: industrial actors can be in favour of sharing the data only anonymously (at least as long as the real origin of the problem is not clear or as long is the problem is not solved yet) – a concern for them is the possible economic loss related to food integrity issues; they prefer to be able to solve the problem internally as soon as possible (by checking their suppliers and taking actions where relevant) – they are also concerned about losing trust at the level of the general population
 - o Moreover, for SMEs: there can be a resource issue for very small companies – a solution for this can be to work with cooperatives or to involve sector organisations to support SMEs in such data sharing systems

'Data and information confidentiality needs to be guaranteed'

- Sharing data among different sectors and levels can increase transparency and increase trust in the sector
- Subtopic – access to raw data:
 - o Not in all cases needed (e.g. raw data of isotope analysis) – focus on sharing of meaningful data
 - o Anonymous yes or no? – if there is a problem, there will be a need of being able to trace the origin of the problem, in case of anonymous data this can be difficult;

however, maybe only a single partner must be able to know the origin of the data without communication this to the general public

- Topic of discussion: at which stage is there a need of notifying authorities?
- Discrimination between early indicators (with the aim to prevent) and outcome indicators (when a problem is already present) → suggestion of sharing data at different levels – need for anonymity can depend on the level (early versus outcome)?

'A new organisation should manage the FI-ISS'

- Everyone in the group is in favour of giving this task to a new organisation
- Public versus private? There seems to be a consensus within the group that the coordination and communication must be done by a public organisation (at EU level – funded by the European commission), but that a technical partner can be in charge of the technical issues (data management, data architecture, ...)
- Working with a public organisation will be of importance when it comes to the perception of the general public (higher trust in a public organisation compared to a private one)
- The group also agrees that communication as well as collaboration between this organisation and other organisations at national as well as EU level (and global?) will be crucial (e.g. organisations dealing with environmental issues, trade issues, the police, Interpol, douane, ...) – other example: UK has a crime unit – also with this kind of initiatives collaboration will be highly relevant

'Role of national food safety authorities?'

- Only discussed very briefly, however, (as indicated above) all kind of complementary actions will need to be combined – as such, collaboration with national FSA will be relevant

Appendix VIII: Round III Transcript of reporting back sessions

Group 1 (Moderator: Niels Lucas Luijckx)

Reporter group 1:

I think I will highlight a very few points.

One of the things is, as you know, there will be a very large reluctance to share data and some people said that people with bad intentions will not share. Well that's of course not the intention of a system, but still, that's true.

So we are in favour of such a system, but I think, some people said to look at smaller systems, either focused on a sector, like for example the sector of organic food, or either focus on past issues. Then, the interesting thing is, and I think that is important to see, is whether you can knit together the existing systems or smaller systems (and we would expect that smaller systems are easier to get people involved in), than knitted together would be the advantage of this kind of system, and knitted together so analysing the data of several systems. So that's one point, I think, we can conclude.

Another conclusion is on what is the incentive for stakeholders to join such a system. I think these incentives were, in our discussion, two ways. One is money, is there a profit, an advantage money-wise to enter such a system and what does it bring back.

And the other thing is, I think that was an interesting thing, is, of course, if within the food chain, which includes not just industry as producing, but also retailers and consumers. If there would be a pulling factor from retailers (we are not buying from you if you don't join the system, if you do not share your data, we do not buy). We know retailers are very powerful in the food chain, so I think that could be a factor, even outside of money, for stakeholders to join.

So the question is, whether real information sharing is important. So, *Group 1 member* made a triangle of what you can say about a product or a batch of products. There is unique identifier, we can discuss the scale for traceability purposes, whether it is a single package or a pallet. But the smaller the package you can identify, the more easy it is to follow it.

Then, if you can, share transformation of the product. If that system should exist, than you already have a very large idea of what is happening in the food chain. And that includes that you need the attributes of these individual food ingredients, the analytical data and transactional data. All these data around the food product, that would be a second or even a last step if people want to share this and use it in a system.

I hope I am saying it correctly, '*Group 1 member*'.

I think these are the main conclusions, I don't know if people from the group want to add anything specific but I think that's the conclusions of group 1.

Group 1 member

Maybe one addition if you allow me, there was strong voices saying, the 82.3% who are in favour, we said it is more or less lip service.

Reporter group 1:

Yes that is true, you could say this is the answer that you would expect them to give but it's not an actual implementation consensus.

Group 2 (Moderator: Prof. Wim Verbeke)

Reporter group 2 (04:55)

On the new organisation, a little bit of yes and no. Yes and no, because we took a different angle. And, we talked about the precedent in the EU with pharmaceuticals and tobacco. Today, the industry are working with the EU for central databases for pharmaceuticals. And they are also doing it with Tobacco. So, if you take that bottom-up approach and look at the highly regulated sectors of pharmaceuticals and Tobacco, you can see that there is something already happening in these sectors. For Tobacco, they are letting the industry come up with technology, recommend technology companies and we are suggesting that as well. That, maybe it should be a technology company rather than a separate organisation. So the technology company with the expertise and the know-how under a service contract could actually execute that component. With possibly, on top of that, a public-private partnership, looking at the governance of that, and managing the exceptions.

So, again, something happening in the EU and we could learn from it. You don't want to let the EU play around with technology, please don't do that. Don't suggest that. But, the big companies that are out there, the Atos', the IBMs, and the others, under service contracts they could do that very well and even blockchain the heck out of it.

On the data vs information, we talked about that sharing data is probably an illusion, that companies will share data. But sharing information, yes. We talked about a project in Vietnam, where you have data coming out of an isotope mass spectrometer. You are not going to share ten pages of raw data on all of the tests that you have done but you may want to share information which is maybe a one-liner 'this has passed or failed for organic or pesticides' and so on and so forth.

So, we talked about data and not being shared, because it is very confidential. But the information that is extracted from that data, at the micro-level could be shared.

On the types of data as well, we also talked about something that, you are all familiar with this term within food safety we talk about food safety as non-competitive. And we talked about, we need to be *recycling/reciting* that mantra in this world as well. Food fraud should be non-competitive. To try to take away some of the pressures of sharing data.

On, all actors involved, should it be mandatory? No, not possible. It is very complex to do that. However, we talked about the fact that one-up and one-down is restrictive. And one of the key issues in not sharing data today is because everyone wants to manage their risk. They are sharing data based

on one-up and one down, which is regulated in the food sector. However, if you are only doing that, you are creating stove pipes all over the world.

And those stove pipes, there is no incentive to innovate beyond those stove pipes. Again, lucky enough we have this thing called blockchain technologies, which will take away that and help us increase transparency and trust.

On the role of FSA, we talked about possibly the lack of skill sets. I think this came out as well during the horse meat scandal and A. Riley, who many of you know, I talked to him about this and he said 'we do not have the investigative skills of a police officer', which is part of the issue.

And, somebody mentioned as well, maybe a focus on risk management, rather than risk assessment. Well, I've worn a police officers' hat in the past, and part of what you need to do is gather evidence. I shared with the group the example of Danone best practice, where they have two executives, both of them report to the CEO, one of them is responsible for food quality and food safety, but the other guy is a former investigative officer from the police. As soon as the food safety and food quality team identifies and finds something, their role stops, they don't do any investigations. They hand it over to a dedicated team that do the investigations. We think that is a good best practice.

In other words, sometimes you need to let the fraud continue a bit more until you gather the evidence, and then you can interact. Of course if the risk is high, you take action immediately. But if it is, water in milk, maybe that could run a bit longer until you find out who's actually doing it. Regulators typically do not have that skills set, which is why Prof. Elliot had recommended to put in these police forces that are dedicated and have that skills. Lucky enough, England, Scotland, Holland, Denmark, and a lot of the countries that we deal with have those skill sets now and are doing a tremendous job. That was the summary from our group, unless I have missed anything? Does any of the team members want to add something?

Group 3 (Moderator: Fien Minnens)

Reporter group 3 10:16

I don't have such a neat summary. We had a wide ranging discussion about all kinds of issues. So, food integrity sharing systems, do they have a potential to detect and prevent issues? There was discussion about just sharing, what do we mean by sharing, a need to actually know what is going to happen to the data. So is it just a sharing system, or a collecting one, and are we just collecting data. So, there is some confusion here.

The role of historical data, we need historical data to understand where fraud is committed. And if then, somebody is going to have the role of actually detecting potential fraud, they need the data. But, there is a lot of range between the raw data and sharing the intelligence, let's say, or the information, depending on how you want to call it.

There was considerable emphasis in the conversation on the need to be clear as to the end point or the purpose of the data. If you have the potential to predict some kind of fraud occurring with wine crossing a border, you cannot make that information public, because then you collapse the market so

there is a whole issue there. What are you going to do with that data at the end of the day? How are you going to actually intervene in the real world?

On the question about whether the trusted third party should be a new organisation or an existing organisation, some opinions were that the trusted third party should be set up by industry. There were issues about partiality and conflict of interest. Further suggestions were that it should be a joint government plus industry effort. And, there was also an awareness in the group that there is a need to protect industry as well as protect the consumer. There was an interesting discussion about the fact that, with regard to food safety, we take that for granted in a certain sense. We never find a label saying that a food is safe, as opposed to labels which say that a food has a certain characteristic.

And most of the fraud, has to do with the characteristics of the food, you don't know any longer if the food is actually authentic. So, a distinction is begin made there between food safety versus food fraud in the sense of labelling something incorrectly. And here it is obvious that the labelling of food, into particular categories, is driven by the commercial incentive to differentiate and be able to sell more. Which is slightly different from, just making sure that the food is fit for purpose, let's say.

Issues about confidentiality of the data - generally there is the view that you couldn't possibly share raw data. But then, if you didn't share the raw data, would the indicators or the aggregate data coming out of the raw data be sufficient to actually provide a functioning system? It is not really clear that that would work.

So, there is a conflict there between anonymising and aggregating data and then, if you are actually using that, the results of that analysis, if you can't trace back to the origin of what is causing the problem, than it is a bit useless.

That leads me to needing some kind of authority that is able to connect the dots. And then, there was a whole further discussion about the kind of game of hide and seek, as somebody put it, between the industry and public authorities. The industry is not prepared to share the data, most data is on papers, so there would be interesting and possibly unpredictable consequences in shifting to a purely machine readable system where data would (we can argue to what degree) be shared but still that immediate accessibility of the data could have potentially important unintended side-effects.

I think that, we came back several times to this issue of, are we talking about data sharing or intelligence sharing. It is much easier to share intelligence then to share data. Because there is this, very much this concern that companies have that if they share data it is going to come back and hit them. I think that summarizes our discussion.

Group 4 (Moderator: Isabelle Sioen)

Reporter group 4 16:01

Our group was a 100% 'yes' for a food integrity sharing information system.

Audience

Was it you only in the group? - laughter-

Reporter group 4

No, really the whole group. And why, there are so many organisations and so many sectors, actually doing and wanting the same thing, although separately. And there are no proper links between what they are doing. And they could learn from each other.

An example was given, combined raw analytical data, from huge measurements and, not clear how that should be done and what the benefit is, but there is a believe that when combining measurements data you may find more signals and less noise. We talked about the actors in the supply chain, we talked for a while about the small SME's, the one person companies. First, we identified that there may be, likely, a resource issue, for just one person. So that is a difficulty. And maybe those kind of companies can organize in a cooperation, or maybe we need a kind of sector organisation. Also, we are afraid that small SME's may be more frightened to share data and also we noted that different countries may be involved when goods are transported across the countries, labels are falsified.

We talked about data and information and we also added there social media data that may be used. We didn't say that in the previous afternoon hours. We talked about consumers, and when should they be notified. On the one hand, SMEs for example, when they share data, and they communicate, they will be building trust. But on the other hand, you can reason that if you notify consumers too early about food fraud, you may lose trust because like 'group member' said, food fraud- food safety, while food fraud is not food safety for us academics, but the consumer may think otherwise.

We talked about when or not to notify authorities, we had some discussion about it. So, when there is an issue, first solve it yourself between the suppliers, and then notify the authorities, for example. That may be a stepwise thing to do.

Anonymised data sharing is much easier, because at that stage you can learn from each other. Well, it is not yet an issue, but it may be far easier. That could serve like an early warning system. And then, a kind of two-level system, anonymised data sharing, and then it goes to a second level which we didn't actually talk about, what this second level should be. But that meant, the investigation has perhaps progressed to another stage.

We talked about what kind of new organisation should there be installed. Well, the advantage of a public organisation, definitely on an EU level, without private funding, we thought should gain trust. If there is private funding involved, the trust in such an organisation may be lower. An advantage of a public organisation is also that it can easier communicate with other organisations, like EFSA, or other expertise organisations.

We had little time about the role of food safety authorities. One, in the UK has already the crime unit, so perhaps we can learn from that. There is again a 100% yes for a role for food safety authorities in the institution that we are think of. Because the main reason is because those have a general trust by the private sector.

So this was my report of group 4.

General conclusion Prof. Wim Verbeke

Thanks a lot for your collaboration, also for the feedback that we received from each of the groups. It seems that at least on one thing, we have a lot of consensus, namely that there might be less consensus than we initially thought.

The two additional rounds, which were more qualitative, in our study, have proven very useful because it has become clear that we cannot simply rely on the quantitative data that we collected in the first phase. So your contributions as well as the contributions that we received electronically prior to this workshop, has been very useful.

Your input also has given us insight on the limitations that we have faced, and the limitations that are also related to our data that we collected. So the challenge is not now back with us to digest all of this information and to report this, which will be done by means of a Deliverable, by work package 17 of the Food Integrity Project. And we hope of course, we can report this back as a scientific deliverable.

On behalf of the whole team that was involved in the preparation of this workshop, thank you again for your collaboration.

Appendix IX: Submitted manuscript Food Research International

Elsevier Editorial System(tm) for Food
Research International
Manuscript Draft

Manuscript Number: FOODRES-D-18-03486

Title: Food supply chain stakeholders' perspectives on sharing information to prevent and detect food integrity issues

Article Type: VSI: ASSET 2018: GFI Summit

Keywords: food integrity; transparency; food supply chain; information sharing; stakeholders

Corresponding Author: Ms. Fien Minnens,

Corresponding Author's Institution: Ghent University

First Author: Fien Minnens

Order of Authors: Fien Minnens; Isabelle Sioen; Niels B. Lucas Luijckx; Wim Verbeke

Abstract: One of the biggest challenges facing the food industry is assuring food integrity. Dealing with complex food integrity issues requires a multi-dimensional approach. Preventive actions and early reactive responses are key for the food supply chain. Information sharing could facilitate the identification and prevention of food integrity issues. This study investigates attitudes towards a food integrity information sharing system (FI-ISS) among stakeholders in the European food supply chain. Insights into stakeholders' interest to participate and their conditions for joining a FI-ISS are assessed. The stakeholder consultation consisted of three rounds. During the first round, a total of 143 food industry stakeholders - covering all major food sectors susceptible to food integrity issues - participated in an online quantitative survey between November 2017 and February 2018. The second round, an online qualitative feedback survey in which the findings were presented, received feedback from 61 stakeholders from industry, authorities and research. Finally, 37 stakeholders discussed the results in further detail during an interactive workshop in May 2018. Three distinct groups of industry stakeholders were identified based on reported frequency of occurrence of and likelihood of detecting food integrity issues. Food industry stakeholders strongly support the concept of a FI-ISS with an attitude score of 4.49 (S.D.=0.57) on a 5-point scale; and their willingness to participate is accordingly high (81%). Consensus exists regarding the advantages a FI-ISS can yield towards prevention and detection. Four key success factors for a FI-ISS are defined, more specifically with regards to (1) the actors to be involved in a system, (2) the information to be shared, (3) the third party to manage the FI-ISS and (4) the role of food safety authorities. Reactions diverged concerning the required level of transparency, the type of data stakeholders might be willing to share in a FI-ISS and the role authorities can have within a FI-ISS.