The Internet of Food Things: Adding Values to the Digitalisation of the UK Food Supply Chain

Conference or Workshop Item

THE INTERNET OF FOOD THINGS: ADDING VALUE TO THE DIGITALISATION OF THE UK FOOD SUPPLY CHAIN

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Abstract

The Internet of Things (IoT) is beginning to have a pronounced impact on the digitalised food manufacturing chain. Whilst the food chain is becoming at once more complex and more critical, the application of IoT has begun to be recognised as a key component of this transformation. However, exactly what the IoT is, or is not, is both evolving and provoking a lively debate. New clarifiers are being added to the term such as the Internet of Industrial Things and the Autonomous Internet of Things to ostensibly help clarify the terminology. For the purposes of the Internet of Food Things Network Plus, our conceptual and physical platform is predicated on the idea of a secure and trustworthy network based on open standards, where-possible commodity devices, and underpinned by societally ratified regulatory arrangements.

1 Introduction

The interdisciplinary EPSRC-funded network has been established to motivate and coordinate leading research in this area. There is a particular focus on encouraging interdisciplinary collaboration especially between disciplines that have so far been unaware of potential topic alignments. We will also act as a broker or match-maker between industry (large and small) and policy-making bodies to accelerate progress wherever possible. The project started in May 2018, and has been funded for three-years. A follow-on subscription model is being explored as interest and opportunities build. The Network has been funded to fund pilot-projects, deliver a programme of annual conferences and quarterly workshops to explore and promote the Internet of Food Things, thus including devices, robotics, AI, machine learning, trust, security and standards, and overall build a community of interest across these domains.

2. Background

The foundations for this Network were laid as part of a previous EPSRC Digital Economy Network Plus called Information Technology as a Utility (ITaaU). One of the major themes that run throughout the lifetime of the Network was the application of technology to improving food security in terms of reducing fraud, and waste, and improving traceability. In addition to a series of conferences and workshops, this strand culminated in a commission from the Food Standards Agency to produce a report on academic literature on the use of IoT to enhance food safety entitled "The Internet of Food Things"[1].

This report made the following conclusions:

i) Data:

1. Data is the most important aspect and the implications of the data and the use made of the data generated, needs to be reviewed before more sensors are placed everywhere!
2. More small-scale projects investigating the sensor deployment in the home, restaurant, shop etc. to establish what measurements are useful, what measurements are achievable.
3. Investigation of smart utensils to see if even in special cases these will help capture information on people and food in a reliable and acceptable way.

ii) Behaviour (People):

4. The roles the people play in all aspects of the food system is difficult to capture but needs to be addressed directly otherwise interpretation is too ambiguous. To this end the economic aspects of the "What's in it for me?" questions need to be addressed for all stakeholders.
5. The integration of different commercial and open systems, whilst avoidable and unnecessary in a single farm, or a unified manufacturer, is a concern in the downstream parts of the supply chain: the need for agreed standards must be addressed to facilitate scalability and interoperability.

iii) Technology:

6. Data sharing infrastructure is needed. IoT systems can provide additional data, which is often already recorded

but not shared. Once that data is shared and can be integrated, it will be clearer what data an IoT system should provide.

7. Value of IoT to the logistics and farming aspects of the food network has been demonstrated in the B2B context and can be applied using commercial systems and these should now need to be tested in an extended environment through to the customer.
8. The food industry is a collection of large and very many small business and lots of consumers, which is ideal for a horizontal IoT integration but the vertical solution seems to be gaining ground. The issues of vertical vs. horizontal integration in this sector need to be studied and addressed and are likely to benefit from regulation.

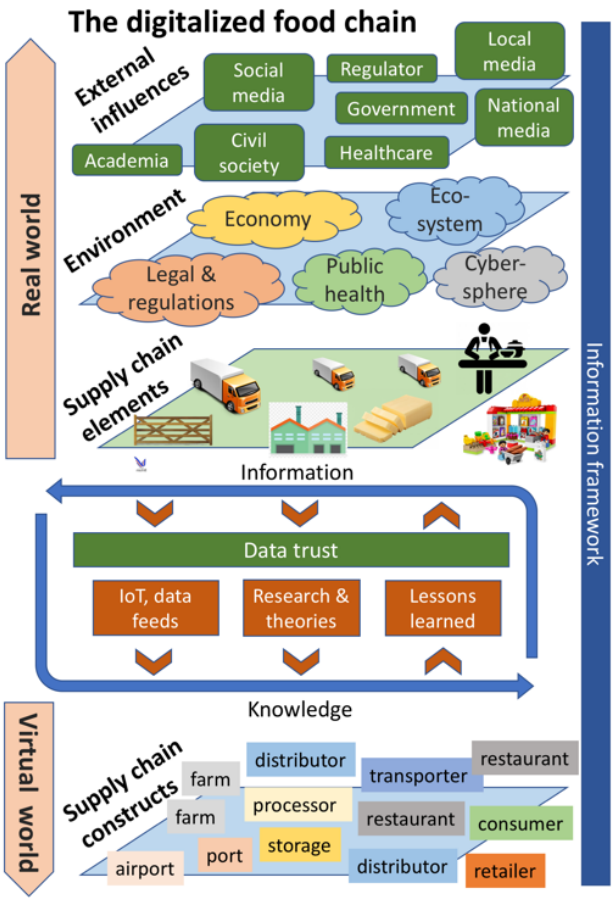
3. Methodology

The overarching approach for running the network is focused on growing the community both in terms of size and breadth of disciplines that relate to the digitalisation of the food manufacturing chain. The tools for achieving this are workshops, conferences and funded calls for pilot projects. Social media, targeted communication and the IoFT mailing list and other related network mailing lists are used to promote the Network and its activities in a virtuous cycle.

In order to manage the targeting of these messages and to better understand who and what we should be considering, we are developing a 3D model of the digitalised food manufacturing chain [2]. As the Network deepens its understanding of the community that exists between the farm gate and the fridge, so these various elements acquire meaning and context.

The approach used for facilitating workshops was developed during the Information Technology as a Utility (ITaaU) Network Plus. The format for events is essentially broken down into four phases: a though-provoking keynote talk to set the scene, a presentation of researched key themes of a the topic in question followed by a discussion to review and refine the discussion priorities, breakout groups then dig deeper in to the agreed hot topics, feedback and review of group discussions leading into a plenary discussion and agreement of priorities and follow-on actions. The key factor is attracting the best people to be present in the first place. IoFT is following this format for its programme of events for the lifetime of the project.

The diagram below is a simplified versions of the multi-tier representation of the digitalised food manufacturing chain. The Internet of Food Things Network Plus brings together people from each of these layers: practitioners, academics, policy-makers, commentators, and representatives of civil society.



1. The digitalised food manufacturing chain

We believe that one of the key factors linking these elements is the data trust. The development of a data trust for the food chain is complex, ambitious and challenging. The key element of trustworthiness is underpinned by the collaborative development and implementation of standards. We are working with various regulatory and standards bodies as well as the wider community to achieve this.

We are preparing a series of calls that will fund pilot studies into the application of IoT in the context of the food manufacturing and food distribution chain. The pilot projects will be integrated with our data trust which will expand as a testbed in order to develop and test the security, human factors, adoption implications, technical challenges and ethical and legal ramifications.

More work needs to be conducted on how the food sector differs from other sectors that are more mature in their adoption of IoT. These include the automotive and aerospace sectors, smart cities, smart homes, scientific discovery, and health and well-being. One indicator of adoption maturity could be a count of the number of frameworks or

implementation models that have been developed for a particular sector.

4 Outcomes

As a result of the events that the Network leadership team have attended to date, a number of preliminary observations have emerged. These themes in addition to the earlier research will help shape the topics for future workshops and other investigations that the Network might initiate:

- We have observed a good range of examples of research groups investigating the use of IoT in various food related scenarios;
- Other associated technologies are being investigated in conjunction with IoT such as blockchain, Distributed Ledger Technology (DLT), and AI;
- The food supply chain represents a complex and highly competitive ecosystem. Delivering enhanced integration is challenging;
- Therefore, a key challenge is the further development of data standards that will permit data to be shared between hitherto independent communities;
- Trustworthiness is therefore a key factor in achieving this;
- Skills will be very important in developing the adoption of IoT in the food supply chain, not just technical skills in IoT devices, but data processing, security, data analytics. In addition leadership. Innovation implementation, and other aspects of organisational transformation will be needed.

Technology not a simple panacea, there is a need for leadership and creativity to develop new processes.

An additional outcome thus far has been the enthusiasm for such a network to exist which has come from many stakeholders in the food manufacturing chain. There appears to be an acceptance that, despite the very real competition in the sector, that to achieve the gains and benefits of other well established (but smaller) sectors such as aerospace and automotive, a clear, coherent and cohesive identity must be realised. We are working with regulators to help develop community-based requirements for future rules and guidelines.

5 Conclusion

The Internet of Food Things Network Plus is still in its infancy. However, building as it does on the foundations of a number of other predecessor projects, we can say that there is already a sense of a diverse and competitive market coming together to work on the standards and technologies that will enable wider society to benefit from what is one of our most essential sectors. Whilst complex technological solutions will be intrinsic to the future of the food supply chain, these potential solutions will enable new business models which can embody social and community dynamics rather than purely traditional financial value chains.

Over the course of various workshops and conferences, as well as pilot projects and directed interventions, the Network will investigate in further detail how the IoT eco system can be adapted and better integrated into the food production and supply chain through better alignment of standards, data formats and interfaces.

6 Acknowledgements

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7 References

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