I AgrE Landwards Conference 2019
Can Big Data lead to Smarter Farming?
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Peterborough

Internet of Things (IoT) for Agriculture

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The views expressed are those of the author alone and do not necessarily reflect the views of Harper Adams University or other institutions
Towards an IoT for Agriculture – Overview

The long transition – 1998 MIT to now – long tails of a sigmoid growth curve

Initial IoT Concept
- Initial concept predicated on RFID (10 cent tags) and ubiquitous tagging of things

Evolving IoT Ecosystem
- Source: IDTechEx

IoT Initialising imperatives
- UK Government Animal and Plant Health Science Strategy
- Workshop to develop proposals for “Internet of Agri-Things” for the understanding and management of crop and livestock diseases: 19-20 November 2015

Emerging IoT Technology & Data Services
- Source: IDTechEx

Internet of Agri-Things (IoAT)

Future – Precision Farming
- IoT Integration

Future – Data Intensive Internet of Food Things (IoFT)
- Specification and Implementation of IoAT/IoFT

GOVERNANCE – A crucial but absent foundation addressing Food Security and Planetary Boundary issues
Towards an IoT for Agriculture – Emergent Ecosystem

Evolving IoT Ecosystem

With permission from IDTechEx
Wherein the concept twenty years on?

- **Significant developments in technology** – communications, sensing, low power ID devices, gateway hardware, systems support.

- **Significant developments in internet and web services**, including developments with regard to cloud computing, big data, machine-to-machine communications, AI…

- **But still no clear IoT specification for agriculture?** - largely process support applications with Internet access – important, but not realising the full potential of the IoT concept.

- **Also lacks Governance**…

- **Specification and Governance could allow more effective accommodation of national and global challenges** – specifically relevant to agriculture and primary food production
Responding to the Growing World Population and Food Security

- 50% increase in global food demand by 2050
- Exacerbated by the needs to avoid adverse impacts upon the environment, climate change and use of resources

Responding to the Critical Demands of Climate Change / Planetary Boundaries

- Nine critical boundaries, even more socio-economic factors.
- Exacerbated by the needs to avoid adverse impacts upon the environment, climate change and use of resources

Applying the precision principles across the farming modalities

- New era being driven by need and by opportunity not only in Livestock, Arable and Horticulture, but also integrated Urban and Aquaculture, and their associated service and supply chains

Urban Outreach and Smart City Farming

- Exploiting potential for Integrated Ecosystem Food & Energy Production
- Extending the concept of Smart City living

Innovation for productivity and sustainability – The Totally Connected Farm

- Innovation in use of resources and environmental response
- Incremental innovation through continuous process improvement
- Systems engineering innovation and the importance of standards
The global needs translate to national, regional and individual farming needs, with prospective solutions focused upon:

- Intensification and phenotyping
- Sustainability
- More effective use of identification, integration and exploitation of foundational science
- Improving production through **process enhancement** and development based upon profound understanding of precision and precision economics
- More effective management
- More effective and efficient use of resources
- More effective use of radical, beneficially disruptive, information technologies and automation (including robotics) – (10’s % improvement and fast return on investment)
- Innovation for productivity and sustainability
The global needs translate to national, regional and individual farming needs, with prospective solutions focused upon:

**A Five Step Plan***:
- Controlling the agricultural footprint
- Improving the yields of existing farmland
- More effective and efficient use of resources
- Shifting diets away from meat
- Reduction in food wastage

* Also – **Distribution**, coupled with efficient track and traceability

The global needs translate to national, regional and individual farming needs to consider:

- Climate change
- Land usage
- Water usage
- Bio-geochemical flows
- Biodiversity

Also socio-economic factors, circular and doughnut-economy issues

**National Climate Emergency** – not just about emissions – Requiring radical **engineering** solutions platform, accommodating future support needs.

Centres and Satellite Farms as an ideal platform for IoAT Implementation

Tackling global challenges requires a well-defined National IoT for Agriculture with Governance

Needs may be considered to include:

- An agriculturally-specific, industry-supported, network specifications
- Open-systems approach for ease of construction and scalability
- Object Identification protocols and standards
- Data identification, open source and proprietary ownership
- Communications protocols and associated standards
- IoT Protocols and associated standards
- Challenge Data, systems and cyber security
- Governance infrastructure….
Satellite Farms as a Test-Bed for IoAT Implementation
Increasing Data (‘Big’ Data) and Needs an Extended ICT Infrastructure

- **The Big Data approach** requires less, but complementary dependence on the strictures of the causality-focused standard scientific method.

- **The approach utilises vast quantities of data to achieve by-proxy correlations** that can assist in developing the foundations for Precision Agriculture.

- “**Big Data Analytics**, how the approach is now termed, provides the potential to catalyse a new revolution in agricultural production, presenting unprecedented opportunities for identifying associations between information and knowledge entities, often faster and with greater temporal significance than conventional small data analytics.

- **Using the data from multitude of sensors** embedded within fields, farm buildings, ground-machines, aerial vehicles and satellite platforms we can effectively inform predictive models that achieve insights and recommendations not previously possible.

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**A Data (‘Big’ Data) intensive future requires IoT-specific meta-data structures and governance to support global challenge solutions**
Staged Approach to realising a framework for IoAT Governance:

- **Preparation** of IoT Statement of Purpose and Structure
- **Identification** of an IoAT Governance Stakeholder Group
- **Identification** and recruitment of a Legislator and Regional Legislators and the Governing Body
- **Legislator/Stakeholder agreement** on:
  - Regulatory approach
  - Agreement on IoT Statement of Structure and Purpose
  - On infrastructural requirements and policy for on-going consideration
  - Access to governance procedures and liaison with Internet governance developers
- **Legislator/Stakeholder agreement** and pursuance of governance and legal agenda on governance requirements.
IoT for Agriculture – Specification and Governance – The International Dimension

IoAT Governance – Stakeholder Specification

Approach to extending the framework for IoAT Governance:

• **Recognising the tools** International specification and governance, including ‘soft law’ as a useful vehicle for deriving quasi-legal instruments for governance.

• **Recognising scope** for International specification and governance, relating to global challenges and associated issues, including identified data streams.

• **Recognising collaborative bodies** for addressing specification and governance requirements.

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## Issues relating to Operation and Usage

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Internet of Things (IoT) for Agriculture

Thank you for your attention,
Any Questions?

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