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Pechakucha Resources November 2023

RESEARCH NETWORKS

Exeter Food

Beastly disruption or responsible transformation in animal agriculture? Stakeholder perceptions of digital livestock technologies

Hugh F. Williamson & Sarah Hartley
DIGIT Lab, Business School, University of Exeter

Exeter Food Network, November 2023

Project Background

Responsible Digital Transformation in UK Animal Agriculture

- DIGIT Lab - a UKRI Next Stage Digital Economy Research Centre
- DIGIT Responsible Research and Innovation (RRI) strand

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University of Exeter Business School

Project Background

- Digital livestock technologies (DLTs) just beginning to enter area of policy debates
- Critical to ensure social and ethical concerns are reflected in these debates, as well as diverse voices and values

Research aims:

- Understand **diversity of public and stakeholder hopes and concerns** about current and potential use of digital livestock technologies in the UK
- Foster the introduction of a **wider range of values** in digital livestock technology development and governance

Methodology

- Anticipatory focus groups (after Macnaghten 2021) with expert stakeholders in UK animal agriculture
- Discussing three cases of early-stage digital livestock technology

Stakeholder groups:

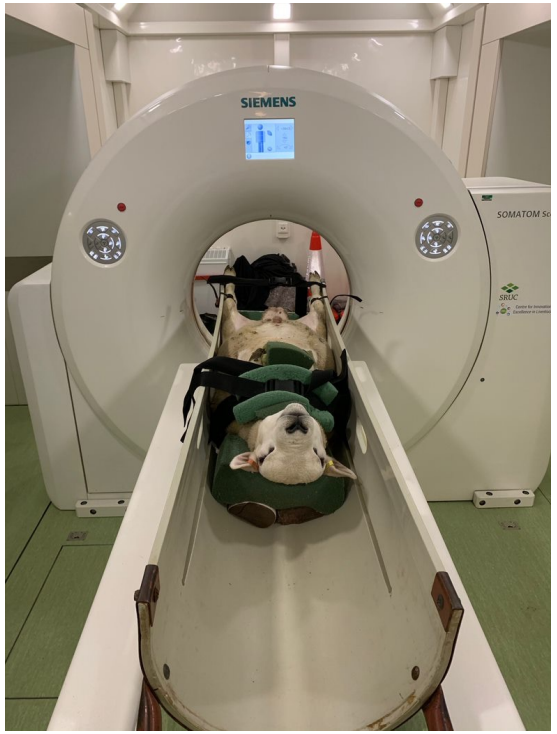
- Agricultural service providers
- Digital technology developers
- Intensive farming
- Organic and regenerative farming
- Animal welfare experts

Methodology

- Anticipatory focus groups (after Macnaghten 2021) with expert stakeholders in UK animal agriculture
- Discussing three cases of early-stage digital livestock technology

Case Study	X-ray CT scanning sheep to breed for smaller guts and lower methane emissions	3D camera early warning system for pig tail biting outbreaks	Integration of production and supply-chain data for data-driven animal breeding
Challenge	Greenhouse gas emissions/Net Zero	Animal welfare, productivity of meat sector	Efficiency and productivity of animal agriculture
Digital Technology Type	Large imaging technology (CT scanner)	Small imaging technology (3D camera), machine learning	Database
Development Approach	Repurposing established technology and data	Bespoke technology and software	Data sharing and integration within existing platform
Animal Rearing Systems	Extensive (sheep)	Intensive/confined (pigs)	Intensive and extensive (multiple species; primarily cattle and sheep)

Case Studies



Case 1: CT scanning sheep to breed for reduced methane emissions

Case 2: 3D camera early warning system for pig tail biting

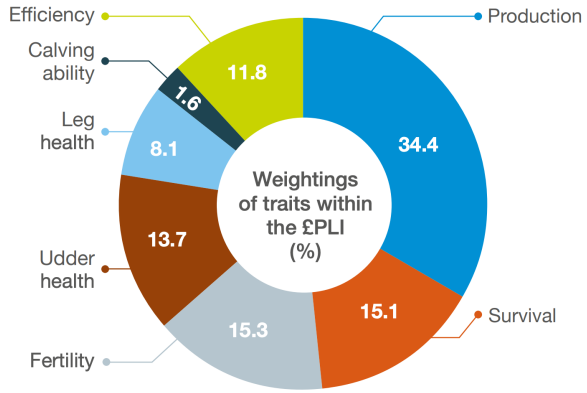
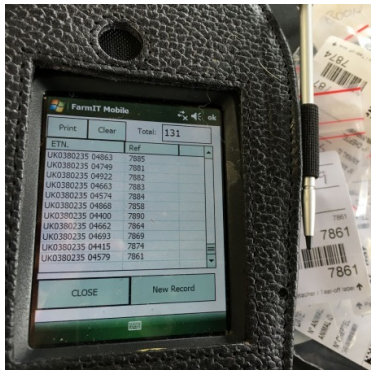


Figure 11. A breakdown of the individual weighting of traits in the £PLI



Case 3: Integrated national database for animal breeding

Images: AHDB, sruc.ac.uk , Williamson

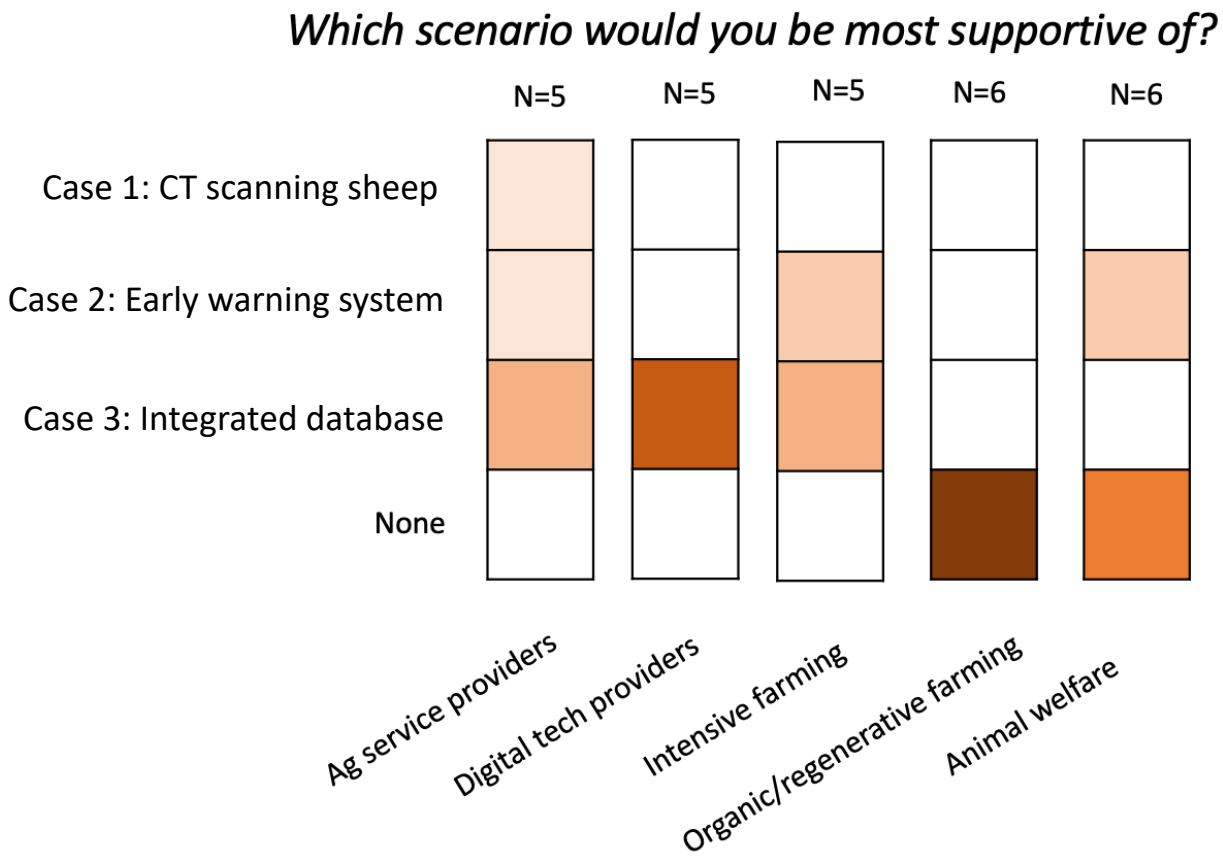
Results

Two overall approaches:

- **Productivist** approach
  - Improving efficiency and productivity as key to addressing other challenges
  - Primary concern is post-Brexit economic conditions

- **Transformative** approach
  - Substantial changes needed to agricultural systems to achieve environmental sustainability and mutual wellbeing of humans and animals
  - E.g. organic and regenerative farming

Results – Polls



NB: Polls were introduced and used as discussion tools, rather than as primary data collection tools

Conclusion

Three general frames of evaluation:

- **Purpose, practicality, effects**

- ‘Obstacles to adoption’ frame dominant in policy/technical sphere
- Increasing work on social/ethical implications (effects) of digital livestock technologies
- But also need greater attention to *purposes* and relation to future visions for food systems

A challenge for governance (funding, policy)

- Requires co-production with diverse stakeholders, beyond productivist agriculture

Acknowledgements

Thanks for listening!
Get in touch: h.williamson@exeter.ac.uk, sarah.hartley@exeter.ac.uk

Thanks to:
- All our anonymous focus group participants and Mel Wright at Rothamsted for help identifying and inviting participants
- Mike Coffey, Rick D'Eath & Nicola Lambe at SRUC for assistance with scenario development
- Camille Bellet, Ann Bruce, James Lowe & Phil Macnaghten for advice on project design and methodology
- DIGIT Lab colleagues and EPSRC for providing funding via DIGIT

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DIGIT LAB

Explaining Famine: subsistence crises and the production of agricultural data in eighteenth century Britain

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Archaeology and History
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When, precisely, did Britain begin trying to explain why famines happen?

- Providential causes (religion, fate).
- Deliberate / military causes.
- Artificial causes: inadvertent famines, but still the result of human agency.
- Natural famines: climate, natural disasters.

Madagascar on the brink of climate change-induced famine

25 August 2021

Climate

WFP/TSIORY ANDRIANTSOARANA

At least half a million children under the age of five are in danger of being acutely malnourished, the UN says

By Andrew Harding
Africa correspondent, BBC News

Madagascar is on the brink of experiencing the world's first "climate change

Source material, themes:

- East India Company Servants internal correspondence
- ‘Expertise’ – Early emergence of scientific, economic, and political authorities on famine.
- Popular media – influence of the press and pamphlets on the developing ‘science’ of famine.
- State power – petitions and political efforts to re-imagine the state as having a responsibility to prevent and intervene in subsistence crises*

Collaborations?

- Work on global food security
- Agriculture and environment
- Communicating about food insecurity / famine

Training emotional & behavioural responses to food to change eating behaviour

Natalia Lawrence, Associate Professor in Psychology

University of Exeter

wellcome

UKRI Economic and Social Research Council

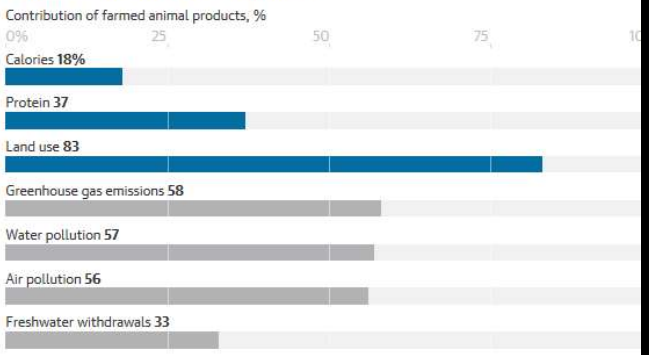
FUNDED BY NIHR | National Institute for Health and Care Research

Our Vision

In order to achieve our purpose, in the next decade we will build on our strong interdisciplinary culture to:

Avoiding meat and dairy is 'single biggest way' to reduce your impact on Earth

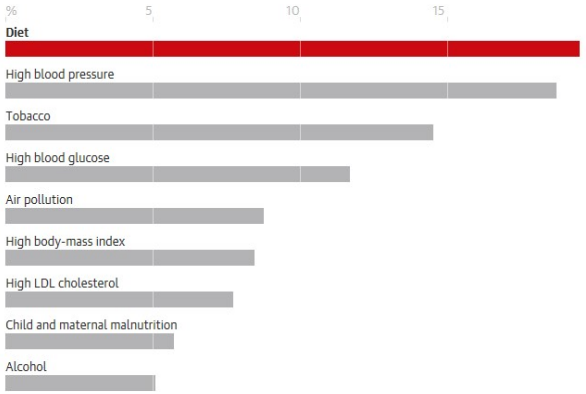
More than 80% of farmland is used for livestock but it produces just 18% of food calories and 37% of protein



The Guardian, 31 May 2018

Poor diet a factor in one-fifth of global deaths in 2017 – study

Global survey says diseases such as cancer and diabetes behind almost 75% of deaths last year



The Guardian, 16 May 2019

More than 2m adults in UK cannot afford to eat every day, survey finds

One in seven adults estimated to be food-insecure, up 57% from January, owing to rising cost of living

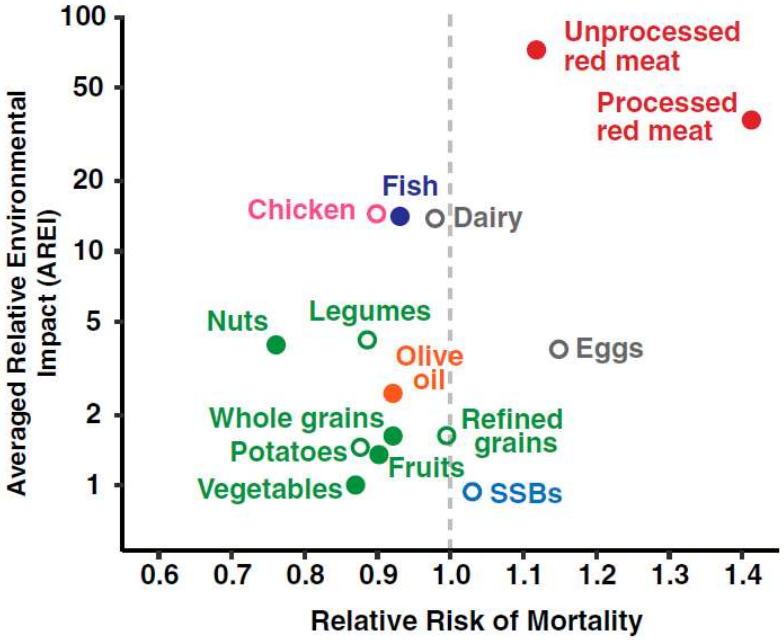
The Guardian, 9 May 2022

Act now to save Somalia from deadly famine

In Somalia today, 7.5 million people are facing food shortages, while more than 200,000 people are at risk of famine, with numbers expected to rise dramatically in the next few months.

The Guardian, 26 Sept 2022

Environmental & health impacts



Clark et al (2019)
www.pnas.org/cgi/doi/10.1073/pnas.1906908116

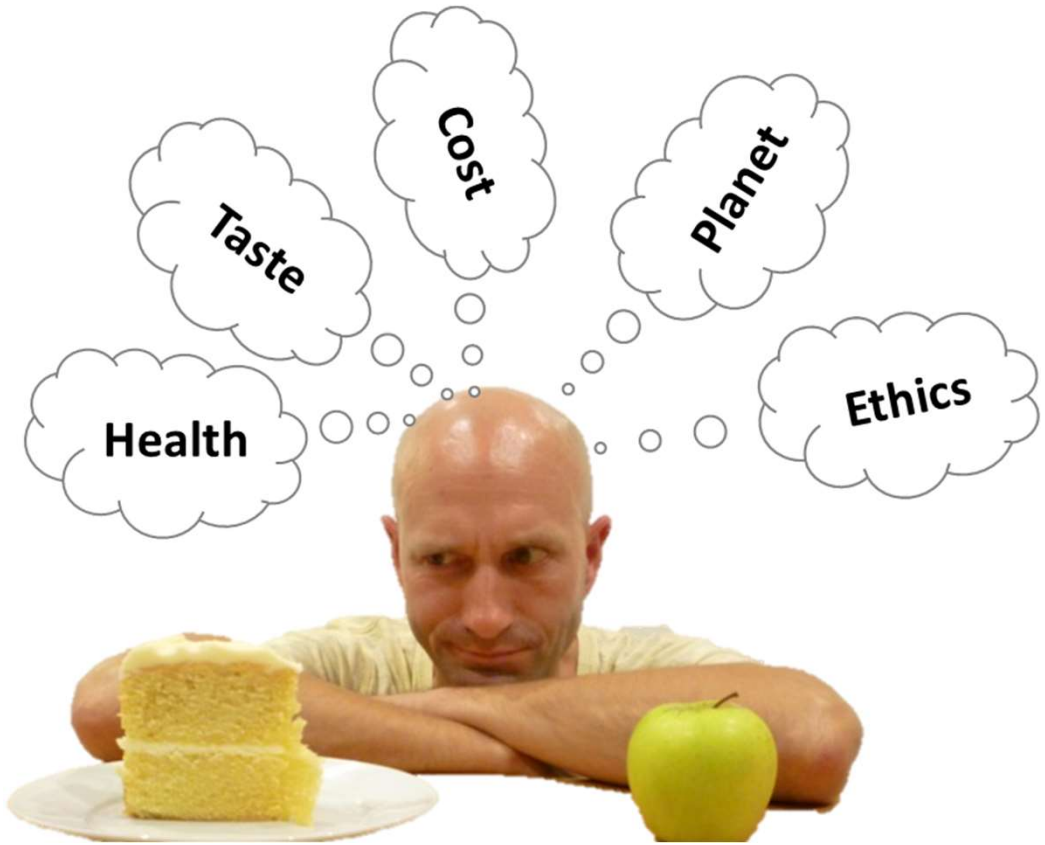
Switching to a more plant-based diet could prevent 24% of premature deaths (11 million lives) (The Lancet 2019)

Vegans have 15% less cancer (Dinu et al 2017)

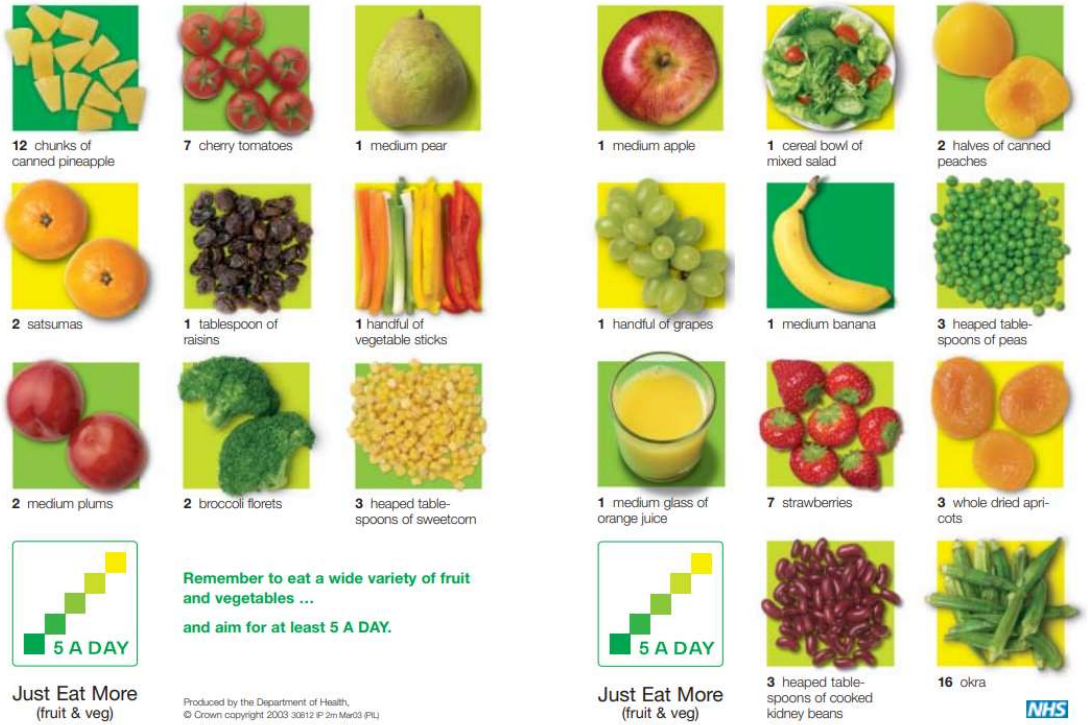
Eating a more wholefoods, plant-based diet (esp legumes and nuts) can add 10 years life (PLoS Medicine, 2022)

Swapping 3% of daily calories from processed meat to plant-sourced protein reduces mortality by 34%
(JAMA Int Med 2016) https://www.gaplesinstitute.org/sustainable-diets/

Food choices



Education?



~25% adults (15% kids) eat 5-a-day

<10% adults eat enough (30g) fibre

~90% adults (100% kids) eat too much sugar

Changing eating behaviour

Changing eating behaviour

International Journal of Epidemiology, 2023, **00**, 1–13

Mediation and moderation of genetic risk of obesity through eating behaviours in two UK cohorts

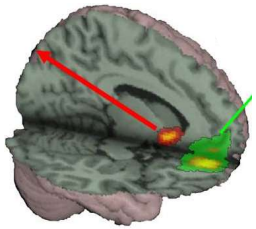
Shahina Begum ,[1,*] Eleanor C Hinton,[2] Zoi Toumpakari,[3] Timothy M Frayling,[4] Laura Howe,[5] Laura Johnson[3], and Natalia Lawrence[1]

Self-control

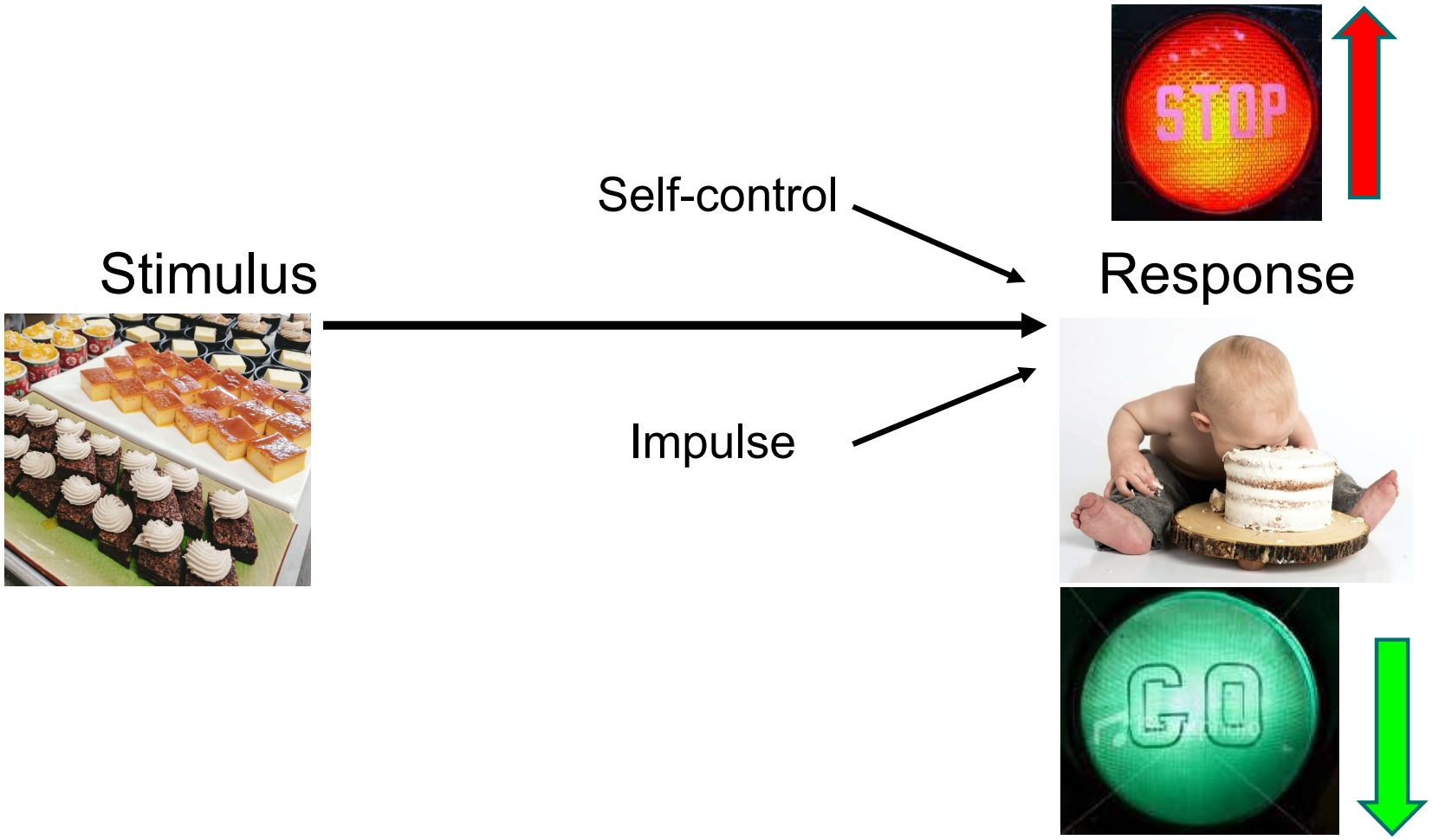
Stimulus

Response

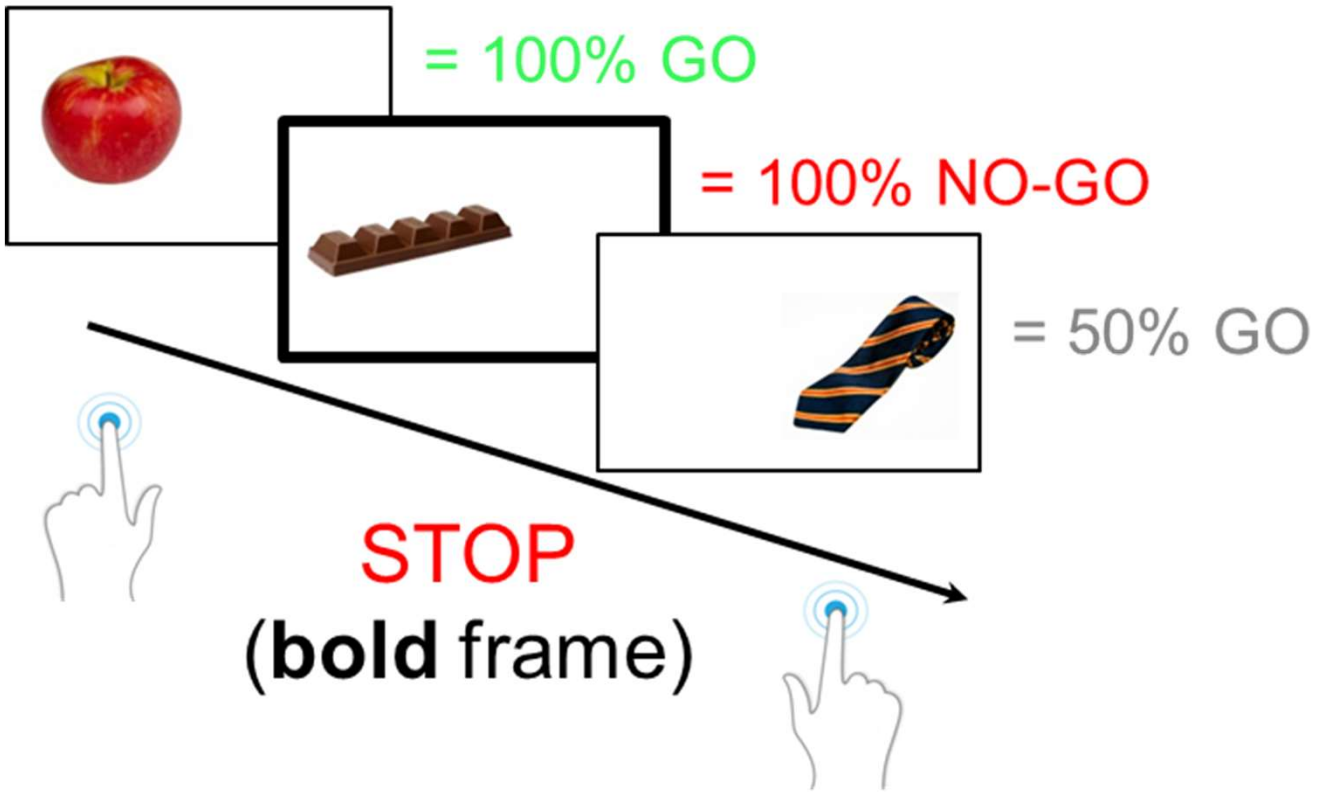
Impulse



Changing eating behaviour



Training stopping to foods



(Lawrence et al., 2015)

https://www.exeter.ac.uk/research/foodt/

Training response inhibition to food is associated with weight loss and reduced energy intake *Appetite* (2015)

Natalia S. Lawrence [a, *], Jamie O'Sullivan [a], David Parslow [a], Mahmood Javaid [a], Rachel C. Adams [b], Christopher D. Chambers [b], Katarina Kos [c], Frederick Verbruggen [a]

From cookies to carrots; the effect of inhibitory control training on children's snack selections *Appetite* (2018)

L. Porter [a, *], C. Bailey-Jones [a], G. Priudokaite [a], S. Allen [a], K. Wood [a], K. Stiles [a], O. Parvin [a], M. Javaid [a], F. Verbruggen [a, b], N.S. Lawrence [a]

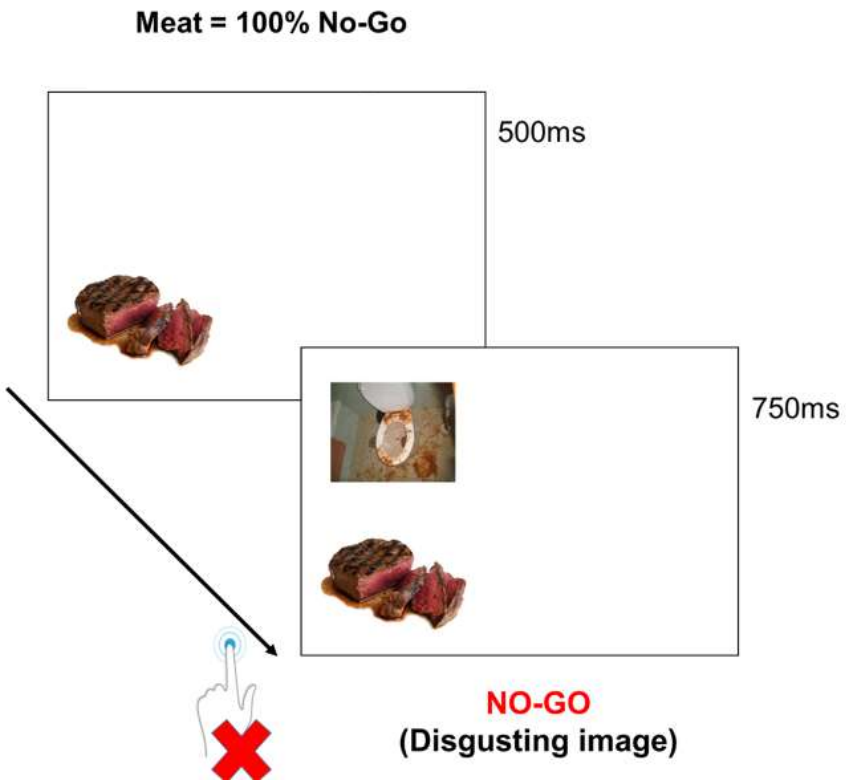
Giving pork the chop: Response inhibition training to reduce meat intake

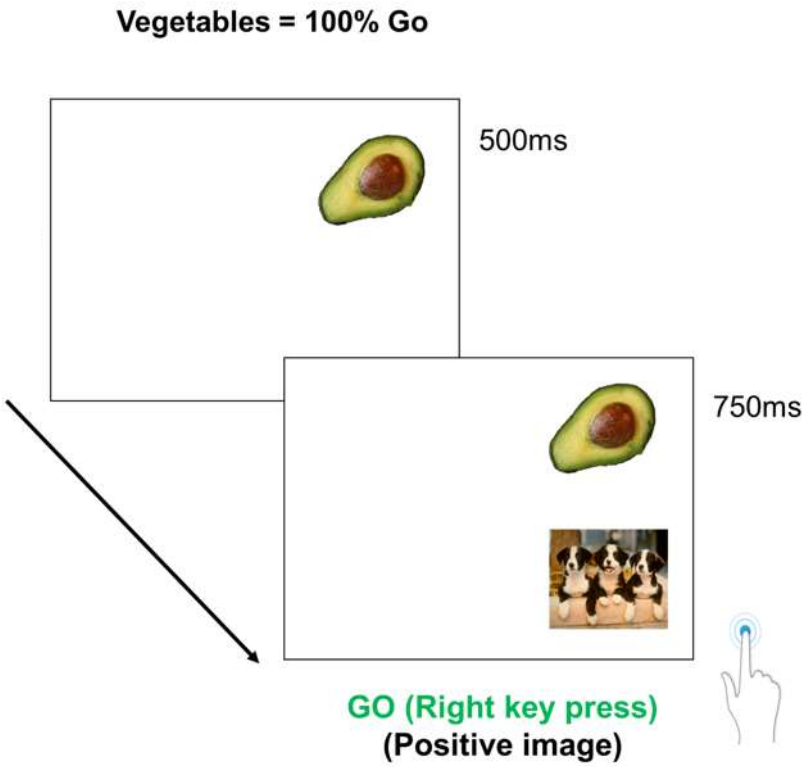
Bethany Camp, Natalia S. Lawrence* *Appetite* (2019)

App-based food-specific inhibitory control training as an adjunct to treatment as usual in binge-type eating disorders: A feasibility trial

Johanna Louise Keeler [a, 1, *], Rayane Chami [a, 1], Valentina Cardi [a, b], John Hodsoll [c], Eva Bonin [d], Pamela MacDonald [a], Janet Treasure [a, 2], Natalia Lawrence [e, 2] *Appetite* (2022)

Enhanced training





Thanks for Listening!

www.exeter.ac.uk/foodt

Natalia.Lawrence@exeter.ac.uk

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Digital Technologies Enabling a Circular Food Supply Chain: The blockchain technology example

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Exeter Food Term One Pechakucha Seminar

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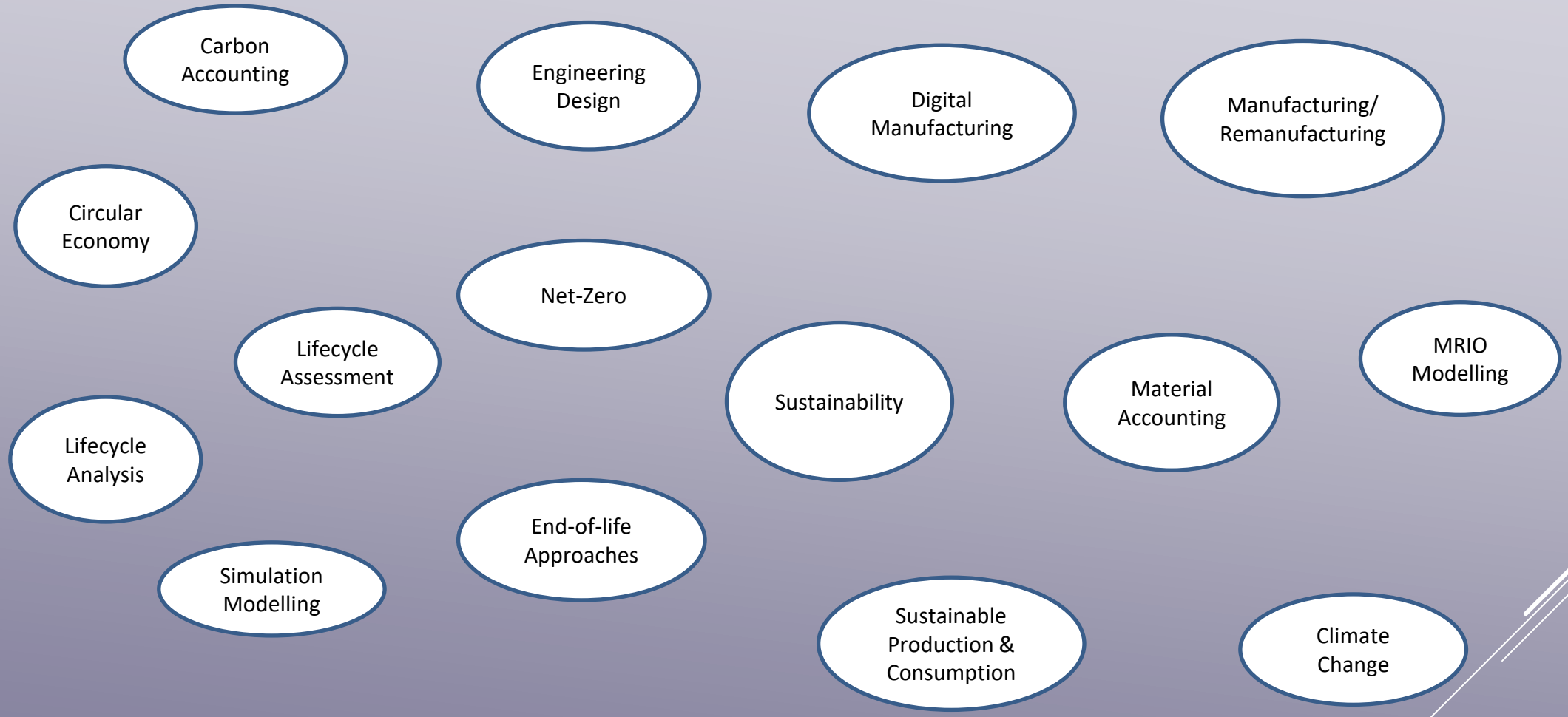
Royal Academy of Engineering



Research Keywords

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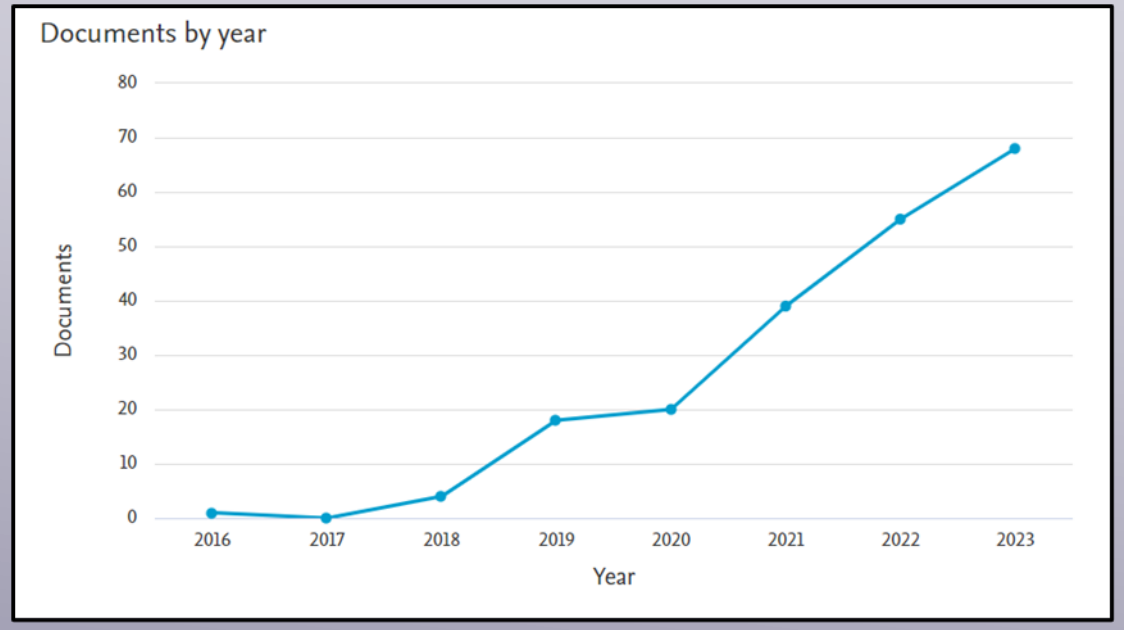
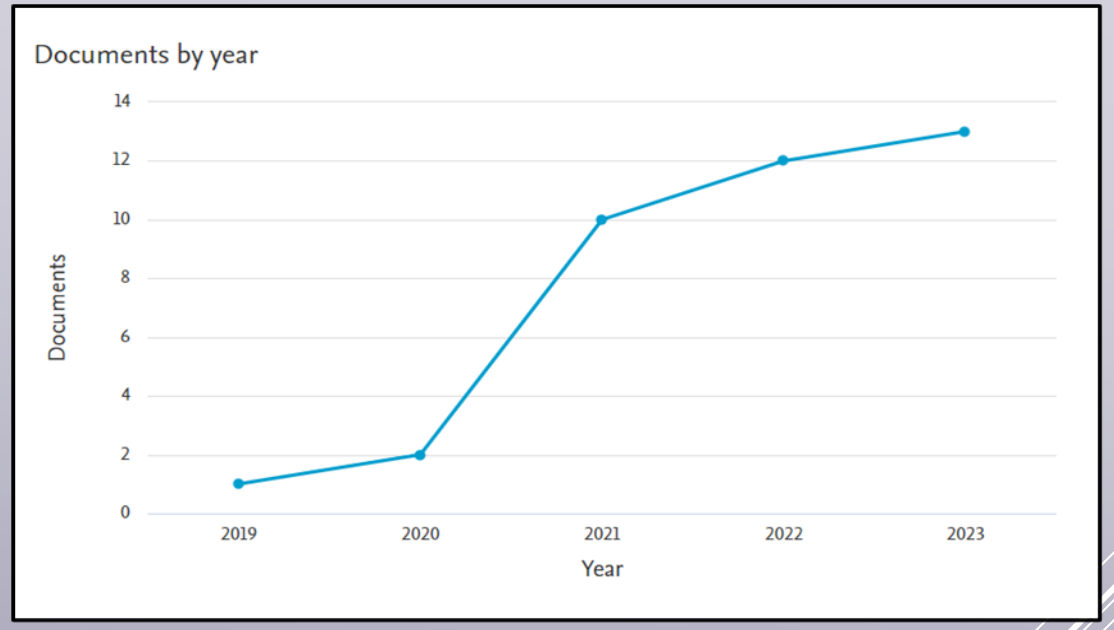


Article Title (2016 – 2023): Number of documents vs. Year of publication "Blockchain" AND "food supply chain"



Article Title (2019 – 2023): Number of documents vs. Year of publication "Blockchain" AND "food supply chain"

Increasing interest in overlap of circular economy (CE), food supply chain (FSC), & blockchain technology (BCT)

*SCOPUS capture of relevant search strings, "blockchain", "food supply chain" and "circular economy".

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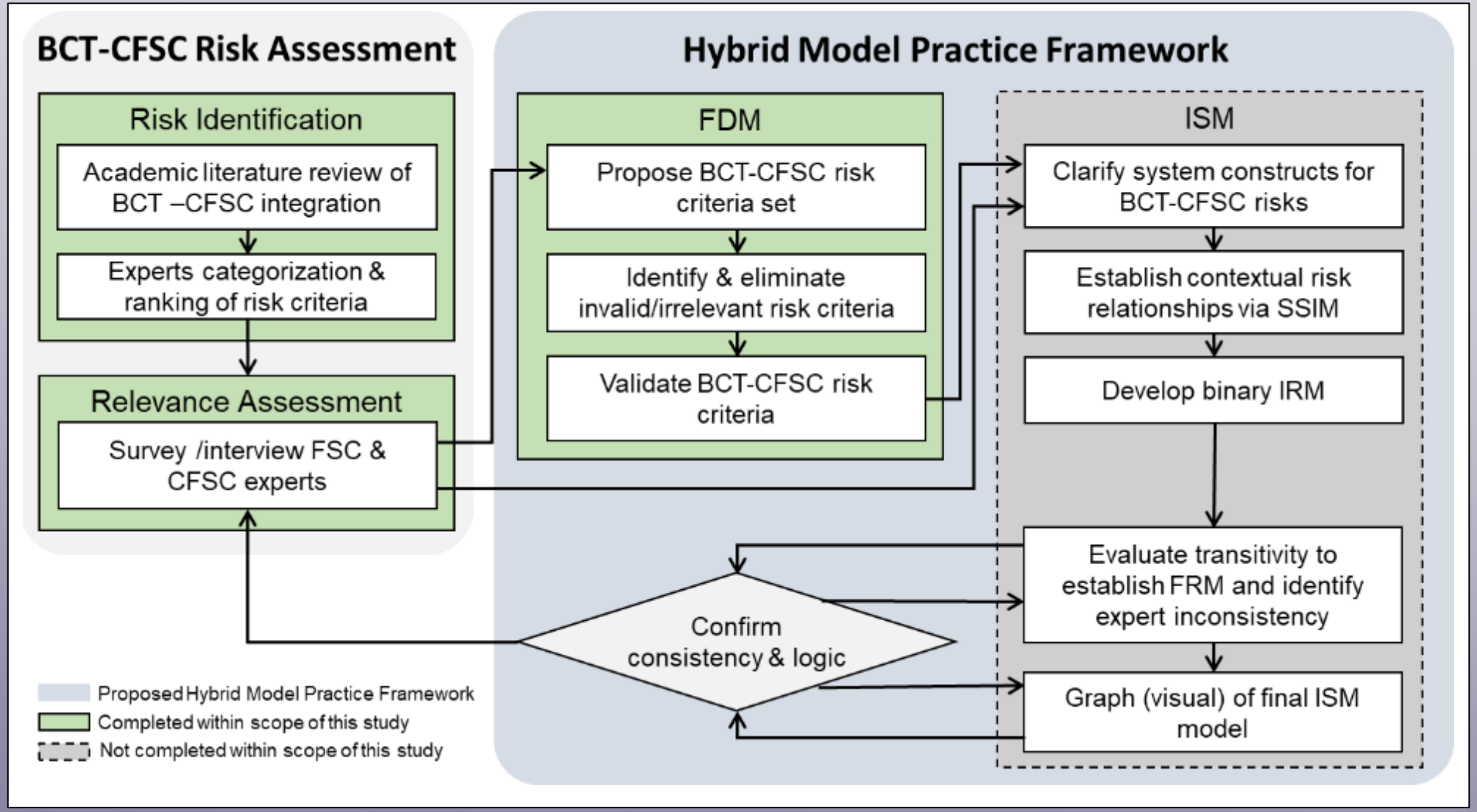
Emerging interest in blockchain (BCT) for circular food supply chains (CFSC's)

- Blockchain technology (BCT) applications being academically explored across all industries
- Supply chain transparency identified as an key opportunity
- BCT may help mitigate risk in food supply chains (FSCs), e.g., contamination, outbreaks
- Exposure of waste flows within the system creates new opportunity for circular economy via circular FSCs (CFSCs).
- However – BCT and CE risks and barriers largely untested
- Need for comprehensive risk identification and analysis methods to inform businesses considering adoption of BCT for FSC / CFSC applications



Hybrid model for BCT-CFSC risk identification: Integrated Structural Modeling (ISM) & Fuzzy Delphi Modeling(FDM) – Initial Framework

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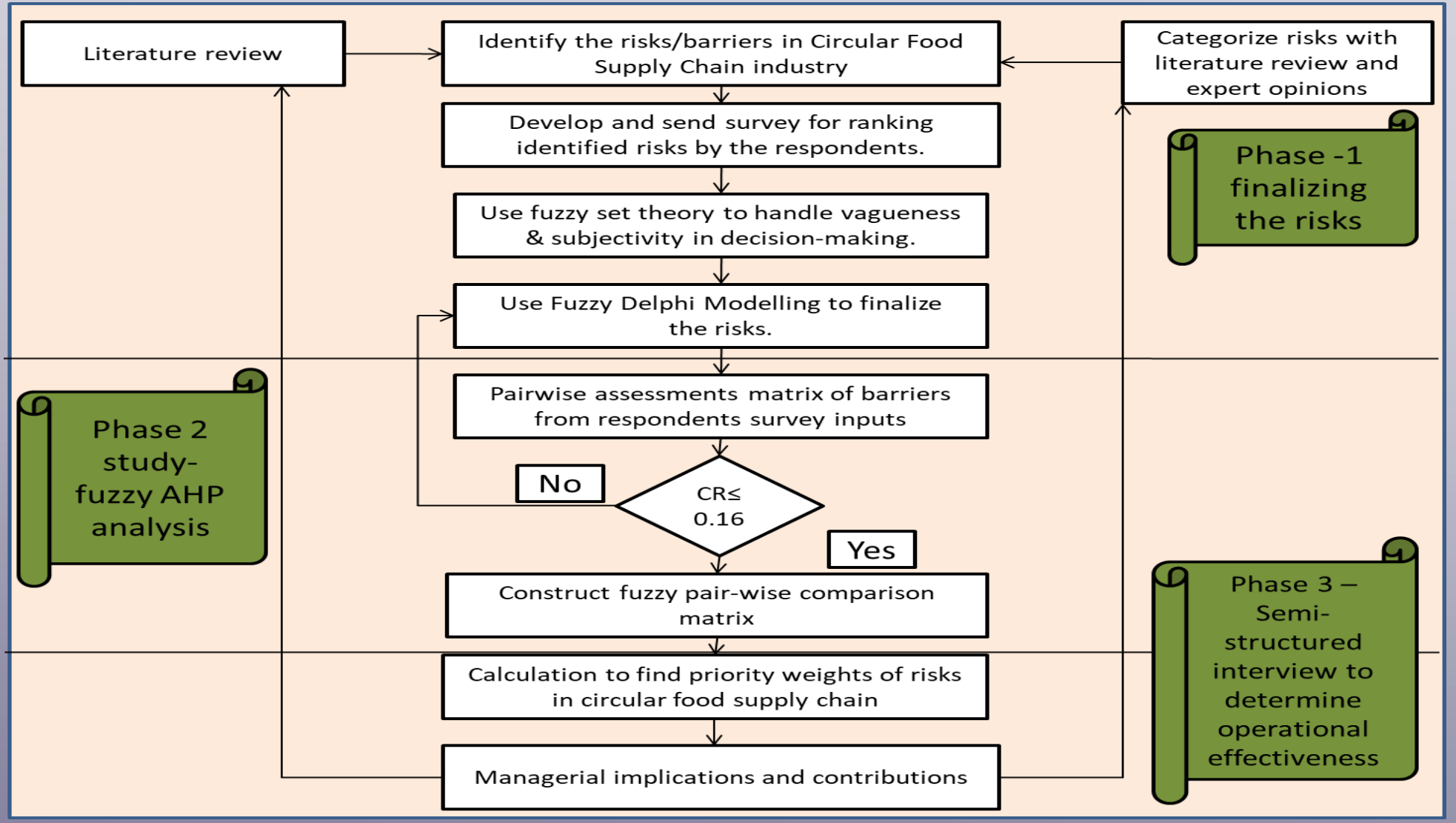

Final Research Framework - Publication

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Respondents Code	Years of BCT Experience (Including Research)	Position	Industry	Qualification	Primary location of business	Gender	Age
R1	8	Senior Researcher	Operations Management	PhD	United Kingdom	Male	38
R2	10	IT Manager	IT Consultancy	MSc	United Kingdom	Male	34
R3	21	General Manager	IT Consultancy	MBA, BTech	India	Male	40
R4	13	Lecturer	Academia	PhD	India	Female	36
R5	9	Senior Researcher	Academia	PhD	United Kingdom	Male	41
R6	2	Lecturer	Academia	PhD	India	Male	31
R7	19	Lecturer/ IT Consultant	Academia/ Civil Service	PhD	India	Male	43
R8	5	Research Fellow	Academia	PhD	United Kingdom	Male	32
R9	15	IT Consultant	"Big 4"	MSc	India	Male	39
R10	7	Researcher	Academia	Mtech	Pakistan	Male	30
R11	6	Researcher/ Consultant	IT Consultancy	MSc	United States	Female	29
R12	12	Research Fellow	Academia	PhD	United Kingdom	Male	32
R13	8	General Manager	Food Supply Chain	PhD	United Kingdom	Male	38
R14	8	Consultant	Supply Chain & procurement	MBA, MSc	Colombia	Female	29
R15	23	Manager	Procurement & Supply Chain	MBA	United Kingdom	Female	33
R16	20	Researcher	Academia	MSc (Logistics)	Portugal	Female	46

Survey Respondents – 16

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FDM global priority rankings of risk categories

Risk Category	Weight	Ranking
[O] Operational	**0.171**	**1**
[FT] Functional	0.169	2
[FD] Funding	0.167	3/4
[BE] Business environment	0.167	3/4
[SL] Security & laws	0.166	5
[T] Technical	0.160	6

At the **CATEGORY LEVEL**: Operational risk deemed most relevant

Risk tied to the implementation & necessary cooperation within and between CFSC companies

Technical risk deemed least relevant

Risk tied to technical challenges of BCT implementation and operation

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FDM global priority rankings of sub-criteria risk categories

	Sub-risks	Global priority	Global ranking
[SL]	**Security (weaknesses and threats)**	**0.0588**	**1**
[SL]	**Anonymity and data privacy**	**0.0548**	**2**
[SL]	**Legal issues and Regulatory compliance**	**0.0525**	**3**
[O]	Organisational resistance	0.0441	4
[FT]	Continuously expanding ledgers	0.0433	5
[O]	Changes in the ruling protocols	0.0433	6
[FD]	Lack of investments funding	0.0429	7
[FT]	Scalability barrier	0.0428	8
[O]	Lack of Expertise	0.0428	9
[BE]	Lack of change drivers (policies, incentives)	0.0426	10
[FT]	Unreliable Speed	0.0424	11
[FD]	Requiring costly new infrastructure	0.0421	12
[T]	Computing (Processing) Power	0.0421	13
[BE]	Lack of proven commercial viability	0.0419	14
[BE]	Lack of Innovation and entrepreneurship	0.0416	15
[T]	High hardware and energy cost	0.0412	16
[BE]	Lack of competitive advantage	0.0409	17
[O]	Lack of standardization and flexibility	0.0409	18
[FD]	High development costs for BCT	0.0407	19
[FT]	Implementation interoperability	0.0406	20
[T]	Lack of consensus algorithm	0.0403	21
[T]	Consensus mechanism	0.0398	22
[T]	Optimum platform/data-enabled infrastructure	0.0378	23

At **SUB-CRITERIA LEVEL**:

Security & Legal risks deemed high-priority

Technical risks (again) deemed low-priority

Greatest risks are not related to BCT, but to implementation challenges specific to companies, food supply chain, and systems.

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BCT Experts for Semi-Structured Interview

Experts Code	Years of BCT Experience (Including Research)	Position/Job Title	Industry	Highest Degree Earned	Primary Business Location	International Business?	Interview Duration
A	19	Professor/CEO	Academia/ Food Supply Chain Entrepreneur	PhD	United Kingdom	Yes	44 mins
B	13	Senior Researcher/ Business Analyst	Academia/ Consultancy	PhD	Denmark	Yes	51 mins
C	9	Director	Blockchain Consultancy (Food Supply Chain)	MBA	United Kingdom, Nigeria	Yes	1 hr 6 mins
D	17	Principal Consultant/Executive Director	"Big 4"/ Tech Consultancy for Food Supply Chain (Asia Division)	MSc	India	Yes	50 mins
E	7	Chief Technological Officer/ Director	Software Consultancy (Food Supply Chain, Finance)	MSc	India	Yes	44 mins
F	5 (25 years in Finance & Treasury)	Principal Founder & CEO	Agricultural/ Food Supply Chain Consultancy	MSc	United Kingdom	Yes	51 mins

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BCT Experts: Some Opinions

"…there is a notion that blockchain technology has the answer for everything, [but] that's not the case. Yes, [BCT] has some specific feature which no other technology can provide. But individual businesses need to understand whether that is something that is actually important and valuable for the business, or not."

"What is the standard I have to follow? What standard [do] I have to follow so that a trust can be generated? [These] standards are the acceptable standard by the fact that everybody can agree to it, and that the community developed it, and have brought it into the ecosystem right."

"…[some] countries are committed to specific policies and specific laws that are making It difficult for [blockchain] to achieve its purposes. For example, Blockchain for financial transactions. They are happy to allow Blockchains to exist for every other thing but not for financial transactions. So that is a barrier… if Blockchain can be used for every other business but is not permitted to get into the financial market because of a desire to maintain control." (Practitioner-Expert E).

"…there are quite a few alliances of a few industry players [who have] come together and said "this is what we want to do", but the [Blockchain] ecosystem definitely has not consolidated… standardization [of practices and processes] is really important, but I don't think the industry is there yet."

"…to actually have the full possibility of the supply chain, you have to have everything from end to end, on one blockchain, right? I'm talking like from the farm down to the shipping companies all the way down to the people that will provide and process the manifest on the ship to those who clear it through custom and the custom agent then to the warehouse then it's distribution down to local stores and super markets…it's monumental. So, the question, now you will start asking yourself is the juice worth the squeeze? What [is] the problem here [we are] actually trying to solve, [are they] trying to kill a fly with a sledgehammer…?"

"…one needs to step back and say, how long have we had this? [General Data Protection Regulation] GDPR is an issue, but it's not only a blockchain issue – it's a normal database issue. Until we have digital identity with the ability amass people's private information, we're going to continue to have this issue."

"Is there actually a need for Blockchain? And food supply chain? Because where problem is, some of these problems you've highlighted here is similar in any industries in terms of digital transformation generally. Blockchain technology is just another strain of technology. Clarifying what operational effectiveness is for these risks must establish industry standards, so we are not replicating what existing technology can do"

Conclusions:Research Gaps identified for BCT-CFSC integration study

Barrier to Blockchain Integration	Reason for Barrier
Trust issues relating to a lack of standards regarding Blockchain use	No set of national or international standards exist for unified Blockchain use. Some managers lack experience and understanding of Blockchain and therefore do not trust the technology.
Poor general understanding of what Blockchain can and cannot do (combating the 'silver bullet' solution myth – the assumption that Blockchain can resolve all information security problems)	The general lack of understanding regarding Blockchain can also lead to problems in identify how the technology can be used within Food and other sector supply chains. Uncertainty is also fostered by generic beliefs of Blockchain being a solution to all SCM problems.
Scale of integrating all links in the supply chain is too great	There is a fear that the cost of implementing Blockchain in a supply chain will be too high.
Concerns relating to Blockchain ownership and possibility of 3rd party hijacking	Lack of trust issues may extend to the nature of Blockchain as it is delivered as a distrusted 3rd party hosted application. Concerns exist about the ability of cyber hackers to take over an existing chain.
Costs of implementation – especially for SME supply chain participants	There is also the question of who pays for this technology introduction and operation in terms of SME partners, who may struggle to afford the implementation of Blockchain in their operation?
How do you verify suppliers outside your home country in the supply chain - trust and provenance issues still exist, even with Blockchain	Blockchain may not address pre-existing concerns about trust and provenance of supply within existing chains.
Energy consumption of Blockchain processing infrastructure is too high	Blockchain infrastructure and in particular server farms have high energy needs and may make significant contributions to carbon emissions in their operation.

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Removing barriers to Blockchain use in circular food supply chains: Practitioner views on achieving operational effectiveness

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Exeter Food Term One Pechakucha Seminar