Food Supply Chain: Are UK Small to Medium Sized Enterprises (SME) Aware of Concept, Drivers, Benefits & Barriers, and Frameworks of Traceability?

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Abstract

Purpose – In this paper the degree of understanding of traceability concept, drivers, systems' characteristics, benefits and barriers, and frameworks is tested with focus on UK small and medium businesses (SMEs) that operate in the food supply chain (FSC).

Design/methodology/approach – This study employs a survey strategy by means of a questionnaire that was sent to food and drink companies operating in the FSC. 164 SMEs answered the questionnaire. Answers were analysed by means of frequency distributions, contingency tables, coding, and pattern matching.

Findings – UK SMEs appear to have a moderate understanding of the definition of traceability. The main drivers for traceability implementation are product safety and quality, even more than regulation. It is also found that SMEs do not consider technology as driver to implement traceability. In term of frameworks employed, about half of the SMEs stated that they were regulatory compliant, and followed industry standards. Furthermore, in term of traceability systems' characteristics, one out of three companies have a basic system in place (only regulatory compliant), while two out of three have a more sophisticated system, with many companies voluntarily tracing the material during the production process, while chain traceability appears not to be widely implemented. Finally, it is felt that the benefits of traceability outweigh the barriers/disadvantages, with the main benefits found in the area of crisis management. Nonetheless, it appears that many benefits are still unknown to SMEs, especially in relation to the firm's operations/strategy. Some implications for government and managers are suggested.

Originality/value – This study fills the gap found in the literature where few recent academic papers focused attention on SMEs awareness of traceability in the FSC.

Keywords Traceability, Food Supply Chain, Food and Drink industry, SMEs, UK

Paper type Research paper

Introduction

The food industry represents one of the largest manufacturing sectors in the global economy (Fritz and Schiefer, 2009), hence the importance of the Food Supply Chain (FSC). The FSC has experienced substantial changes in the recent years. Roth *et al.* (2008) have identified three major trends, such as globalisation, consolidation across many food categories at all levels of the FSC, and commodisation where food products are (i) traded as undifferentiated commodities, (ii) traded in large quantities, and (iii) sourced from global locations, in order to achieve cost minimisation. The three above-mentioned factors lead towards a FSC based on extensive global sourcing, thus complicating supply chain management, and due to an increasing numbers of subjects involved this can increase the vulnerability of the supply chain and can affect – amongst other things – the traceability of food products (Roth *et al.*, 2008).

Definition of Traceability

Different actors, such as regulators, international bodies, professional associations and academics, have tried to define traceability. However, there is no general consensus , and among scientific papers some inconsistencies can be found (Olsen and Borit, 2013). Bosona and Gebresenbet (2013) defines traceability *"as a part of logistics management that captures, stores, and transmits adequate information about a food, feed, food-producing animals or substances at all stages in the food supply chain so that the product can be checked for safety and quality control, traced upward, and tracked downward at any time"*. This definition is considered among the most accurate.

Drivers of Traceability

An in depth analysis of the literature allowed the authors to categorise the drivers of traceability between external and internal factors. Firstly, in term of external drivers, regulations can be seen as an imposing driving force. These regulatory enforcements are aimed at ensuring product quality and safety (Aung and Chang, 2014; Bosona and Gebresenbet, 2013; European Commission, 2007; Fritz and Schiefer, 2009; Manos and Manikas, 2010) and improve controls (Donnelly and Olsen, 2012; Wang *et al.*, 2009), under an increasing consumers awareness of food safety and quality. Moreover, technology can play a big role in allowing a wider and more effective implementation of supply chain traceability (Manos and Manikas, 2010).

As far as internal drivers are concerned, traceability can be fostered by the firm's needs of (i) seeking efficiency, through exchange of relevant information within the whole food supply chain (Aung and Chang, 2014); (ii) expanding into certain markets where traceability standards are required (Bosona and Gebresenbet, 2013; Donnelly and Olsen, 2012), and enhancing competiveness through perceived product differentiation based on information (Aung and Chang, 2014; Heyder *et al.*, 2012); (iii) improving the image of the firm (Heyder *et al.*, 2012); and (iv) having a tool to minimise liabilities for hazardous products (Fritz and Schiefer, 2009). Furthermore, the size and negotiating power of a firm can drive traceability as it is found that larger firms have generally better traceability systems (McEntire *et al.*, 2010) and can work with suppliers to improve them (Rábade and Alfaro, 2006). Finally, the last elements that can drive traceability are the degree of internationality of the supply chain, and the degree of complexity of the product: the higher the supply chain internationality and/or the product complexity, the greater the amount of resources employed in the traceability systems (Rábade and Alfaro, 2006).

Benefits and Barriers of Traceability

The implementation of traceability systems carries a number of advantages but also barriers/disadvantages. This research divides benefits and barriers within three areas of interest: crisis management – in relation to the control of a food crisis; firm/supply chain related; and consumers & society – in relation to consumers' expectations and social issues.

Firstly, if benefits related to food crisis management are taken into consideration, traceability (i) can allow for compliance with the existing regulation (Storøy *et al.*, 2013; Resende-Filho and Hurley, 2012); (ii) is recognised as a mechanism for safety (Kher *et al.*, 2010; Alfaro and Ràbade, 2009; Regattieri *et al.*, 2007) and quality (Lxe, 2011; Kher *et al.*, 2010); (iii) can lead to a cost reduction when recall of hazardous product is needed (Storøy *et al.*, 2013; Banterle and Stranieri, 2008); and (iv) can enable rapid recall or withdrawals of products in case of a food crises (Folinas *et al.*, 2006).

The benefits of traceability can be perceived both in term of wider advantages for the supply chain, which becomes more competitive and efficient (Banterle and Stranieri, 2008; Bosona and Gebresenbet, 2013; Canavari *et al.*, 2010; Lxe, 2011; Regattieri *et al.*, 2007), and in term of advantages for the single firm, such as: (i) cost reduction (Bosona and Gebresenbet, 2013) and improvements in efficiently (Fritz and Schiefer, 2009) of logistics; (ii) improvement in inventory management (Lxe, 2011; Alfaro and Ràbade, 2009); (iii) technological contribution (Bosona and Gebresenbet, 2013); and (iv) competences development (Bosona and Gebresenbet, 2013). Furthermore, strategically, traceability information can have a positive impact as a marketing tool through product differentiation in term of specific product qualities and safety standards (Storøy *et al.*, 2013; Liao *et al.*, 2011; Banterle and Stranieri, 2008); a tool to access markets that require higher traceability standards (McEntire *et al.*, 2010), and to protect the brand image by showing transparency of food production (Mejia *et al.*, 2010).

Finally, traceability can have a positive impact on consumers and society. In fact a transparent supply chain can (i) lead to trust building along the supply chain and among consumers (Aung and Chang, 2014; Kher *et al.*, 2010; Mejia *et al.*, 2010; Alfaro and Ràbade, 2009; Fritz and Schiefer, 2009; Regattieri *et al.*, 2007); (ii) can help in reducing the healthcare costs and loss of life due to food outbreaks (Mejia *et al.*, 2010), and (iii) can have a positive impact on the environment because the transparent information provided by traceability systems can help firms in sourcing materials in a sustainable way (Bosona and Gebresenbet, 2013).

In term of disadvantages/barriers of traceability related to the characteristics of the whole food supply chain, several authors mention lack of standardisation as one of the

biggest barriers (Bosona and Gebresenbet, 2013; Storøy *et al.*, 2013; Kher *et al.*, 2010; Mejia *et al.*, 2010; McEntire *et al.*, 2010; Regattieri *et al.*, 2007).

A second barrier is the cost associated with traceability system implementation (Aung and Chang, 2014; Kher *et al.*, 2010; McEntire *et al.*, 2010; Zhang *et al.*, 2010). Nevertheless, because of the development of technology, the costs of traceability tools could decrease (McEntire *et al.*, 2010).

A third element that can constitute a barrier is the information limitation and difficult accessibility especially for food with many ingredients (Olsen and Borit, 2013) or several transformation processes (Storøy *et al.*, 2013). In this context being able to develop connections between internal (inside company) and chain (among companies of the supply chain) traceability is key (Bosona and Gebresenbet, 2013).

Another source of limitation is the firm's internal capabilities. In fact, it is found that lack of skilled staff to implement traceability (Bosona and Gebresenbet, 2013); lack of awareness and knowledge regarding available technologies and frameworks (Bosona and Gebresenbet, 2013; Canavari *et al.*, 2010); and reluctance – especially from small businesses that are used to work in a certain manner – to embrace technology as solution for traceability enhancement (Lxe, 2011), can be an important barrier to traceability implementation.

In term of consumer and society perspective, some issues arise related to ethical and privacy in data transferring (Bosona and Gebresenbet, 2013; Donnelly and Olsen, 2012); and uncertainties of the impacts on consumer health of certain technology used in traceability systems - i.e. electromagnetic radiation (Bosona and Gebresenbet, 2013). Finally, the fact that information about the product stored and transmitted by the traceability systems is not always suitably delivered to the final consumers (Charlier and Valceschini, 2008) can constitute a barrier.

Traceability Frameworks

First of all, in term of regulatory frameworks, the '1-step up and 1-step down' approach is employed by both the EU and US regulation as far as traceability of food products is concerned (Aung and Chang, 2014). This model is based on the fact that information is filtered in each stage of the supply chain – only certain information is shared with the immediate suppliers/customers, and it is opposed to the aggregated information models, where no information filters are applied (Bosona and Gebresenbet, 2013).

Secondly, many international standards are trying to improve standardisation within the traceability practices. Examples are (i) the ISO 9000 standards that thanks to its diffusion provides a managerial approach and makes it easier to adopt traceability systems (Canavari *et al.*, 2010); (ii) the British Retail Consortium (BRC) Food Safety Standard – building on the principle of ISO 9000 – can help establishing good manufacturing practices, and it also covers the legal requirements for traceability and management of recalls (BRC, 2015); (iii) the Safe and Local Supplier Approval (SALSA) – which targets small firms and is a simplified version of the BRC standard – includes a traceability requirement to prove the ability to trace all raw materials through all stages of production and delivery (SALSA, 2012); (iv) the Global Trace Item Number (GTIN) allows for consistency when assigning batch number by using standard attributes to organise and categorise products (Lxe, 2011); and (v) the GS1 traceability standard allows to integrate all products, processes and quality information as well as material flow and logistics information into one system, and it helps in achieving both internal and chain traceability (Thakur *et al.*, 2011).

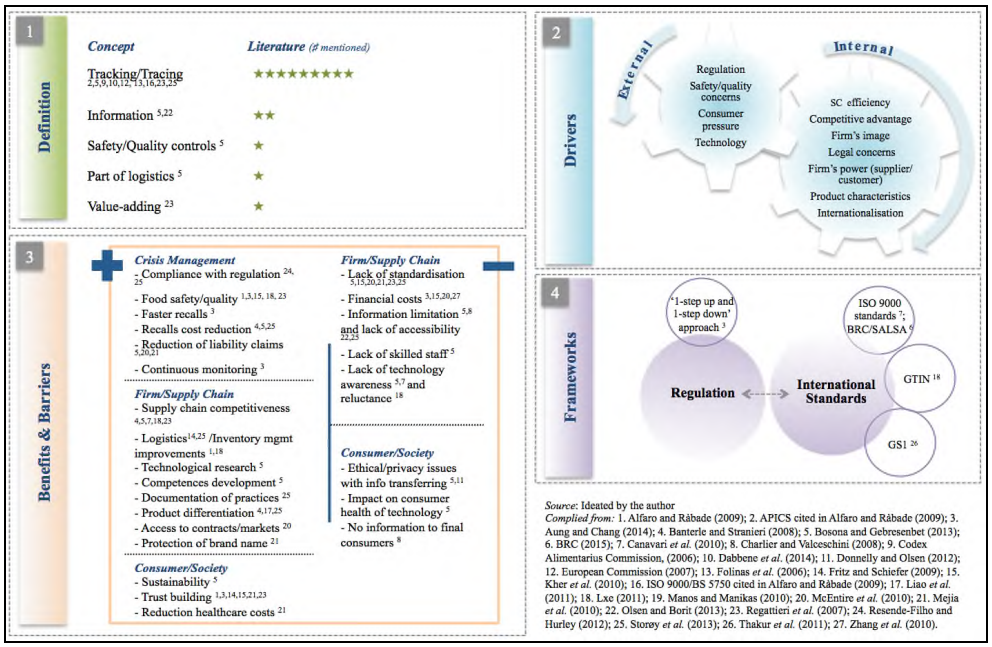
Objectives

To the best of the authors' knowledge, no recent academic papers cover awareness of concept, drivers, benefits and barriers, and frameworks of traceability of UK SMEs that operate in the food supply chain.

Theoretical Framework

The existing literature allowed the building of the Traceability Theoretical Framework – TTF (*Figure 1*) in order to test the awareness of concept, drivers, benefits and barriers, and frameworks of traceability within the UK SMEs in the FSC.

Figure 1 Traceability Theoretical Framework illustrating the concept, drivers, benefits and barriers, and frameworks of traceability



Source: Ideated by the author
Complied from: 1. Alfaro and Rábade (2009); 2. APICS cited in Alfaro and Rábade (2009); 3. Aung and Chang (2014); 4. Banterle and Stranieri (2008); 5. Bosona and Gebresenbet (2013); 6. BRC (2015); 7. Canavari *et al.* (2010); 8. Charlier and Valceschini (2008); 9. Codex Alimentarius Commission, (2006); 10. Dabbene *et al.* (2014); 11. Donnelly and Olsen (2012); 12. European Commission (2007); 13. Folinas *et al.* (2006); 14. Fritz and Schiefer (2009); 15. Kher *et al.* (2010); 16. ISO 9000/BS 5750 cited in Alfaro and Rábade (2009); 17. Liao *et al.* (2011); 18. Lxe (2011); 19. Manos and Manikas (2010); 20. McEntire *et al.* (2010); 21. Mejia *et al.* (2010); 22. Olsen and Borit (2013); 23. Regattieri *et al.* (2007); 24. Resende-Filho and Hurley (2012); 25. Storøy *et al.* (2013); 26. Thakur *et al.* (2011); 27. Zhang *et al.* (2010).

Research Methodology

This research employs a mixed deductive/inductive (80%/20%) approach. The proposed approach has the advantage of starting from what it is known and studied in the literature, and then tries to verify it (deduction), meanwhile allowing for less rigidity in order to explore alternative explanations of the phenomenon under consideration (induction) (Saunders *et al.*, 2012, p. 143-149). This approach fits a research area such as food traceability where much debate is going on without a clear consensus. The nature of this study can be considered as mainly descriptive (Saunders *et al.*, 2012, p. 170-172). Due to time constrains, a cross sectional approach was employed – i.e. study a phenomenon at a particular point in time (Saunders *et al.*, 2012, p. 190-191). This work employs a survey strategy as it was found to be the best method to gather information from a population which is too large to observe directly (Babbie, 2013, p. 229-237), such as SMEs the UK. The tool employed to carry out the survey is a questionnaire. This is an effective tool to obtain information about awareness (Gideon, 2012, p. 91-93; Dillman, 2009), and from a varied number of respondents (Thomas, 2013, 140-150), which is the aim of this study.

The main questions included the questionnaire related to the topic of this paper is reported below (the survey was formed by 11 questions, but here only the questions from 4 to 9 are reported[1]):

[1] If the answer to question 5 was different than 'Yes', the respondent was led to a different section of the questionnaire, which is not reported in this paper.

4. Which of the elements below best describe the concept of "traceability" of a product along the Supply Chain? ***(Tick ONE or MULTIPLE choices)***

- ☐ Tracking (follow downstream path of a product)
- ☐ Tracing (determine the origin of a product)
- ☐ Safety controls
- ☐ Quality controls
- ☐ Information (capture, and/or store, and/or transmit)
- ☐ Part of logistics management function
- ☐ It adds value to the product
- ☐ Other (*please specify*) _____

5. Does your company have any form of traceability system in place? ***(Tick ONE choice)***

- ☐ No
- ☐ Not sure
- ☐ Yes

6. Which of the following items do you consider being the most important and the least important in driving the implementation of your traceability system? ***(Drag ONE item for each box)***

Items	**Most Important**
Regulation	
Safety/Quality concerns	
Consumer pressure	
Technology	
To obtain competitive advantage	**Least Important**
To improve company's image	
Suppliers/customers' request	
Product characteristics	
Other (*please specify*) _____	

7. My company's traceability system: ***(Tick ONE of MULTIPLE choices)***

- ☐ Is Regulatory compliant
- ☐ Follows industry standards (i.e. ISO9000, GTIN, GS1, etc.) – *Please specify which standard* _____
- ☐ Is integrated with logistics function
- ☐ Is integrated with production function
- ☐ None of the above

8. What are the main benefits of your traceability system? ***(Open question)***

9. What are the main barriers for the implementation of a traceability system in your company? ***(Open question)***

Overall, 2,729 questionnaires were sent via e-mail to UK SMEs in the food and beverage industry – which must be considered a "convenience sample" (Gideon, 2012, p. 54-74). A total of 164 companies responded with a complete questionnaire[2] – the vast majority, nearly 90%, were small firms with less than 50 employees (of which 40% were micro firms with less than 10 employees). The active response rate is ca. 27%[3], which is above what is typically reported in the literature – 10-20% (Saunders *et al.*, 2012, p. 258-291).

In order to analyse the answers, frequency distributions, contingency tables, coding, and pattern matching[4] are employed.

[2] By asking some background questions, it was made certain that the job function of the respondent was related to supply chain management, and that they were familiar with the concept of traceability.

[3] Calculated as Saunders *et al.* (2012, p. 258-291):
Active response rate = Tot. num. of responses / (tot. num. in sample – ineligible – unreachable)
where total responses = 164; total number in sample = 2,729; total ineligible = 2; total reachable = 615; total unreachable = 2,114.

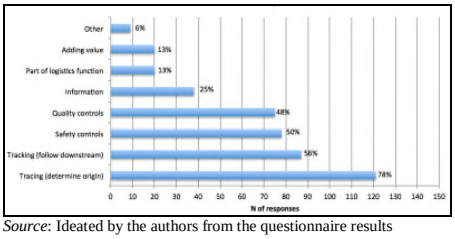
[4] The open question was coded within categories. When the answer was related to a specific category, a number equal to 1 was given. These categories were then grouped within areas.

Results

Definition of Traceability

Nearly 80% of the respondents believe that traceability is associated with tracing, followed by tracking (56%), and around half of the respondents think that traceability is related with product safety and quality – *Figure 2*.

Figure 2 Definition of traceability

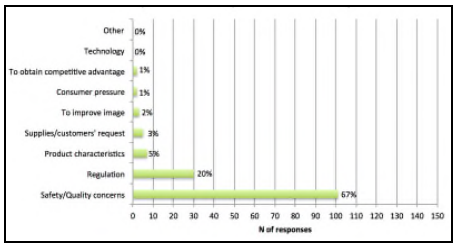


Source: Ideated by the authors from the questionnaire results

Drivers of Traceability

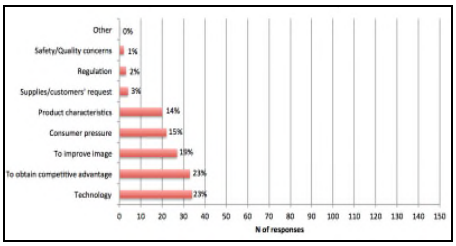
The most important drivers of traceability systems' implementation are safety and quality controls (nearly 70% of the respondents) and regulation (20%) – *Figure 3*. In term of the least important factors, there is no such a clear view, with five factors such as technology, obtain competitive advantage, improve image, consumer pressure, and products characteristics all at between 14% and 23% response rate – *Figure 4*.

Figure 3 Most important drivers for traceability system's implementation



Source: Ideated by the authors from the questionnaire results

Figure 4 Least important drivers for traceability system's implementation

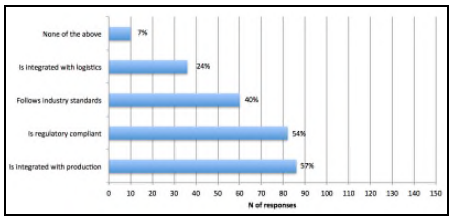


Source: Ideated by the authors from the questionnaire results

Characteristics of Traceability Systems

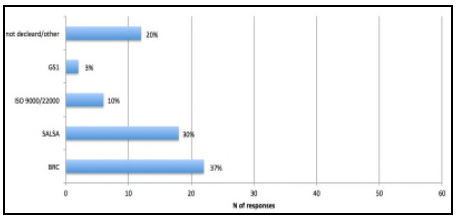
When asked to define their traceability systems, the two most frequent answers are 'integrated with production' and 'is regulatory compliant' (both around 55%), followed by 'follows industry standards' (40%) – *Figure 5*. Among the companies that follow an industry standard, in descending order, BRC (37% or respondents), SALSA (30%), and ISO 9000/22000 (10%) are the ones followed – *Figure 6*.

Figure 5 Characteristics of traceability system



Source: Ideated by the authors from the questionnaire results

Figure 6 Types of Industry Standards

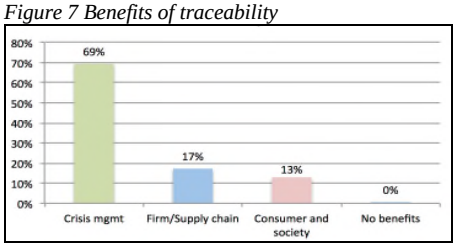


Source: Ideated by the authors from the questionnaire results

Benefits and Barriers of Traceability

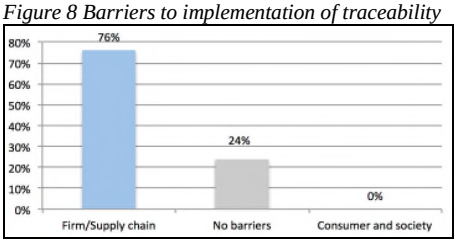
UK SMEs believe that the vast majority of the benefits are found in the area of crisis management (70%); only 17% are related to the firm/supply chain, and 13% to consumer/society – *Figure 7*. As far as barriers are concerned, it is found that nearly 80% of them are in the area of firm/supply chain, with consumer/society area carrying no perceived barriers. It is worth noting that there is a significant proportion of respondents (24%) that declare no barriers – *Figure 8*.

Figure 7 Benefits of traceability



Source: Ideated by the authors from the questionnaire results

Figure 8 Barriers to implementation of traceability



Source: Ideated by the authors from the questionnaire results

Discussion

Definition of Traceability

As mentioned in the *Results* section, nearly 80% of the respondents believe that traceability is associated with the tracing concept (determine the origin), followed by tracking (follow downstream – 56%) (Question 4). This is consistent with the traceability definitions that are found in the literature. In fact, 9 out of 10 definitions - Dabbene *et al.* (2014), Bosona and Gebresenbet (2013), Storøy *et al.* (2013), ISO 9000/BS 5750 cited in Alfaro and Ràbade (2009), APICS cited in Alfaro and Ràbade (2009), European Commission (2007), Regattieri *et al.* (2007), Codex Alimentarius Commission (2006), Folinas *et al.* (2006) - explicitly mention either tracking, tracing, or both elements.

Interestingly, the concept of 'Information' was chosen by only 25% of the companies. This result might appear unexpected, because a traceability system essentially carries information along the supply chain. Nevertheless, respondents might have implicitly correlated track/trace with information, thus considering the actual 'Information' choice redundant. Furthermore, also in the literature, the concept of information is often not specifically mentioned when it comes to define traceability. In fact, only 2 out of 10 definitions - Bosona and Gebresenbet (2013), Olsen and Borit (2013) - explicitly contain the word 'information'.

Moreover, only 13% of the sampled companies believe that traceability is part of a logistics management system. Nevertheless, when asked to define their own traceability system (Question 7), 25% of the companies stated that it 'Is integrated with logistics', of which only 33% selected 'Is part of logistics function' when defining traceability (Question 4). This might show an inconsistency between what traceability is believed to be, and the actual characteristics of the systems implemented by companies.

All in all, UK SMEs appear to have a moderate understanding of the definition of traceability as provided by the literature, although some minor contradictions remain, partially confirming the thesis of Olsen and Borit (2013) who identifies some inconsistencies and confusions among definition of traceability.

Drivers of Traceability

As mentioned in the *Results* section, the most important factors that drive the implementation of a traceability system are safety and quality concerns (nearly 70% of the respondents) and regulation (20% of the respondents), which are both external drivers. No internal drivers received a significant response rate.

Analysing the answers in more detail, only 60% of the companies that believe safety/quality concerns is the most important driver for traceability implementation, also included the concept quality or safety controls in the definition of traceability (Question 4). This indicates an inconsistency between theoretical understanding and how traceability is perceived in practical terms. Furthermore, the drivers 'Supplier/customers request' and 'Improve image' score very low as most important drivers, which is in contrast with what Heyder, Theuvsen, and Hollmann-Hespos (2012) state as driving factors for traceability.

In term of least important factors, five factors such as 'technology', 'obtain competitive advantage', 'improve image', 'consumer pressure', and 'products characteristics' all rated between 14% and 23%. 'Technology' scored also 0% as most important factor, which may support the point of view of an existing reluctance, especially from small businesses, to embrace technology as solution for traceability enhancements (Lxe, 2011).

Characteristics of Traceability Systems

As far as traceability systems' characteristics are concerned, nearly 60% of companies stated that their system is integrated with production. Among these companies, only 36% also claimed logistics integration. The findings have two implications. Firstly, these results confirm that, notwithstanding the fact that the European regulation does not enforce internal traceability (i.e. matching up all inputs to outputs - McEntire *et al.*, 2010), many companies are voluntarily tracing the material during the production process, which can have the benefit of faster and more precise tracing activity as outlined by Donnelly *et al.* (2012). Secondly, chain traceability, which is another element that Donnelly *et al.* (2012) consider as key aspect of tracing activity, and that can be related with logistics (i.e. information related to movements of products from and to other participants of the supply chain), appear not to be widely implemented – only 24% of the companies responded that they are integrated with logistics. One of the explanations might be found in the fact that, if a third

party Logistics Company (3PL) is employed, the responsibility of the product's traceability may contractually lie with the 3PL.

Furthermore, about half of the SMEs' traceability systems are regulatory compliant (54% of the respondents), and follow industry standards (40% of the respondents). One would expect companies that declared to have a traceability system in place, to affirm regulatory compliance – as traceability is mandatory – but this is not reflected in our results. Although some explanations could be found, such as unawareness of regulatory compliance because of the lack of understanding of regulation, these results signal that the government and associations should put energies in educating the SMEs with regard to regulatory requirements. This lack of understanding of regulations/standards is strengthened by the fact that among the companies that follow industry standards, only half declared that they are also regulatory compliant. This should not be the case, as industry standards tend to fulfil regulatory requirements[5].

In order to sum up the findings about the characteristics of traceability systems among SMEs in the UK, answers were filtered to form 3 categories:

- *Basic*: only regulatory compliant. 27% of the companies.
- *Intermediate*: Regulatory compliant & industry standards (14%) or Regulatory compliant & integration with logistics/production (25%). 39% of the companies.
- *Advanced*: Regulatory compliant & industry standards & integration with logistics/production. 34% of the companies.

The results show that, although around 30% of the companies have a traceability system that is only regulatory compliant (Basic 27%), it is also true that 34% of them fall into the advanced category. However, if the size of the company is taken into consideration, only 24% of micro companies (i.e. less than 10 employees) have an advanced system in place, 10 points lower than for the overall group, and 15 points lower than for the small and medium companies (i.e. between 10 and 249 employees). These results give some support to claims from literature that smaller businesses may need help with regards the implementation of advanced traceability tools and systems (Institute of Food Technologists, 2011, Fritz and Schiefer, 2009). However, micro firms might not want to enhance their traceability systems because a basic/intermediate one may be satisfactory if the complexity of their business is considered.

All in all, the results related to type of traceability system show a possible lack of understanding of the regulatory compliance characteristics, and a variability of the type of systems, confirming the suggestions by Karlsen *et al.* (2013) of no theoretical recognised common practice in the food and drink industry.

Benefits and Barriers to Traceability

In term of benefits of traceability systems, in the *Results* section it was pointed out that the vast majority of the benefits are found in the area of crisis management (70%). Analysing the categories within this area, the most mentioned ones, in descending order, are continuous monitoring (19%), faster/facilitated responses to recalls/crisis (13%), compliance (12%), safety (12%), and quality (9%). This is broadly in line with the TTF.

As far as firm/supply chain related benefits, only 17% of the answers fall into this area, but none of the single categories have a frequency that can be considered significant, with supply chain efficiency, product differentiation, and access to markets rating at around 2-4%, which are the categories that are also found in the literature. Moreover, although not very significant in term of frequencies, it is worth mentioning the fact that two new categories can be included in the area of firm/supply chain related benefits; for some companies traceability system is 'simple to use' and it provides 'peace of mind', the latter showing that the benefits of traceability are sometimes not easy to allocate within specific categories.

Finally, in term of customer/society related benefits, which represents only 13% of the total responses, the category related to trust building (in term of customer satisfaction/protection and complains resolution) is the one that is most firmly indicated. On the contrary, companies are not aware that traceability may contribute to sustainability or may help in reducing healthcare costs related to food incidents, which are the other two categories suggested by the literature.

On the other hand, as far as the barriers to implementation of a traceability system are concerned, one out of four SMEs express the view that there are no general barriers to

[5] For example the British Retail Consortium (BRC) Food Safety Standard can help establish good manufacturing practices, including the legal requirements for traceability (BRC, 2015).

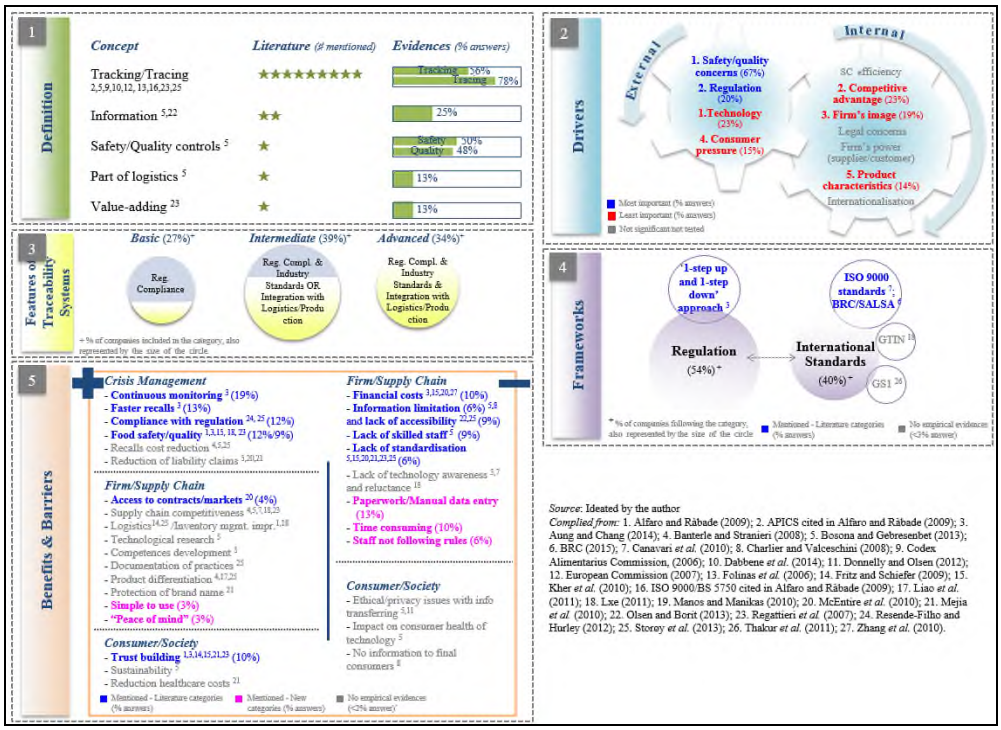
traceability, and no barriers are mentioned in the consumer/society related area. However, it is found that existing barriers are related to the area of firm/supply chain, such as costs (10% of respondents), difficult accessibility to suppliers' information (9%), information limitation and difficult accessibility due to multi-ingredients/transformation process products (6%), lack of skilled staff (9%), and lack of standardisation/transparency (6%). These are all categories that are found in the literature. Two points are worth noting. First of all, it appears that cost is one of the major barrier for SMEs, in line with the view of many authors (Aung and Chang, 2014; Kher *et al.*, 2010; McEntire *et al.*, 2010; Zhang *et al.*, 2010). Second of all, the lack of standardisation, which is by far the most frequently mentioned barrier in the literature (Bosona and Gebresenbet, 2013; Storøy et al., 2013; Kher *et al.*, 2010; Mejia *et al.*, 2010; McEntire *et al.*, 2010; Regattieri *et al.*, 2007), is not considered as much of an impediment within the sampled SMEs. Furthermore, two new categories, which are not included in the TTF, are discovered related with the bureaucracy and time consuming aspects of the traceability systems (23% of respondents), and staff not following the rules (6%).

All in all, it can be argued that the overarching statement made by Kher *et al.* (2010), expressing the point of view that many studies show that benefits of traceability outweigh the barriers/disadvantages, holds as far as UK SMEs companies are concerned. In fact, sampled companies mentioned 232 times the different categories related to benefits, and 172 times the different categories related to barriers. Nonetheless, our findings show that many benefits related to traceability appear unknown to SMEs, especially in the areas of firms/supply chain, which is in line with research by Fritz and Schiefer (2009) that shows how companies tend to underestimate the benefits of an efficient traceability system.

UK SMEs Traceability Evidence-Based Framework

The TTF presented in the Theoretical Framework section can be updated in order to reflect the findings related to UK SMEs that operate in the FSC. The Traceability Evidence-Based Framework – TEBF – is shown in *Figure 9*.

Figure 9 Traceability Evidence-Based Framework illustrating the concept, drivers, characteristics, frameworks, and benefits and barriers of traceability



Conclusions

This research can help to understand how governments and managers can improve traceability practices within the food supply chain. This study employed a survey strategy by means of a questionnaire that was sent to food and drink companies operating in the FSC. 164 SMEs answered the questionnaire. Answers were analysed by means of frequency distributions, contingency tables, coding, and pattern matching.

UK SMEs appear to have a moderate understanding of the definition of traceability as provided by the literature – tracing, tracking, safety, and quality – although some minor contradictions remain – such as the low number of firms which chosen 'information' as concept associated with traceability.

In term of drivers of traceability implementation, it was found that the main drivers are confirmed to be product safety and quality, even more than regulation; these strong drivers are external ones. Moreover, it was found that UK SMEs are reluctant to use technology as driver for traceability implementation.

As far as UK SMEs traceability systems' characteristics are concerned, although around 30% of the companies have a basic system in place (only regulatory compliant), it was also found that 34% of them fall into the advanced category (regulatory compliant + follow standards + integrated with production/logistics). Nevertheless, is was discovered that micro companies (less than 10 employees) are less likely than bigger firms to have an advanced system in place. These findings may signal that very small firms might need some external help in order to enhance their systems.

Furthermore, notwithstanding the fact that the European regulation does not enforce internal traceability, it was found that many companies are voluntarily tracing the material during the production process. On the contrary, chain traceability appears not to be widely implemented.

Moreover, the study shows that around half of the SMEs' claim to be regulatory compliant (54% of the respondents), and to follow industry standards (40% of the respondents). Although some explanations could be found for such a low rate of regulatory compliance, such as lack of regulation understanding, it was argued that these results signal that the government and associations should put energies in educating the SMEs with regard regulatory requirements.

Finally, when it comes to benefits and barriers of traceability our findings show that benefits of traceability – especially concentrated in the area of crisis management (continuous monitoring, faster/facilitated responses to recalls/crisis, compliance, safety, and quality), outweigh the barriers/disadvantages (costs, difficult accessibility to suppliers' information, information limitation and difficult accessibility, lack of skilled staff, and lack of standardisation / transparency). Nonetheless, it was argued that many benefits related to traceability appear still unknown to SMEs, especially in the areas of firms/supply chain – such as supply chain efficiency, logistics/inventory management improvements, product differentiation, protection of brand name, competence development, and best practices documentation.

Implications

This study carries two main implications for regulators and managers.

Firstly, as far as policy makers are concerned, scholars suggest three main ways for government to promote traceability standards developments: (i) deregulation and liberalisation; (ii) strengthened regulation that can encourage (intended or not) private companies to develop private standards; and (iii) direct support of private initiatives (Hall, 2010). It is argued that the UK government could fund programmes to educate SMEs in order to convey the message that traceability is not a regulatory burden but it can have positive effects - if taken as strategic tool - that can go beyond crisis management. These initiatives could take form of conferences, sponsored training courses, and similar, with the involvement of representatives from industry trade associations, such as the Brewing, Food & Beverage Industry Suppliers Association (BFBi, 2015), Food and Drink Federation (FDF, 2015), and British Soft Drinks Association (BSDA, 2015). Furthermore, the UK government could draw from the Japanese experiences and put forward methods to directly support private initiatives, for example by promoting technical research, engaging in debates over standards' contents, or pushing companies in to using traceability systems and consumers in demanding traceability information (Hall, 2010).

Moreover, the fact that technology is seen as one of the least important driver for traceability system implementation conveys the message that SMEs in the food industry should be incentivised to use the available technology (i.e. RFID, GPS, smart phone applications, etc.). Some actions could be taken such as tax exemptions for companies that wish to invest in new technologies that are not economically viable as per today, but if developed, could be in the future. These exemptions could follow what it is currently in place for R&D costs that can be claimed back by companies (EBS, 2015).

Secondly, in term of business implications, managers should comprehended that benefits of traceability are not limited to the management of safety/quality crisis: 'being traceable' should be seen as a strategic objective as it is 'being green', for the broader benefits, as pointed out in this study. In fact, it is argued that traceability could follow the sustainability development path, which Lee (2008) explains in three steps: from being 'nice to do' for only image purpose, to 'must do' if companies wanted to keep up with competitors, to what it is now a 'must do' for operational reasons in term of improving operational performances. It is claimed that traceability could follow this path because it is likely that consumer pressure will become more relevant in the future. Because of this, managerial actions and efforts should be put in place to interact with consumers in order to predict and understand their requirements and expectations, especially because consumers' demand patterns are still not very clear (Heyder *et al.*, 2012), and studies around the willingness to pay a premium for products that can deliver traceability information, are producing contradictory empirical results (see Trautman *et al.*, 2008). It is argued that this 'mentality switch' should be applied to all sizes of companies. Nevertheless, for very small companies, the principle of 'proportionality to the size of operations' might apply.

Limitations and Research Suggestions

The findings and corresponding business implications presented in this work are based on a non-representative sample of 164 UK SMEs, which restricts the generalisation of results. Therefore, future research studies could expand the sample size and improve the sample representativeness. Notwithstanding its limitation, this study provides a starting point for several future research streams.

One area of interest could be the investigation of the contractual arrangements between SMEs food manufacturers and the logistics companies (3PLs), to understand where the responsibility of traceability lies and thus trying to explain why only two of ten companies declared that their traceability systems are linked with logistics (but nearly six out of ten declared to have systems integrated with production). This area of investigation assumes more relevance because of the increasing importance of 3PLs companies – i.e. nearly 50% of total logistics expenditures are related to outsourcing, and transportation is among the most outsourced activities (Langley and Capgemini, 2014). The study would shed some light whether or not different degrees of implementation exist between what Donnelly *et al.* (2012) call internal (related with production) vs. chain (related with logistics) traceability, arguably both key elements of traceability within the whole supply chain.

Moreover, it would be interesting to understand whether or not the results of the same or similar studies would lead to different results if large companies or companies from different countries are also taken into consideration.

Finally, this study did not distinguish between actors in the FSC – i.e. primary producer, marketer, industrial producers, wholesaler, and retailers (Fredriksson and Liljestrand, 2015; Dani and Deep, 2010) – when sending out questionnaires. A further area of investigation could be found in understanding whether or not different actors within the supply chain have different opinions with regard traceability.

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