Seeing is believing: CCTV perspectives in food manufacturing





Emma J. Samuel*, Ellen W. Evans and Elizabeth C. Redmond ZERO2FIVE° Food Industry Centre, Cardiff Metropolitan University, Wales, United Kingdom. *Corresponding author: emsamuel@cardiffmet.ac.uk





Introduction

The use of closed-circuit television (CCTV) systems in slaughterhouses in England became mandatory to monitor regulatory compliance and animal welfare in November 2018¹. Such a requirement is not currently in force in food and drink manufacturing and processing businesses, however, CCTV systems are often installed for multiple reasons including monitoring food handler behaviour, site security or simply to encourage workforce productivity^{2,3}.

As such, ongoing maintenance of CCTV systems is essential to effectively meet the business needs⁴. Likewise, an operational appreciation of CCTV capabilities and limitations enables proactive adaptations to the system such as when production layouts are reconfigured or production workflows change. Fundamentally, CCTV systems provide access to a large volume of retrospective and real-time data and a well-informed design increases facility awareness from a single viewing platform^{5,6}.

As a tool to support food business due diligence, CCTV footage should offer an objective account of preceding and actual events'. Remote observation across food manufacturing departments via CCTV can be used to inform future training needs, support verification for regulatory and auditing purposes and compliment food security defences^{o-10}.

Therefore, the rationale for each CCTV camera placement should be clear, support an associated risk mitigation purpose and be adhered to by all CCTV system To date, no studies have considered this aspect of CCTV implementation in food manufacturing and processing and opportunities exist to explore this novel research field with a view to creating improved observational opportunities from many perspectives.

Purpose

The aim of this explorative case study was to evaluate CCTV camera positions in a multi-site food and drink manufacturing and processing business to assess the field of views and highlight potential future surveillance system refinement.

Methods

- One multi-site food manufacturing and processing business was selected for the observation study.
- The company CCTV system was accessed remotely and an audit of all camera positions (as identified on the 17th December 2018) across three sites were recorded individually utilising a 'screen grab' method.
- Analysis of each screen grab still was undertaken to determine purpose to include security, hygiene practices, workflow processes and other vantage points and anomalies.
- Ethical Approval was obtained from the Health Care and Food, Ethics Panel at Cardiff Metropolitan University (Ref: 9396).

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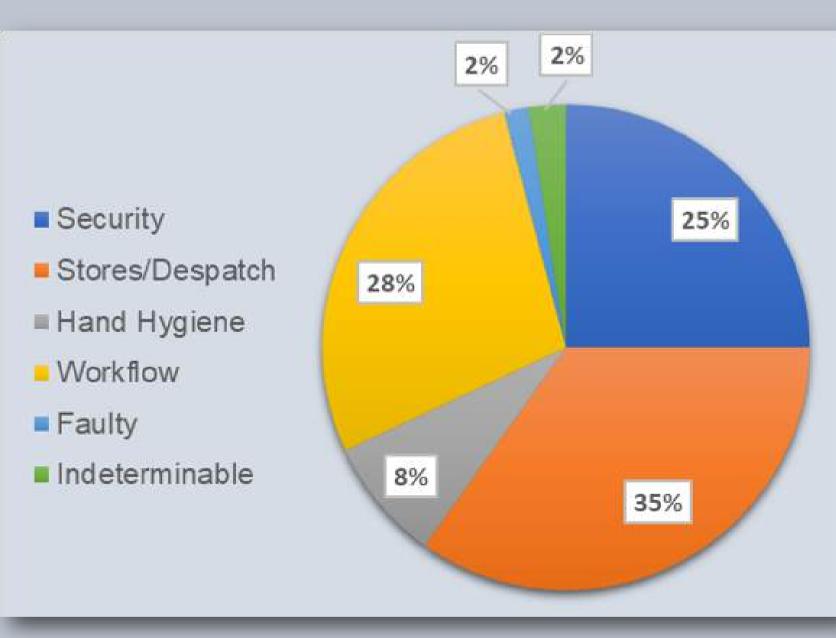
CCTV camera purpose and positioning

Evaluation of 122 fixed CCTV camera positions at three satellite sites (as detailed in Table 1) in a food manufacturing business assessed the field of view perspectives to identify and highlight potential opportunities for

Table 1: CCTV systems installed at each site

Site	Cameras	Production detail
SITEA	32 Camera System	Ready to eat foods (e.g. sandwiches, savoury slices)
SITE B	58 Camera System	Raw meat processing and manufacturing
SITE C	32 Camera System	Cooked meat processing and manufacturing

Figure 1 indicates the distribution of identified determinants to include site security (e.g. vulnerable access points and personal security in changing areas), storage and despatch areas, hand hygiene equipment (e.g. sinks, sanitiser and hand drying facilities), production workflow and other vantage points which were indeterminable or indistinguishable.



Cameras considered defunct (faulty or indeterminable) accounted for 4% of Primarily, the majority (60%; n=73) of cameras appeared to be focused on security and safety related factors (e.g. issues, theft and

Figure 1: Camera positions by purpose (*n*=122)

Hand hygiene facilities (i.e. where food operatives wash and dry hands pre/ during production) were visible in 8% of camera field of views; only 5% offered visual perspectives on precise behaviour. As demonstrated in Figures 2 and 3 below, minor camera position adjustment could increase hygiene behaviour visibility across sites by a further 7% (providing coverage of 16 out of 24 hand sinks present) without compromise to the existing CCTV system.



Figure 2: Hand hygiene area denoting sink position with blue arrow (Site A, Camera 28)



Figure 3: Hand hygiene area denoting sink position with blue arrow (Site C, Camera 14)

Obstructed field of views

Results

Inevitably as production work-flows fluctuate so to do the demands on facility layout and storage areas. As demonstrated by Figures 4 and 5 below, considering the impact this may have on camera field of views would ensure that timely adaptations can be applied in order for continuously recorded footage to remain relevant for observational purposes.



Figure 4: Production stores (Site C, Camera 23)

reconfiguration to readily food access/egress in event of an incident or investigation.



workflows.

observational or security)

can be attributed to the field

of view captured by camera

modification (e.g. removing

and controlling goods placed

on the top rack) would be a

simple and immediate

solution allowing improved

perspectives on warehouse

23 (Figure 4). A minor

Figure 5: Maturation room (Site B, Camera 25)

a finite number of cameras)

Similarly, as demonstrated by camera 13 (Figure 6), re-siting the storage rack in the corridor would provide an improved field of views for security purposes as well as capture activity in the production office; effectively serving a dual camera purpose.

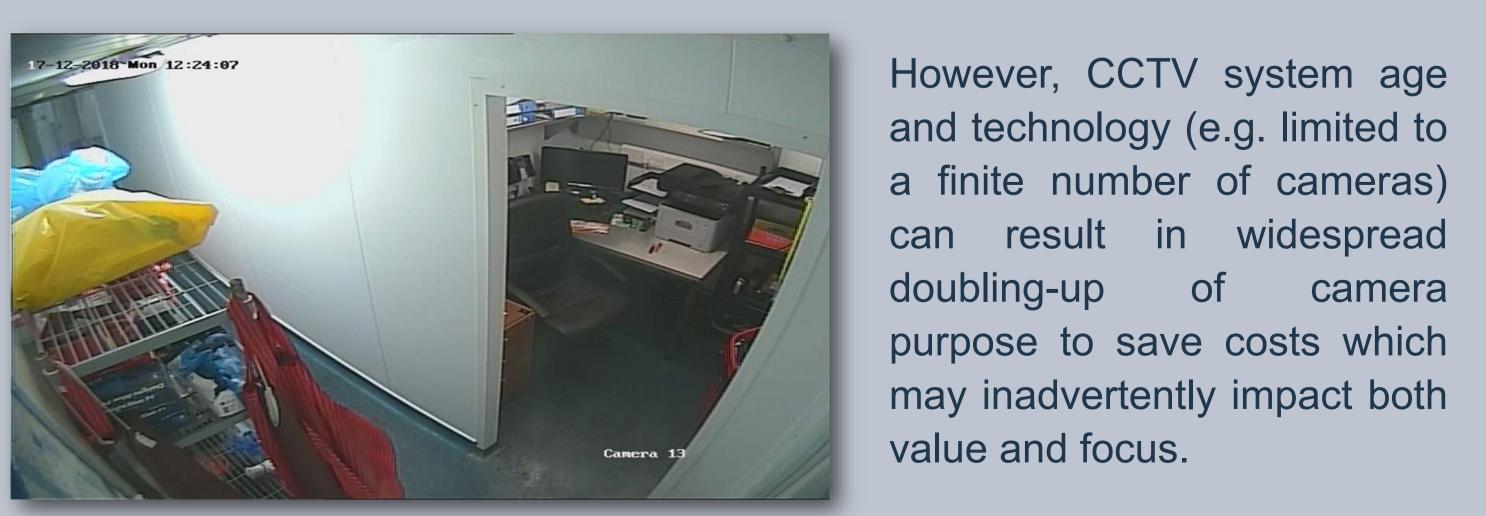


Figure 6: Corridor and production office (Site C, Camera 13)

CCTV design, planning and maintenance

More than a third (35%) of cameras across all sites recorded footage in despatch areas where food handler populations were least present or in storage areas infrequently used. As demonstrated by Figures 7 and 8, the same viewpoint is provided from two opposing camera perspectives which may benefit from the installation of one central 360° panoramic camera (providing greater field of views than two fixed state camera positions).

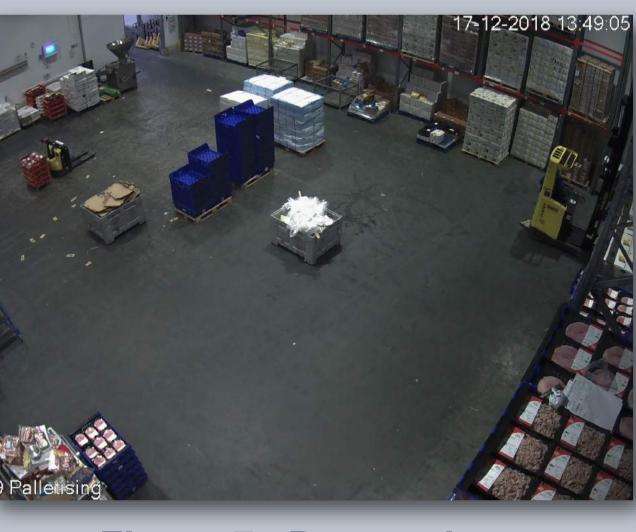


Figure 7: Despatch (Site B, Camera 9)

Identifying cameras that can be reused (demonstrated by Figure 9; camera 14 in a production room currently used for storage) highlights additional surveillance opportunities in a system that may be operating at full capacity. This would negate additional expenditure to increase CCTV system functionality.



Figure 8: Despatch (Site B, Camera 18)



Figure 9: Production/Storage (Site B, Camera 14)



Figure 10: Production office (Site A, Camera 13)



Figure 11: Production area (Site C, Camera 21)

Figures 10 and 11 highlight the importance of a proactive maintenance and service programme to ensure that CCTV systems are operating as intended. Camera 10 is out of focus while camera 21 should provide a production hall field of views (both potentially safeguarding food production systems, security threats and vulnerabilities, food handlers and ultimately business reputation).

Significance of study

- While not a substitute for management presence in food production, CCTV systems offer multiple observational opportunities across large facilities from one single platform. CCTV monitoring is an efficient method to identify training opportunities, workflow improvements as well as urgent health, safety and food hygiene malpractices requiring immediate attention in large sites with multiple production rooms.
- Clarity on CCTV system installation purpose (be it security, food handler hygiene, process workflows, analytics or deterrent) should be considered during design to maximise return on business investment and support intrinsic business values (with operatives being trained accordingly).
- Regular CCTV system review is practical and essential to identify adaptations, modifications or remedy that may increase system efficiency and ensure that footage is relevant and fit for evidential purpose.
- Installation support by a contractor familiar with food industry requirements would ensure competent advice for suitable - over convenient - camera siting.

Recommendations

Opportunities exist to develop food industry guidance to support CCTV system installation in food manufacturing and processing sites. A risk analysis and threat assessment approach (together with example installation assimilations) would capitalise on existing controls to avoid unsatisfactory perspectives and duplicity.

References

¹ Department for Environment, Food and Rural Affairs (2018). Guidance on the Mandatory Use of Closed Circuit Television in Slaughterhouses (England) Regulations 2018. Retrieved 20 May 2019, from https:// assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/729424/cctv-

Mitenius, N, Kennedy, S P and Busta, F F (2013). Food Defense. In: Mortarjemi, Y and Lelieveld, H (eds.) Food Safety Management: A Practical Guide for the Food Industry. London: Academic Press, Elsevier Science & Technology; 2014. Retrieved 26 May 2019, from

Cocca, P, Marciano, F and Alberti, M (2016). Video surveillance systems to enhance occupational safety: A

case study. Safety Science, 84; 40-148. Retrieved 27 May 2019, from https://www.sciencedirect.com/science/ sakanikas. V and Dagiuklas. T (2018). Video surveillance systems-current status and future trends.

Computers and Electrical Engineering, 70; 736-753. Retrieved 27 May 2019, from https:// www.sciencedirect.com/science/article/pii/S0045790617311813 Bogomolova, S (2017). Mechanical observation research in social marketing and beyond. In: Kubacki, K and Rundle-Thiele, S (eds.). Formative research in social marketing. Singapore: Springer. Retrieved 28 May 2019,

from https://link.springer.com/book/10.1007/978-981-10-1829-9 Manufacturing, Rockaway, 20 March 2018 [Article]. Retrieved 27 May 2019, from https://search-proquest-

com.ezproxy.cardiffmet.ac.uk/docview/2016080984/1EF8D23AB2E443A5PQ/1?accountid=15588

⁷ Food Standards Agency (2018). 2 Sisters and Standards in Poultry Processing: Food Standards Agency Response to the Environment, Food and Rural Affairs Committee Committee's First Report. Retrieved 28 May

https://publications.parliament.uk/pa/cm201719/cmselect/cmenvfru/861/86103.htm

Evans, EW and Redmond, EC (2018). Video observation of hand-hygiene compliance in a manufacturer of ready-to-eat pie and pastry products. International Journal of Environmental Health Research. Retrieved 27 May 2019, from https://doi.org/10.1080/09603123.2018.1558183

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, 30(2); 686-691. Retrieved 26 May 2019, from https://www.sciencedirect.com/science/article/pii/S0956713512004409

Manning, L and Soon, J M (2016). Food safety, food fraud and food defense: A fast evolving literature. Journal of Food Science, 81(4); 823-824. Retrieved 26 May 2019, from https://onlinelibrary.wiley.com/doi/ epdf/10.1111/1750-3841.13256