Triangulation: effective verification of food safety and quality management systems and associated organisational culture

by Manning, L.

DOI: https://doi.org/10.1108/WHATT-02-2018-0009

Manning, L. 2018. Triangulation: effective verification of food safety and quality management systems and associated organisational culture. *Worldwide Hospitality and Tourism Themes*.

14 May 2018

emerald PUBLISHING

Worldwide Hospitality and Tourism Themes

Triangulation: effective verification of food safety and quality management systems and associated organisational culture.

Journal:	*Worldwide Hospitality and Tourism Themes*
Manuscript ID	WHATT-02-2018-0009
Manuscript Type:	Article
Keywords:	Food Service, Audit, Inspection, Checklist, Hospitality

Triangulation: effective verification of food safety and quality management systems and associated organisational culture.

Introduction

The Codex Alimentarius Commission (CAC, 2003) defines verification as "the application of methods, procedures, tests and other evaluations, in addition to monitoring to determine compliance". The British Retail Consortium (BRC) Global Food Standard builds on this in their definition of verification namely: "the application of methods, procedures, tests and other evaluations, in addition to monitoring, to determine whether a control or measure is or has been operating as intended" (BRC, 2015 p. 119). Alternatively, The Food Law Code of Practice (England) March 2017 (p148) defines verification as: "the checking, by examination, and the consideration of objective evidence, whether specified requirements have been fulfilled". Thus verification can be considered as the use of methods, procedures, tests and checks to provide objective evidence that requirements specified in either quality management system (QMS) or food safety management system (FSMS) standards, or in the FSMS/QMS designed by a particular organisation or an element of the organisation's FSMS/QMS have been met or organisational activities are operating as planned and how they were designed to function (Luning *et al.,* 2009; Bergh *et al*., 2016). It is important to note here that in the literature food safety is sometimes seen as an independent food attribute and distinct from quality characteristics, whilst in other literature food safety attributes are seen as being a subset of overall quality attributes for a food material or product. Specified requirements can relate to the product, the process, people or general production environment and can be an element of regulatory compliance i.e. a legal requirement or market compliance, or both. Product verification, such as chemical, physical and microbiological analysis or hygiene testing including surface swabbing for microbiological analysis often involves high analytical costs, and sometimes inappropriate laboratory turnaround times that do not support a just-in-time driven food supply system (Manning, 2016). Process verification through the assessment of documentation, product and process certification and traceability data is less costly than destructive product inspection and testing, but such verification processes rest on the ability to assess valid, authentic, objective and representative evidence (Manning and Soon, 2014).

Verification can be described as first party, where an organisation verifies its own activities; or second party whereby verification is undertaken within a supply chain between two parties where there is a contractual obligation e.g. supplier audits and third party. Third party verification is undertaken by an external organisation when the first party develops their QMS and their FSMS to meet a given system standard and an independent third party organisation undertakes verification activities to confirm the degree of compliance with those standards. Examples of system standards that are used for the basis of judging compliance include the BRC suite of supply chain standards (BRC, 2017), and the ISO suite. Whilst the BRC suite of standards and ISO standards are referenced in this paper, there are a number of third party standards used in food manufacturing and supply. The focus on the BRC suite of standards in this paper is due to their being a connected food safety culture module which can be assessed by third party certification bodies as well as the more formal aspects of the FSMS and QMS (BRC, nd).

The aim of this paper is to critique the existing and emerging alternative approaches being used by regulators and industry to verify the presence and efficacy of FSMS. The paper is structured as follows: firstly there is an introduction to key concepts in the area of

study; secondly there is a review of the strengths and weaknesses of the current use of TPC audits to verify compliance and the interface with regulatory controls and the transition towards risk based regulatory controls where regulated private assurance as an option is gaining greater focus.

Auditing as a tool for product and process verification

Inspection

Inspection can be defined as a conformity evaluation by observation and judgement accompanied as appropriate by measurement, testing or gauging (Hinkle, 2006) through product sampling or process assessment of documentation via a checklist approach of accompanying documentation. The Food Law Code of Practice (England) March 2017 (p. 143) defines inspection as "the examination of any aspect of feed, food animal health and animal welfare in order to verify that such aspect(s) comply with the legal requirements of feed and food law and animal health and welfare rules." The practical difference between what is an inspection and what is an audit is nuanced. Indeed, the terms audit and inspection are used interchangeably in the literature with greater differentiation in more historic literature than when compared to contemporary discourse. An inspection is often seen as a "moment in time" checklist based approach (Souness, 2000) where the decisions are binary i.e. complaint or non-compliant with very little emphasis on continuous improvement.

Systems-based and compliance-based audits

BS EN ISO 9001: 2015 defines an audit as a systematic, independent and documented process for obtaining audit evidence (records, statements of fact or other information) and evaluating the evidence objectively to determine the extent to which audit criteria (policies, procedures and requirements) are fulfilled. This required a systematic examination of an auditee's processes, arrangements and activities to determine whether they conform to standards and procedures, meet audit criteria and if there are any opportunities for improvement (Mallen and Collins, 2003; Blewett and O'Keeffe, 2011). In this context an auditee is an individual, department or organisation being audited. To give benefit to the organisation for the resources utilised in preparing, undertaking and following up audit activities afterwards, auditing should highlight evidence of compliance and best practice as well as report non-compliance and corrective action (Bergh *et al.,* 2016). Compliance can be determined firstly in terms of whether the organisation's documented management system (FSMS and QMS) meets the criteria and requirements of the third party certification (TPC) standard or alternatively the requirements of legislation and official controls. Thus an audit should give a fully rounded picture of the current status of the organisation and areas of excellence as well as where preventive or corrective action is required. Blewett and O'Keefe (2011) argue that auditing too can be mechanistic in nature and use binary assessments of whether activities are either completed or not completed, are black or white rather than grey, or are considered simply as good or bad practice. This means the focus of this type of the audit is primarily on compliance.

This first approach, which is both mechanistic and binary in terms of whether the organisation's documented formalised systems have addressed a legislative and/or TPC requirement, or conversely have not is often called a systems audit. Secondly the audit can examine the organisation's performance and whether it meets both the TPC standard,

official controls and/or the requirements of the FSMS and QMS where these extend beyond the stated criteria within the standard or legislation in terms of a compliance based audit.

Performance-based audits

The third type of audit is a performance based audit where the examination is one that considers better or best practice and thus extends beyond simple compliance. Official control audits are an example of performance audits that are used to evaluate governance in terms of cost verses benefits aspects. The three types of verification audit have been compared in Table 1.

Performance based audits derive their meaning from the degree of engagement of all parties in the audit process, and the quality of the relationship between auditor and auditee (Pollit *et al.,* 1999; Weets, 2008; Morin, 2001; 2004; 2008; Läikkö-Roto and Nevas, 2014). Meaning is a social construct that links people to their environments and as a result influences their perception of a given function or activity e.g. the role of auditing (Rapoport, 1988; Coolen and Ozaki, 2004). Food safety culture as a construct describes the emergent history and traditions of a given organisation that give meaning to the underlying values and beliefs held by members of formal and informal social groupings (Buchann and Huczynski, 2004; Griffith *et al.,* 2010). A deeper analysis of food safety culture is described in paper one of this special themed journal edition (Manning, 2018). Thus performance based audits go further than simple compliance assessment against TPC elements and examine both the formal FSMS and QMS and the informal business practices that are influenced by organisational culture. Performance based auditing extends towards identifying weaknesses in the FSMS or QMS that have not yet given rise to non-compliance but where the auditor recommends that the organisation considers undertaking preventive action before non-conformance potentially arises in the future (see Table 1). These recommendations may or may not be addressed by the organisation but can underpin continuous improvement in management systems and operational performance. This latter approach requires auditors to step away from a mechanistic style of auditing to use a more holistic approach that embraces not only the system and compliance element of auditing, but also considers much wider aspects such as the organisational culture of adopting, implementing and monitoring food safety and quality aspects of products and processes employed.

Third party certification

Certification is the process whereby an accredited certification body provides written assurances, normally in the form of a certificate, that based on a formal assessment, which usually includes an audit, an organisation conforms to the requirements of a given standard (BRC, 2017). A certificate is usually issued with the audit report verifying the result of the audit, including a scoring system grade (if that forms part of the TPC scheme) and stating that the audit has been conducted against particular audit criteria (Blewett and O'Keeffe, 2011) as defined in the standard. TPC schemes cover the certification of the management of the production, storage and handling of the products at a discrete point in the supply chain (Manning and Soon, 2014) and can interface in a modular approach to provide whole chain assurance. A certification body is a provider of certification services and is accredited to do so by an authoritative body (BRC, 2017) Accreditation is the process by which an independent authoritative body gives formal recognition of the competence of a certification body to provide certification services against a specified system standard (BRC, 2017).

Whilst the differentiation between an inspection and an audit is not explored in depth here, what is of interest is whether a TPC audit is executed based on a checklist approach alone (akin to inspection) or whether the auditor has the flexibility to also assess criteria that are not defined explicitly in the audit checklist.

Checklist-based auditing

The checklist approach to auditing, sometimes called *evaluation myopia,* has been described as the rigid application and non-reflective use of a certification standard causing the auditor to overlook the side effects or side impacts that can occur i.e. a blinkered approach to verification (see Martz, 2010). This can result in an auditor only verifying the quality and food safety criteria that are specifically defined in the standard, thus unknown or emerging issues may well go unnoticed and unexamined (Manning, 2013; Manning and Soon, 2014). Flores-Miyamoto *et al.,* (2014) argue that whilst checklist based auditing might be technically correct, myopia can occur if auditors use a checklist to prove they have undertaken the audit appropriately, but there may be no incentive for the auditor to identify wider material weaknesses or deficiencies in the QMS or FSMS. It is argued that there are considerable resources employed in the development and excessive use of manuals, guidebooks, protocols, and checklists for audits often when the contribution of such tools to audit efficiency and effectiveness is unclear (Leeuw, 2011; Läikkö-Roto and Nevas 2014).

The UK Food Standards Agency (FSA) uses a checklist based approach for their official premises and food audits (FSA, 2017a). Powell et al. (2013) state that whilst food service inspection is the cornerstone of local public health, the scores derived can be a poor predictor of foodborne illness. Further they argue whilst TPC audits are a valuable snapshot verification tool and can be a cost-effective way to assure food safety in a supply chain of reducing financial margins where cost-effectiveness is key, food businesses that have approved certified status still continue to be linked with food incidents, product recalls and foodborne illness outbreaks. Manning (2013) built on this concern over the effectiveness of verification by developing a verification risk (VR) model to identify the components of VR that prevent weaknesses or actual non-conformance being identified and addressed during an audit. The degree of VR reflects the products and processes being audited and could arise either from inherent product characteristics (such as clumping, heterogeneity), inherent hazard characteristics (such as low infective dose), inherent weaknesses in the sampling plan for the method of verification or a weak sampling protocol that is being used by the regulator, TPC company, or the organisation itself and/or a lack of resources to undertake effective sampling and surveillance (Manning and Soon, 2013). Flores-Miyamoto *et al.,* (2014) assert that studies into the cost effectiveness and process improvement capabilities of auditing in food production are scarce.

Risk-based auditing

Effective auditing has been described as the activities and actions completed to ensure that the maximum number of actual deviations from the expected state of conformity to a specific standard, law or regulation are identified during the audit, whereas efficient auditing is described as where non-conformity is identified with the minimum amount of resources i.e. in efficient auditing approaches there is an element of trade-off between the cost and the benefit derived (Kleboth *et al.,* 2016). Effective auditors must not only be able to assess compliance, but also be able to determine the level of risk in a given

situation and draw together the information available to determine the effectiveness of the FSMS in that context (Powell *et al.,* 2013).

The characteristics of an excellent audit are that it is quick to apply yet still accurate, is non-invasive i.e. the evidence can be collected with the least possible effort from the auditee, scalable, avoids bias whilst being theoretically grounded, is transparent, and stimulates consensus building (Salama *et al.,* 2009). However, Trotman and Wright (2012) suggest that to prevent identification of non-compliant activities or illicit behaviour, an auditee organisation may develop concealment strategies, especially where the auditee organisation is aware of the analytical procedures and audit processes used by auditors during audits. Because they may second guess the verification activities as part of a concealment strategy it is important for the auditor to use a range of evidence sources to determine the level of risk, degree of compliance and the culture of the organisation that gives context to the FSMS and QMS employed i.e. that triangulation of evidence should be undertaken. This suggests that limiting the amount of objective evidence gathered during an audit to a single source is problematic. Arens *et al.,* (2010: p. 134) described auditor independence as the "mental attitude that is taking unbiased viewpoint in the performance of audit tests during the accumulation and evaluation of evidence, the evaluation of the results, and the issuance of the audit report." Auditor independence means that auditors have a responsibility to examine a range of objective evidence in order to provide an opinion for that given date or timeframe on whether the evidence assessed reflects the organisation's activities and the organisation's degree of compliance with regulatory and/or market standards (Smith and Emerson, 2017). However, barriers to undertaking detailed in-depth auditing exist. Time pressure can affect auditor behaviour and as a result audit quality in terms of both the need to complete an audit of the scope and depth required and also to provide a report of sufficient depth that can inform appropriate action by the auditee organisation. Audits are often called "snapshots" i.e. the resources available in terms of auditor time and expertise will influence the scope and depth of the audit and by implication reliability of the audit process and the audit result (see Powell *et al.,* 2013).

In light of these challenges, Albersmeier *et al.,* (2009) considered the trustworthiness of TPC as a quality signal, raising concerns with regard to validity and reliability, and auditor independence and objectiveness based on the use of inspection techniques based on *checklist governance*, i.e. identifying the presence of QMS or quality performance elements and contrasts this model, with the concept of risk-based auditing. The checklist content will also influence the depth and scope of the audit (Powell *et al.,* 2013). Albersmeier *et al.,* (2009) compared the characteristics of inspection based and risk-based audits (see Table 2).

From a positive viewpoint, a risk-based auditing programme ensures optimum and cost effective utilisation of verification resources and limited budgets (Van Asseldonk and Velthuis, 2014) especially for micro and small sized organisations where the cost of TPC can be a challenge. Proportional risk-based product and process sampling especially by regulators can be described as stratified sampling based on firstly the levels of risk to consumers and the wider food supply chain, and secondly the concept of earned recognition as a factor of influence when sampling plans, including audit frequency is determined (Manning *et al.,* 2014). Proportional risk-based product sampling is implemented where the sample size and population reflects respective risk level (Thurmond, 2003; Manning *et al.,* 2014). The sampling architecture is important to define especially the criteria (strata) which inform the risk assessment, the validity and repeatability of the sampling methodology and the confidence limits when interpreting the results. The most important criteria to address

when developing a verification sampling framework are to embed risk-based verification systems in a framework so they interact with and activate each other i.e. promote input – output – input processes (see BS EN ISO 9001: 2015); development of verification methodology must be appropriate, sensitive and accurate whilst also being repeatable and reproducible between verification activities. If they are designed to promote early detection of non-compliance whilst minimising false positives, then verification activities must be timely, promote rapid information transfer and the audit report must affect appropriate preventive and corrective action, as required. It is important to ensure system efficiency, and cost-effective surveillance (Briedenbach *et al.,* 2004) as well as net value and return on investment.

Some weaknesses in the use of TPC as a form of FSMS verification have been raised. The process sampling activities used within such TPC audits are constrained by the time available i.e. a snapshot in time, planned frequency of verification activities, volume of data to be assessed, any planned or unplanned sampling bias, and the potential for deviation from the scope of the audit and the quality of the standard against which the audit is being undertaken (Manning, 2013; Powell *et al.,* 2013). The Global Food Safety Initiative (GFSI, nd), a collaborative group of non-governmental food industry actors (CAC, 2017), through their benchmarking activities drive the recognition, consistency and continuous development of TPC schemes and thus play a strong role in the development of industry practices that drive improved audit depth and triangulation of verification activities associated with examining FSMS and the associated food safety culture. The GFSI Technical Working Group on Food Safety will play a pivotal role in this development.

Regulatory approaches to TPC

TPC standards can subsume and/or replicate national legislative requirements or governance arrangements and a trend is emerging within regulatory modernisation programmes to recognise certain aspects of such schemes (CAC, 2017). Thus TPC are being used to drive a more risk-based regulatory approach to food safety governance and delivering food safety objectives. Countries where this approach is being considered include Canada, the Netherlands and the UK (CAC, 2017). Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products which will come into full force by 14 December 2019 states that "competent authorities should perform official controls regularly, on a risk basis and with appropriate frequency… The frequency of official controls should be established by the competent authorities having regard to the need to adjust the control effort to the risk and to the level of compliance expected in the different situations." In the UK, earned recognition is a regulatory framework for reducing, wherever possible, the frequency and type of official controls on businesses that demonstrate continued legislative compliance (Food Law Code of Practice (England) March 2017), such as regulatory inspection and product sampling. Earned recognition considers the value of TPC as a means to identify food businesses that are of lesser risk and thus require less regulatory interest. Whilst the competent authority is still central to the regulatory process a tighter more risk based approach that rewards good practice with less frequent inspection via the recognition of TPC is increasingly seen as a better form of regulation (Albersmeier *et al.,* 2009). TPC has been described by the Food Law Code of Practice (England) March 2017 (p. 148) as: "Independent verification of business compliance against a predetermined standard which

has been endorsed by the [Food Standards Agency] FSA as being equivalent to /complying with the requirements for food law." In the UK, the FSA is responsible for ensuring that an effective regulatory regime is in place to verify that food business meet their obligation to ensure food is safe and is what it says it is (FSA, 2017b p. 2). In the emerging regulatory approach "Regulating our future" (ROF) the FSA state: "We will continue to inspect and assure each [TPC] scheme to be confident that its standards, independence and trustworthiness meet our expectations, being clear that this use of regulated private assurance is not self-regulation" (FSA, 2017b, p. 10).

The FSA are therefore considering within ROF, rather than earned recognition, the use of regulated private assurance (Robinson, 2017). However, Turku et al. (2018) argue that there is a major difference between unannounced regulatory control inspections that are independent, potentially more authentic and focus primarily on the safeguarding of consumer interests whilst TPC is part of a market economy with the associated risk that brings and the potential difference in focus of predominantly announced TPC audits might lead to non-compliance going unrecognised (Martinez *et al.,* 2013; Verbruggen and Havinga, 2015). Turku *et al.,* (2018) conclude that due to the longer timescale of a TPC audit versus an official inspection, the content of the different audits/inspections and the competence of the auditors (official audits versus industry audits) that TPC audits had greater impact on business risk management than official control inspections. Unannounced TPC audits within a given timeframe are now being adopted within the requirements of standards such as the BRC Global Standard, but Turku *et al.,* (2018) state that TPC audits cannot be held as a replacement for official food controls and further work needs to be undertaken to consider why discrepancies occur between the audit outcomes/inspection results from the two approaches. Robinson (2017) stated that:

> "whilst there is significant commonality between BRC Global Standards audits and [competent authority] CA inspections, there is a perceived difference in the purpose, assessment focus and approach between them. CAs carry out an inspection, which focuses on assessment of any risk to public health and compliance against relevant legislation, whilst the focus of BRC Global Standards audits is to assess compliance against the requirements of the Standard. Although the Standard has been developed to assist businesses to meet legal requirements, it was the view of the CAs and FSA assessors that this is not the primary focus of the audit assessment. This perceived fundamental difference raised a number of concerns about the Standard being used as the basis for a full replacement of CA interventions by BRC Global Standards audits, however there was general acceptance that the audits could be used to help inform the [risk=based] frequency and/or focus of CA interventions of certificated businesses." Robinson (2017 p.4)

Therefore the transition from the use of TPC audits initially as a compliance verification tool within a wider remit of organisations needing to demonstrate compliance with contractual obligations and due diligence (Elliott Review, 2013) to secondly then TPC being used as a risk-assessment tool for CA inspections within a regulatory risk-based assessment is under consideration in the UK and also the wider EU. This means that the purpose of use of the outputs of TPC is changing and the use of regulated private assurance (FSA, 2017b) as proposed under ROF is of interest not only within food manufacturing, but also for the

hospitality sector. If the FSA and CAs are going to use the data derived from TPC to determine risk and thus the need for regulatory intervention then there is a suggestion that TPC needs to be more robust in terms of verification activities in order for there to be confidence in such an approach. The Elliott Review stated there was a reluctance to rethink and redesign how auditing is undertaken, and highlighted that:

> "The review has found that the quality and completeness of these private audits are variable, and some of their requirements appear futile or unreasonable. The growing number of audits commissioned by retailers is not achieving the intended purpose. The auditing regime has, in some cases, become an industry in itself, because it requires food businesses to pay for their audit. As a result, there is a danger that an audit regime can be used for raising revenue, placing unnecessary costs on food businesses, particularly SMEs." (Elliott Review, 2013 p. 40).

The Elliott Review (2013) determined that there is a proliferation of first party, second party and third party audit as well as official control inspections that are developed piece meal and with little co-ordination. The duplication uses resources and comes at a cost, and in their current framing the varied requirements whilst being designed to demonstrate due diligence could provide an opportunity for the FSA to implement an earned recognition approach. This requires a given TPC standard or standards to be recognised by the FSA as being compatible with regulatory controls and thus the degree of compliance identified could be used as a proxy for then reducing the requirement for official controls inspection. Powell *et al.,* (2013) assert that TPC audits are only one type of performance indicator and they need to be supplemented with assessment of data from other sources including microbial testing, second-party audits, internal audits, laboratory results and raw product certifications. Different types of verification are now described in more detail.

Types of verification and their validity

Verification includes auditing methods, procedures and tests, product sampling and analysis and is used to determine if the FSMS system including the hazard analysis critical control point (HACCP) system is developed, implemented and is working correctly (CAC, 2003). Further the frequency of verification should be sufficient to confirm that the FSMS is working effectively (CAC, 2003). The concerns over the failures in verification, perceived barriers and perceived benefits have been identified in the literature (see Table 3). The perceived benefit is that verification can ensure product and process compliance, but there are barriers in that verification is costly, includes duplication and lacks value.

Verification of process and product through review and auditing provides the auditor with a range of evidence, or audit observations, which can be both qualitative e.g. interviews, observations and records, or quantitative based on measurement and test (Manning and Soon, 2014) the so-called question – observe - measure (QOM) approach. Triangulation is the obtaining audit evidence from multiple sources using multiple approaches and will increase the likelihood that an auditor acquires sufficient and well-integrated understanding of the organisation, its internal management structure and its performance (Bell *et al.,* 2005). Triangulation allows for comparison between sources of evidence, especially in complex, multi-layered and multi-dimensional situations in order to provide qualified confirmation of audit findings by counterbalancing the strengths and weaknesses of different methodologies and approaches to increase the credibility of audit

findings, improve consistency and aid generalisability (Kopinak, 1999; Bauwens, 2010; Yeasmin and Rahman, 2012; Carugi, 2016; Jespersen and Wallace, 2017). Triangulation is a strategy of acquiring and evaluating complementary evidence that if undertaken effectively can improve auditor judgment, the decision-making processes and the management of detection of risk, and therefore, the overall quality of the audit. (Bell *et al.,* 2005). A multi-method approach to triangulation of verification methods drives both efficient and effective auditing because every method of verification has its limitations (Kleboth *et al.,* 2016). Due to the cost, triangulation between first, second or third party audits and quality assurance or food safety performance metrics such as compliance with microbiological targets is limited in practise.

Bergh *et al.,* (2016) differentiate between the use of interviews, questionnaires, surveys and scoring systems, but state that ensuring validity and reliability is important. Stadlmüller *et al.,* (2017) considered triangulation between hygiene inspection undertaken by trained regulatory inspectors during unannounced audits using a survey based hygiene scoring system, along with food sampling and environmental samples such as swab samples, surface samples, floor drain samples and slicer dust. In high-risk organisations, the results demonstrate a correlation between deficiencies in operational hygiene (as indicated by the developed hygiene inspection score) and food rejections or recommendations for food business operators demonstrating hygiene inspection score data together with other data from national control authorities can be used to determine a risk rating for a given organisation. Luning *et al.,* (2011) distinguish between diagnostic tools that determine the level of performance of a FSMS; selection tools that are designed to help a selection process and determining the most appropriate analysis and detection system and improvement tools that are designed to drive improvement with the FSMS (Manning, 2018). These tools go beyond compliance based auditing to ensuring performance-based auditing (see Table 1). Research studies that have sought to adopt a triangulation approach include Albersmeier *et al.,* (2009); and Sampers *et al.,* (2010). Henriques *et al.,* (2014) suggest document review, a checklist based audit combined with microbiological testing (surface swabs and product testing). The use of audits with laboratory tests incl. DNA analysis and isotope ratio-based fingerprint analysis has also been suggested (Fauzi and Mas'ud, 2009; van der Spiegel *et al.,* 2012) but again these methodologies are expensive and may not translate to routine verification in industry. FSMS diagnostic tools include the FSMS diagnostic instrument (FSMS-DI) (Luning *et al.,* 2008; 2009) and a microbiological assessment scheme (MAS) (Jacxsens *et al.,* 2009). Boeck et al. (2016) combined the use of FSMS-DI; MAS and a food safety climate self-assessment tool described in De Boeck *et al.,* (2015).

With particular emphasis on food service, Griffith *et al.,* (2017) considered triangulation to assess both food safety management and food safety culture using semi-structured interviews rather than a self-assessment questionnaire and where possible the responses were verified using objective evidence such as documents, records and observations. Griffith (2014) consider triangulation to be better than a traditional TPC audit, which may only assess the visible outer layer of FSMS and shallow elements of food safety culture.

From the financial literature, Trotman and Wright (2012) consider the triangulation of audit evidence in fraud risk assessment in terms of evidence from both systems and compliance audits, but there may be some audit objectives where triangulation is neither required, necessary nor practical. However it is essential to have sufficient objective evidence to prove validity and authenticity if triangulation is not used (Bell *et al.,* 2005). Kleboth *et al.,* (2016) assert that triangulation will avoid the existence of blind spots during

an auditing process in the food supply chain especially with regard to emerging trends or drivers that can influence risk. Therefore triangulation can provide consistent, complementary or alternatively contradictory evidence, reinforcing and amplifying the results of a traditional audit (Bell *et al.,* 2005), but there are barriers such as cost which impact on its implementation in practice.

The British Retail Consortium (BRC) Global Standards, in an industry approach to assessing food safety culture, have adopted a low cost version of the Culture Excellence Survey in their voluntary Food Safety Culture Module that can be added to the core BRC audit (BRC, nd). This additional module that assesses people, process, purpose and proactivity includes both a self-administered questionnaire completed by a prescribed number of employees and also a third-party assessment questionnaire completed by the auditor so that cross-checking, or triangulation, can occur. This voluntary module supports the information gathered during third party audits, alongside additional auditor observations of factors that impact on food safety culture. Further details of the Culture Excellence survey can be found in papers three and four of this special themed journal edition (Taylor & Rostron, 2018; Taylor & Budworth, 2018).

Conclusion

The aim of this paper is to critique the existing and emerging alternative approaches being used by regulators and industry to verify the presence and efficacy of FSMS. This has been considered from both the perspective of market approaches to ensure food safety objectives are met at all stages of the food supply chain via adoption of TPC and also the use of TPC to develop more risk-based regulatory controls as this more hybrid approach would reduce the regulatory burden on CAs and food business organisations alike. Combined with the developed Primary Authority scheme in the UK this could allow rationalisation of the official inspections and the wider TPC landscape (Elliott Review, 2013; FSA, 2017b). However this form of co-regulation whilst having resource efficiency benefits also raises concerns over the depth of audit employed and the quality of the audit undertaken with particular focus on the types of verification and their efficacy. The efficiency and effectiveness of verification has been explored not only in considering FSMS compliance with regulatory requirements and market standards but also consideration of food safety culture and its influence on compliant behaviour and reducing risk. The use of triangulation within verification activities has been highlighted and critiqued and much research work is being undertaken.

TPC using systems-based and compliance-based audits alone will not deliver effective verification of the FSMS and continuous improvement of the organisation's products and processes over time. Performance-based approaches that consider risk factors and the cultural context of how formal systems are implemented, monitored and internally verified are required and some examples of these methodological approaches are given in the paper. Triangulation needs to be undertaken during the FSMS verification process which at its simplest is a Question, Observe, Measure (QOM) triad of objective evidence collection and at its more complex involves TPC compliance audits and performance assessment using data analysis methodology and product, process and environmental testing.

Triangulation is essential to ensure effective verification and as TPC standards and regulatory official control evolve, the use of multiple sources of evidence of performance is essential. Effective verification of FSMS and QMS and the associated organisational culture

is essential to ensuring that the food produced is safe and consistently of the quality required by customers and consumers.

References

Albersmeier, F., Schulze, H., Jahn, G., and Spiller, A. (2009), "The reliability of third-party certification in the food chain: From checklists to risk-oriented auditing," *Food Control*, Vol. 20, No. 10, , pp. 927-935.

Arens, A. A., Best, P., Shailer, G., Fidler, B., Elder, R. J., and Beasley, M. S. (2010), *Auditing Assurance Services in Australia: An Integrated Approach.* 8th edition. Pearson Australia, NSW 2086.

Baş, M., Yüksel, M. and Çavuşoğlu, T., (2007), "Difficulties and barriers for the implementing of HACCP and food safety systems in food businesses in Turkey." *Food Control*, Vol. 18 No. 2, pp. 124-130.

Bauwens, A. (2010), "The use of method triangulation in probation research." *European Journal of Probation*, Vol. 2 No. 2, pp. 39–52.

Bell, T. B., Peecher, M. E., and Solomon, I. (2005), *The 21st century public company audit: Conceptual elements of KPMG's global audit methodology*. KPMG LLP.

Bergh, L.I.V., Hinna, S., Leka, S. and Zwetsloot, G.I., (2016), "Developing and testing an internal audit tool of the psychosocial work environment in the oil and gas industry." *Safety science*, Vol. 88, pp.232-241.

Blewett, V. and O'Keeffe, V., (2011), "Weighing the pig never made it heavier: Auditing OHS, social auditing as verification of process in Australia." *Safety science*, Vol. 49 No. 7, pp. 1014-1021.

BRC (nd), "What is food safety excellence?" Available from: https://www.brcglobalstandards.com/brc-global-standards/food-safety/additional-modules/food-safety-culture-module/ (accessed on 24/11/17)

BRC (2017), BRC Global Standards, Available at: https://www.brcglobalstandards.com (Accessed on 5th November 2017)

BRC (2015), *British Retail Consortium Global Standard Food Safety*. Issue 7. BRC, London.

Breidenbach, E., Sievi, M., Weber, U., Heiz, H. and Stärk, K.D.C., (2004), Fundamental principles for risk-based planning of random sampling to trace hazard in imported meat. In *Proceedings 5th World Congress Foodborne Infections and Intoxications, 7–11 June 2004, Berlin*.

BS EN ISO 9001: 2015 (2015) Quality management systems: requirements. TSO London ISBN 9780580918162.

Buchann, D. and Huczynski, A. (2004), *Organizational Behaviour: An Introductory Text*, 5th Ed., Pearson Education Limited, Madrid.

CAC (Codex Alimentarius Commission) (2017*), Joint FAO/WHO Food Standards Programme. Codex Committee on Food Import and Export Inspection and Certification Systems.* Twenty-Third Session. Discussion Paper on Regulatory Approaches to Third Party Certification in Food safety. February 2017 CX/FICS 17/23/8

CAC (Codex Alimentarius Commission) (2003*), Hazard Analysis and Critical Control Point (HACCP) System and Guidelines for its application, Codex Alimentarius Commission Food Hygiene Basic Texts* (Revision 4). Available at: http://www.codexalimentarius.org

Carugi, C. (2016), "Experiences with systematic triangulation at the global environment facility", *Evaluation and Program Planning*, Vol. 55 No. 1, pp. 55–66. http://dx.doi.org/10.1016/j.evalprogplan.2015.12.001.

Coolen, H., and Ozaki, R., (2004). "Culture, Lifestyle and the Meaning of a Dwelling", in *International Conference on Adequate and Affordable Housing for All: Research, Policy and Practice* (pp. 24-27).

De Boeck, E., Jacxsens, L., Bollaerts, M., Uyttendaele, M. and Vlerick, P., (2016), "Interplay between food safety climate, food safety management system and microbiological hygiene in farm butcheries and affiliated butcher shops", *Food Control*, Vol. 65, pp. 78-91.
De Boeck, E., Jacxsens, L., Bollaerts, M., and Vlerick, P., (2015). "Food safety climate in food processing organisations. Development and validation of a self-assessment tool". *Trends in Food Science and Technology*, Vol. 46, pp. 242-251.
Elliott Review (2013), Elliott Review into the Integrity and Assurance of Food Supply Networks – Final Report: A National Food Crime Prevention Framework (July 2014) HM Government. London.
Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products Available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32017R0625
Fauzi, A. M., and Mas'ud, Z. A. (2009), *Instrumentation techniques for potential application in halal products authentication.* Paper presented at the 3rd IMT-GT international symposium on halal science and management, 21st-22nd December 2009, Kuala Lumpur, Malaysia.
Flores-Miyamoto, A., Reij, M.W. and Velthuis, A.G.J., (2014), "Do farm audits improve milk quality?". *Journal of Dairy Science*, Vol. 97 No. 1, pp.1-9.
Food Law Code of Practice (England) March 2017, Available at: https://www.food.gov.uk/enforcement/codes-of-practice/food-law-code-of-practice (Accessed on 5th November 2017)
FSA (Food Standards Agency) (2017a), Audit documents, Available from: https://www.food.gov.uk/enforcement/auditandmonitoring/auditdoc (accessed 10/11/17)
FSA (Food Standards Agency) (2017b) Regulating our future. Available from: https://www.food.gov.uk/sites/default/files/rof-paper-july2017.pdf (accessed 10/11/17)
Griffith, C.J., Griffith, C.J., Jackson, L.M., Jackson, L.M., Lues, R. and Lues, R., (2017), "The food safety culture in a large South African food service complex: Perspectives on a case study", *British Food Journal*, Vol. 199 No. 4, pp.729-743.
Griffith, C. (2014), *Developing and Maintaining a Positive Food Safety Culture*. 1st Edition. Highfield Publications.
Griffith, C.J., Livesey K.M., and Clayton, D.A., (2010), "Food safety culture: the evolution of an emerging risk factor?" *British Food Journa*l, Vol. 112 No. 4, pp. 426–438
GFSI (Global Food Safety Initiative) (nd) Available at: http://www.mygfsi.com/about-us/about-gfsi/what-is-gfsi.html (accessed 24/11/17)
Henriques, A.R., da Gama, L.T. and Fraqueza, M.J., (2014), "Assessing Listeria monocytogenes presence in Portuguese ready-to-eat meat processing industries based on hygienic and safety audit.", *Food Research International*, Vol. 63, pp.81-88.
Hinkle, S., (2006), *Take a quality ride: the realities of implementing a quality management system*. iUniverse.
Jacxsens, L., Kussaga, J., Luning, P.A., Van der Spiegel, M., Devlieghere, F., Uyttendaele, M., (2009), "A microbial assessment scheme to support microbial performance measurements of food safety management systems", *International Journal of Food Microbiology,* Vol. 134, pp. 113–125.
Jespersen, L. and Wallace, C.A., (2017), "Triangulation and the importance of establishing valid methods for food safety culture evaluation", *Food Research International*, Vol. 100, pp.244-253.

Keener, K. P. E. (2007), Verification programs: safe food guidelines for small meat and poultry processors. http://www.extension.purdue.edu/extmedia/FS/FS-24-W.pdf

Kleboth, J.A., Luning, P.A. and Fogliano, V., (2016), "Risk-based integrity audits in the food chain–a framework for complex systems", *Trends in Food Science & Technology*, Vol. *56*, pp.167-174.

Kopinak, J. K. (1999), "The use of triangulation in a study of refugee well-being.", *Quality and Quantity*, Vol. 33 No. 2, pp. 169–183.

Läikkö-Roto, T. and Nevas, M., (2014), "Auditing local official food control: perceptions of auditors and auditees", *Food Control*, Vol. *37*, pp.135-140.

Leeuw, F. L. (2011), "On the effects, lack of effects and perverse effects of performance audit", in J. Lonsdale, P. Wilkins, & T. Ling (Eds.), Performance auditing (pp. 231-247).

Luning, P. A., Jacxsens, L., Rovira, J., Oses, S. M., Uyttendaele, M., and Marcelis, W. J. (2011), "A concurrent diagnosis of microbiological food safety output and food safety management system performance: cases from meat processing industries". *Food Control*, Vol. 22, pp. 555-565.

Luning, P.A., Marcelis, W.J., Rovira, J., Van der Spiegel, M., Uyttendaele, M., and Jacxsens, L., (2009), "Systematic assessment of core assurance activities in company specific food safety management systems", *Trends in Food Science & Technology,* Vol. 20, pp. 300–312.

Luning, P.A., Bango, L., Kussaga, J., Rovira, J. and Marcelis, W.J., (2008), "Comprehensive analysis and differentiated assessment of food safety control systems: a diagnostic instrument", *Trends in Food Science & Technology*, Vol. 19 No. 10, pp.522-534.

Mallen, D., and Collins, C., (2003), The Audit Skills Handbook; A Basic Introduction to Planning and Performing Business Management Systeyem Audits. Consensus Books (Standards Australia International Ltd), Sydney

Manning, L. (2018), "The value of food safety culture to the hospitality industry", *Worldwide Hospitality and Tourism Themes*, Vol. 10 No. 2.

Manning L. (2016), "Food Fraud, policy and food chain", *Current Opinions in Food Science*, Vol. 10, pp. 16-21

Manning, L., Wright, M and McKellar, D (2014), Development of risk-based sampling guidance for enforcement officers, Details available at: http://www.food.gov.uk/science/research/research/choiceandstandardsresearch/fs222001 (Project duration 2013-2014) details not published by FSA to date.

Manning, L and Soon, J.M, (2014), "Developing systems to control food adulteration", *Food Policy*, Vol. 49 No. 1, pp. 23-32

Manning, L., and Soon, J.M., (2013), "Mechanisms for assessing food safety risk", *British Food Journal*, Vol. 115 No. 3, pp. 460-484

Manning, L., (2013), "Development of a food safety verification risk model", *British Food Journal*, Vol. 115 No. 4, pp. 575-589

Martinez, M. G., Verbruggen, P., and Fearne, A. (2013), "Risk-based approaches to food safety regulation: What role for co-regulation"? *Journal of Risk Research*, Vol. 16 pp. 1101-1121.

Martins, E. A., and Germano, P. M. L. (2008), "Microbiological indicators for the assessment of performance in the hazard analysis and critical control points (HACCP) system in meat lasagne production", *Food Control*, Vol. 19 No. 8, pp. 764-771.

Martz, W., (2010), "Validating an evaluation checklist using a mixed method design", *Eval. Program Plann.* Vol. 33 No. 3, pp. 215–222.

Morin, D. (2008), "Auditors general's universe revisited. An exploratory study of the influence they exert on public administration through their value for money audits", *Managerial Auditing Journal,* Vol. 23 No. 7, pp. 697-720.
Morin, D. (2004), "Measuring the impact of value-for-money audits: a model for surveying audited managers", *Canadian Public Administration,* Vol. 47 No. 2, pp. 141-164.
Morin, D. (2001), "Influence of value for money audit on public administrations: looking beyond appearances", *Financial Accountability and Management*, Vol. 17 No. 2, pp. 99-117.
Nguyen, T., Wilcock, A., and Aung, M. (2004), "Food safety and quality systems in Canada: an exploratory study", *International Journal of Quality & Reliability Management*, Vol. 21 No. 6, pp. 655-671.
Panisello, P. J., and Quantick, P. C. (2001), "Technical barriers to hazard analysis critical control point (HACCP)", *Food Control*, Vol. 12 No. 3, pp. 165-173.
Pollit, C., Girre, X., Lonsdale, J., Mul, R., Summa, H., and Waerness, M. (1999), *Performance or compliance?: Performance audit and public management in five countries*, New York, Oxford University Press.
Powell, D.A., Erdozain, S., Dodd, C., Costa, R., Morley, K. and Chapman, B.J., (2013), "Audits and inspections are never enough: a critique to enhance food safety." *Food Control*, Vol. 30 No. 2, pp. 686-691.
Rapoport, A., (1988), "Levels of meaning in the built environment", in: F. Poyatos (ed.), *Cross-cultural perspectives in nonverbal communication*, C.J. Hogrefe, Toronto, 317-336.
Robinson, Y. (2017), Summary Report of the Pilot Project on the Potential for Recognition of the BRC Global Standard for Food Safety (September 2017) Available at: https://www.food.gov.uk/sites/default/files/fsa-brc-report-oct17.pdf (accessed on 10/11/17)
Salama, K.F., Luzzatto, D., Sianesi, A. and Towill, D.R., (2009), "The value of auditing supply chains", *International Journal of Production Economics*, Vol. 119 No. 1, pp.34-45.
Sampers, I., Jacxsens, L. Luning, P. A. Marcelis W. J. Dumoulin, A and Uyttendaele. M. (2010), "Performance of food safety management systems in poultry meat preparation processing plants in relation to *Campylobacter* spp. contamination", *Journal of Food Protection*, Vol. 73, pp. 1447–1457.
Smith, K.J. and Emerson, D.J., (2017). "An analysis of the relation between resilience and reduced audit quality within the role stress paradigm", *Advances in Accounting*, Vol. 37, pp.1-14.
Souness, R., (2000), "HACCP in Australian food control," *Food Control*, Vol. 11 No. 5, pp.353-357.
Stadlmüller, L., Matt, M., Stüger, H.P., Komericki-Strimitzer, T., Jebousek, K., Luttenfeldner, M. and Fuchs, K., (2017), "An operational hygiene inspection scoring system for Austrian high-risk companies producing food of animal origin", *Food Control*, Vol. 77, pp.121-130.
Swanson, K. M. J., and Anderson, J. E. (2000), "Industry perspectives on the use of microbial data for hazard analysis and critical control point validation and verification", *Journal of Food Protection*, Vol. 63 No. 6, pp. 815-818.
Taylor, J. Z. and Budworth, L. (2018), "Food safety culture: patterns and trends from a quantitative analysis of the Culture Excellence assessment program", *Worldwide Hospitality and Tourism Themes*, Vol. 10 No. 2.
Taylor, J.Z. and Rostron, K. (2018), "The development of a safety and quality culture assessment tool from a longitudinal, mixed method research journey", *Worldwide Hospitality and Tourism Themes*, Vol. 10 No. 2.

Taylor, E. (2001), "HACCP in small companies: benefit or burden?", *Food Control*, Vol. 12 No. 4, pp. 217-222.
Thurmond, M.C. (2003), "Conceptual foundations for infectious disease surveillance", *Journal of Veterinary Diagnostic Investigation*, Vol. 15, pp. 501-514
Tompkin, R. B. (1994), "HACCP in the meat and poultry industry", *Food Control*, Vol. 5 No. 3, pp. 153-161.
Trotman, K.T. and Wright, W.F., (2012), "Triangulation of audit evidence in fraud risk assessments", *Accounting, Organizations and Society*, Vol. 37 No. 1, pp.41-53.
Turku, M., Lepistö, O. and Lundén, J., (2018), "Differences between official inspections and third party audits of food establishments", *Food Control*, Vol. 85, pp.459-465.
Van Asseldonk, M.A.P.M. and Velthuis, A.G.J., (2014), "Risk-based audit selection of dairy farms", *Journal of dairy science*, Vol. 97 No. 2, pp.592-597.
Van der Spiegel, M., Van der Fels-Klerx, H.J., Sterrenburg, P., Van Ruth, S.M., Scholtens-Toma, I.M.J. and Kok, E.J., (2012), "Halal assurance in food supply chains: Verification of halal certificates using audits and laboratory analysis", *Trends in Food Science and Technology*, Vol. 27 No. 2, pp.109-119.
Verbruggen, P., and Havinga, T. (2015), "Food safety meta-controls in The Netherlands." *European Journal of Risk Regulation,* Vol. 6, pp. 512-524.
Weets, K. (2008), How effective are performance audits? A multiple case study within the local audit office in Rotterdam. In Paper for the 5th International conference on accounting, auditing & management in public sector reforms. Amsterdam, 3-5 September.
Yeasmin, S., & Rahman, K. F. (2012), "'Triangulation' research method as the tool of social science research", *BUP Journal*, Vol. 1 No. 1, pp. 154–163.

Paper 2 Tables

Table 1. Types of verification audit

Compliance auditing		**Performance –based audit**
Systems-based audit	**Compliance-based audit**	
An audit that examines whether the organisation's documented, formal management system complies legislation and/or with the criteria in a TPC standard, or first or second party standard or customer specifications.	An audit examines whether the practices observed and identified in records and questioning of staff meet both the standard against which the audit is being performed and the requirements in the formal management system. This approach can be binary (against a checklist or equivalent) or holistic and consider multiple sources of evidence to reach a conclusion on the level of compliance.	An audit that considers business performance against best practice and extends beyond binary compliance audits. This will include considerations such as cost vs. benefit, and business risk. Performance audits extend beyond compliance to consider meaning. Performance based audits address both the visible and the invisible food safety culture.
The scope of the audit can include food safety, quality, and/or environmental aspects as defined at the opening meeting by the criteria in the standard itself or where the audit scope may be extended to include other audit criteria.	The scope of the audit can include food safety, quality, and/or environmental aspects as defined at the opening meeting by the criteria in the standard itself or where the scope may be extended. Depending on the development of the audit approach, observations may be included within the audit report which are weaknesses identified by the auditor, but have not yet given rise to non-conformance.	The scope of the audit can include food safety, quality, and/or environmental aspects as defined at the opening meeting by the criteria in the standard itself or where the scope may be extended. All observations are included within the audit report with regard to compliance or non-compliance and also weaknesses in the system or practice that have not yet given rise to non-conformance, but could if controls are lacking or could fail.
If business improvement and food safety culture are not explicitly identified in the TPC standard or scope of the audit it will not be verified.	If business improvement and food safety culture are not explicitly identified in the TPC standard or scope of the audit it will not be verified.	Business improvement and assessment of food safety culture is embedded within the scope of the audit and will be verified.

Table 2: Compliance inspection versus risk-based auditing (adapted from Albersmeier *et al.,* 2009)

Compliance inspection (Checklist governance)	**Risk-based auditing**
Consistency driven by checklist of criteria to inspect.	Rather than checklist driven there is concentration on specific risk areas.
Stepwise review of the list of requirements and level of compliance and allocation of resources.	Stepwise improvement of the efficiency and effectiveness of the audits undertaken.

Consistent expenditure and time given to each audit and auditee.	Reduction of expenditure and time by use of selection process for audit programme.
Consistent time intervals between audits.	Risk-based audit intervals.
Consistent training for all inspectors.	Training of auditors for special risk areas.
No bias towards who is inspected and how often.	Adopt of concepts such as co-regulation, hybridized food safety governance and earned recognition.
Inspection and product sampling based on weighted formula with some unannounced audits to triangulate.	Randomly chosen audits without announcements plus additional risk-oriented sampling.

Table 3. Failures, perceived barriers and perceived benefits to verification (adapted from Van der Spiegel *et al.,* 2012; Kleboth *et al.,* 2016)

Failures in verification	**Source**
Inappropriately performed	Keener (2007)
Lack of technical resources	Panisello and Quantick (2001)
Lack of record keeping	Baş *et al.,* (2007)
Perceived barriers to verification	
Costly	Panisello and Quantick, (2001); Nguyen *et al.,* (2004)
Duplication	Taylor (2001)
Lack of value	Kleboth *et al.,* (2016)
Perceived benefits to verification	
Ensures system compliance	Tompkin (1994); Swanson and Anderson, (2000); Martins and Germano (2008)