Sandpit – Shaping 21st Century Abattoirs
Challenges and opportunities

Introduction

The UK meat industry, worth £4.4 billion a year to the British Economy, is a challenging, highly competitive market. While technological developments have rapidly accelerated other sectors, elements of the meat processing industry have been slower to capitalise on new innovations, particularly in relation to the delivery of official controls. Abattoirs in the UK are highly variable: from small, local slaughterhouses processing a handful of animals a week to industrial scale facilities processing thousands per day. However, in most cases, from the smallest to the biggest operations, the official control processes have hardly changed since Victorian times. While abattoir workers and meat inspectors perform highly skilled functions, technology has the potential to augment their capabilities, allowing them to more strategically target their attention and expertise and better protect consumer food safety interests.

'21st Century Abattoir' Sandpit

The upcoming sandpit is a key milestone for the '21st Century Abattoir Project', a collaborative initiative between STFC Food Network + (SFN) and the Food Standards Agency (FSA). Our shared vision for this project is to support the delivery of official controls through innovation, and to both facilitate and champion interaction between the research community and industry, creating an opportunity for impact. We believe investment in this sector should lead to the development of modular, accessible innovations and data systems that can support pinch-points across the breath of the industry's scale. It is becoming ever more critical that UK abattoirs are able to secure trust in British meat from UK consumers and international trading partners, both of which expect premium quality, safe and traceable products.

The SFN and FSA appointed a team of researchers[1] to conduct a review in order to help frame this discussions, and to better understand the current challenges the abattoir sector is facing and how the advanced technological, data systems, supply chain and materials expertise the SFN and associated partners represent can be harnessed to deliver improved food safety and authenticity to support sustainable, efficient and trustworthy '21st Century Abattoirs'.

We are delighted to have such a wealth of expertise taking part in this interdisciplinary challenge and collaborative opportunity. Over the course of the Sandpit, you will have the opportunity to develop your ideas with FSA Field Operations experts, representatives from the abattoir industry who have first-hand experience of the challenges and the impact these solutions could have, as well as a host of multidisciplinary researchers. After an intense period of discussion, iteration and development of proposals, the Sandpit will culminate in a series

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of pitches to the cross-representative selection panel. The FSA and SFN have ring-fenced match-funding to a total value of up to £250,000 to support the delivery of several co-designed and co-selected pilot projects developed from the '21st Century Abattoir' Sandpit. On the day it will be down to you to tackle these challenges and we are excited to see what innovative, collaborative proposals will be put forward.

Overview of Abattoir Processes

We have provided a brief overview of the abattoir processes highlighting the key activities before (ante-mortem i.e. live animals) and after (post-mortem) slaughter. The process starts with animals being unloaded, then passing through lairage (waiting area), slaughter, dressing and chilling. During the process the FSA has a vital role to play through inspections at various control points to ensure abattoirs meet official control guidelines.

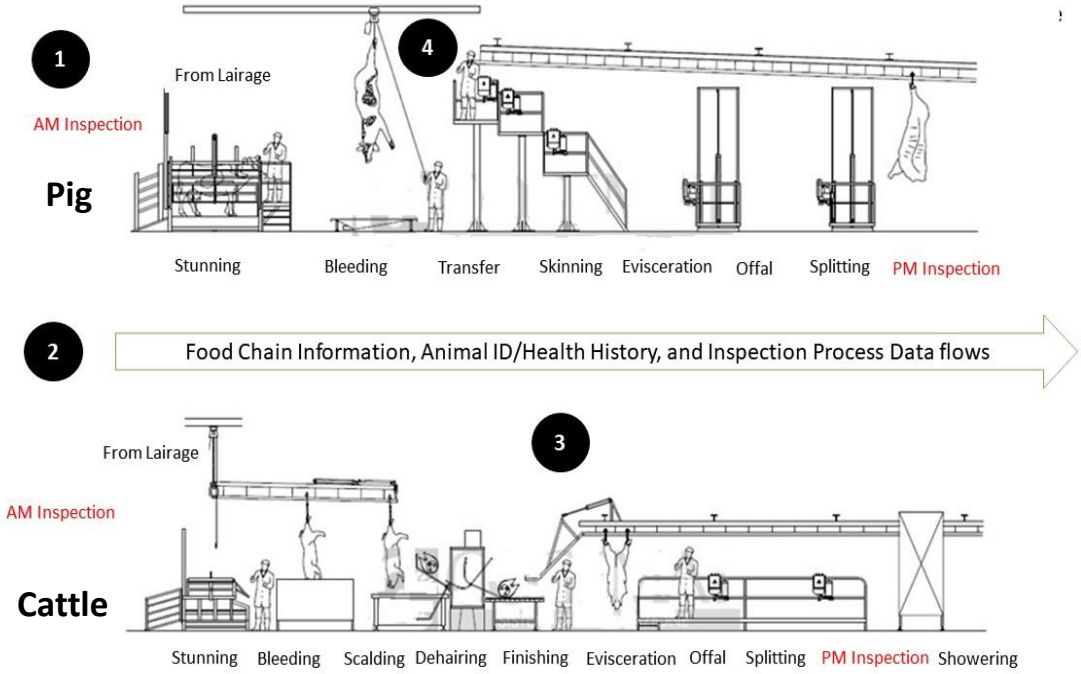

Figure 1: Schematic view of abattoir processes and key challenges identified during review: 1) Ante-mortem checks are purely visual, while post-mortem inspections are undertaken through visual checks, palpation, the use of knives to cut tissue (incisions) which are associated with greater contamination risk; **2)** The flow of data across the inspection process is not joined up and is captured in real time via different media (paper records, system entries); **3)** All processes ahead of the unloading and after chilling are also assured by the FSA official controls **4)** Processes for ante- and post-mortem inspections are labour intensive and require the professional services of official vets and highly skilled meat hygiene inspectors.

Source: adapted from Cogemat Slaughtering Systems, (2019)[2]

[2] Cogemat Slaughtering Systems, (2019). Cattle Slaughterhouse Lines. Available at: http://www.slaughterhousequipments.com/cattle-slaughterhouse-lines.html [Accessed, 19th September, 2019]

Official Veterinarian inspections:

- At unloading:
  - Visual checks for cleanliness and health, inspecting each animal moving and at rest
  - Food Chain Information (animal passport)
- During lairage (waiting area before slaughtering):
  - Inspections related to space, access to food, lighting, and water
- Animal welfare assessed throughout
- Recording of any disease conditions for surveillance purposes
- Referrals and information sharing (the FSA records ante-mortem inspection checks, verified by Food Business Operator (FBO), and shares with producers, farm vet and the competent authority with relevant information)
- Referrals could be made if animals arrive injured

Official Veterinarian/Meat Hygiene Inspector's checks

- Visual checks of carcases and offal
- Test/monitor for diseases/contamination
  - Visual inspection of carcase for physical contamination or condition *(e.g. in pigs: anaemia, badly bled, gut content, emaciation, erysipelas, generalised tuberculosis (TB), tumours, melanosis, jaundice, machine damage, poly-arthritis, septic peritonitis, suspect fever, abnormal odour)*
  - Any observed or suspected contamination leads to the detention of carcase or offal for further inspection procedures at post-mortem inspection
  - Categorisation of contamination in line with official control
  - Testing (as required) through sampling activity; including Residue in Meat testing, Tuberculosis testing, Trichinella testing.
- Health marking of meat to declare fit for human consumption
- Record keeping (of inspection results) and information sharing

Records are kept in various plant-based systems such as the Hellenic system, which connects to the FBO and farmer. Other abattoirs use clickers to record pathological conditions and manually input data onto the IRIS system.

Key challenges and opportunities:

The key challenges and opportunities identified during the review process have been categorised into three main themes as listed below. Sandpit attendees will divide themselves between the three themes on the day, please consider which theme you would most like to work on.

Theme 1: Data architecture, governance and virtual systems

This theme will investigate the existing and emerging approaches to the architecture and governance of inspection, quality and safety data:

1. *The locus of power*: various agencies operate and control the data required for managing inspections and abattoir processes. This theme would explore opportunities for using technologies to establish a value chain approach to ante- and post-mortem inspection data generation, architecture, reporting and governance.
2. *The basis for governance*: the current and emerging mechanisms for audits, voluntary disclosure, and public accountability.

Ante-Mortem

- Transforming the collection, updating and storage of food chain information (FCI) and animal health data for improved accuracy, traceability, and utility of inspection reports.
- Developing a data governance model for the coordinated and standardized collection, processing, sharing, dynamic updating and storage of inspection data.
- Enabling an interoperable, distributed, and coordinated system for sharing, validating, and verifying FCI, animal health, and visual inspection data by multiple stakeholders (agencies, FBOs, retailers and consumers).
- Use of technology, big data analytics and AI along with integrated management approaches to augment strategic surveillance and regulation
- Big data analytics-based forecasting and decision-making using collected animal/inspection data (e.g. improving the management and forecast of TB reactor animal schedules by FBOs and relevant agencies. This will help FBOs and agencies such as FSA, APHA, and Defra to coordinate and share animal data for scheduling the slaughtering of animals (both TB reacted and non-TB) on a given date at licensed abattoirs, and help with animal health forecasting to enhance inspection preparedness and decision making).

Post-Mortem

- Collecting, storing and transmitting post-mortem inspection data for forecasting/predictive decision making (animal health, farm compliance, disease outbreak trends etc.).
- Record keeping (of inspection results) and inter-agency information sharing
- Automation of critical control points for real time data collection to avoid human errors and increase efficiency
- Standardisation of post-mortem inspection processes across abattoirs by augmenting individual judgements (Official Veterinarian/Meat Hygiene Inspector)

through use of virtual systems that could e.g. highlight examples of other confirmed cases, use data to flag if multiple carcasses on same run, from same supplier are affected etc.

Theme 2: Application of cutting-edge technologies

Ante-Mortem

- Use of technology to support visual checks by Official Veterinarian for animal welfare related issues such as behavioural stress and physiological indicators during unloading and in lairage.
- Use of technology to capture animal health data using acoustics, ultrasound, heart rate monitoring, and temperature sensors among others
    - Automation of data captured during unloading and at lairage
- Data capture technologies to standardize collection of data (RFID, Optical Character Recognition, Intelligent Character Recognition, Bar code recognition, Template based intelligent capture, Intelligent Document Recognition)

Post-Mortem

- Automation or use of technology to replace manual palpation or incisions in carcase and offal during post-mortem inspection – limiting risks of microbial cross-contamination
- Increasing efficiency and accuracy of post-mortem inspections by augmenting Meat Hygiene Inspectors' visual checks for meat classification with appropriate technologies
    - Technologies to classify and grade meat quality
    - Offal inspections
    - Technologies for identifying birds that are dead on arrival (e.g. IR thermography)
    - Exploring technologies such as REIMS, NIR Spectroscopy, X-Ray inspection systems, augmented reality technologies to aid visual inspections, bone tagging etc. for the above use at slaughter lines and inspections
- Use of advanced freezing methods (i.e. Cryogenics) for efficient freezing and to reduce risks such as contamination from oil spill, grease etc.

Theme 3: Supply chain and digital transformation

- Use of technologies to enhance traceability of individual animals (not only by batches) in case of hazards and breach of compliance
- Extracting more value from digitisation/digitalisation of captured data at various stages of the processes of official control, abattoir as well as supply chains
- Promoting paperless factories - developing a process for transformation of all data collected and stored manually to digital forms
- Standardising and digitising labelling and certification requirements to enhance trust, authenticity through ease of access for stakeholders – including consumers
- Use of Blockchain to improve quality and safety adherence, regulatory compliance (time stamp), end-to-end traceability, end-to-end supply chain (food chain) visibility, food safety guarantee, consumer engagement/trusts, and data management and sharing.