Ok to Spray

Applications of Variable Rate and other Precision Ag Technologies

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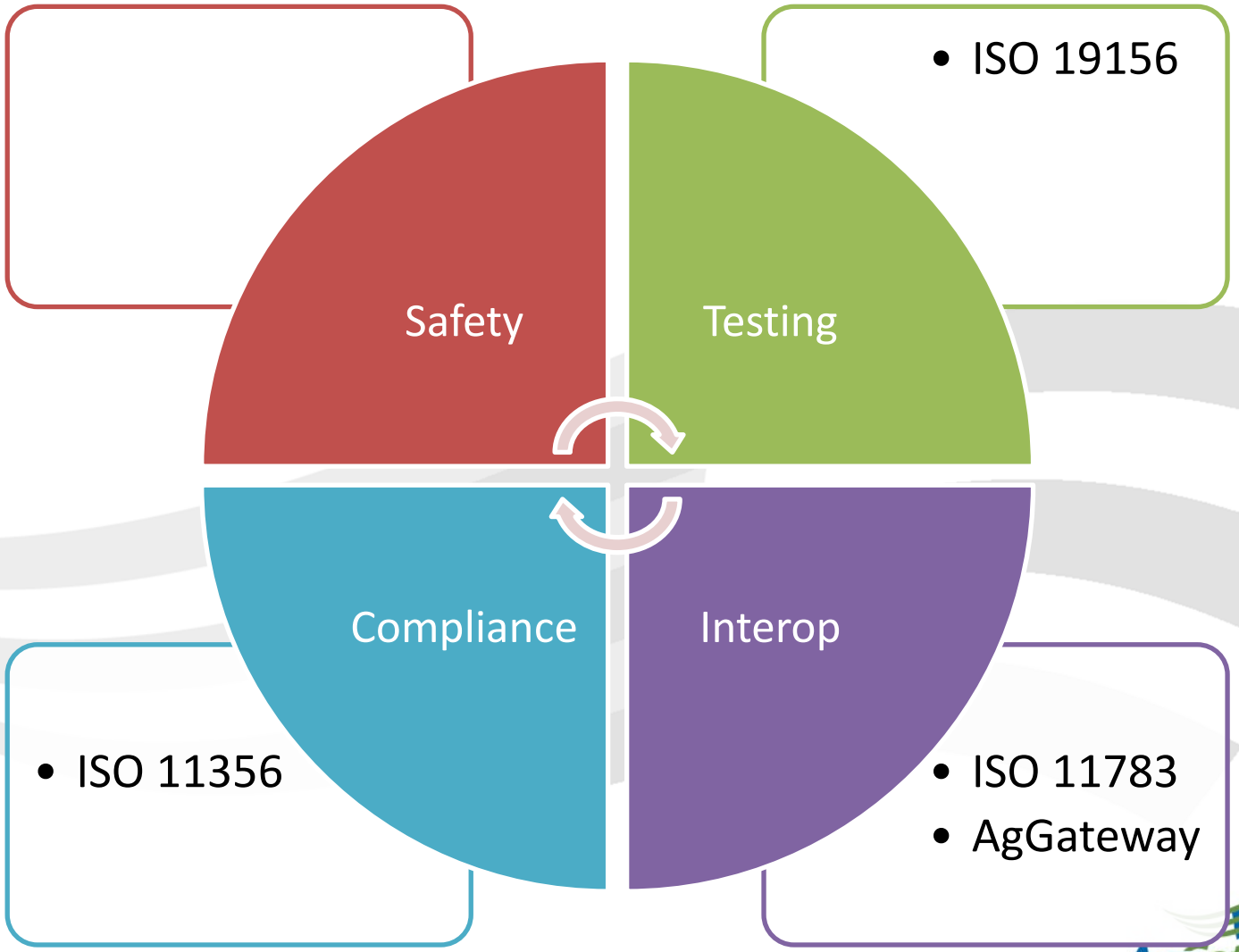
To be presented at InfoAg
August 2-4 2016

Objectives

- Standards Development
- Standards Progress since 2007
- Spray Drift Explained
- Precision Ag Technologies Relevant to Spray Drift Mitigation
- Summary

Standards in Precision Ag



Conflicts in Data Standards Development

Universality vs. Regional & Cultural Specificity

Development of standards which can successfully be applied globally but can also be adapted to meet unique regional needs without modification of the core data elements.

Interoperability vs. Opportunity for Innovation

Development of standards which facilitate interoperability and data transfer between systems and also provide opportunity for innovation by entrepreneurial individuals and companies.

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Support of Information Agriculture with the ISO 11783 Data Transfer Standard

6ECPA – Skiathos Greece – June 07

Joe W. Tevis, Ph D., Director
Nyle Wollenhaupt, Ph D., Worldwide Agronomy
Michael Schmidt, Technical Lead, Embedded SoftwareAGCO Global Technologies

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Precision Ag Functions Reviewed (2007)

Data Logging – Sensors	Well Supported
Single Product Variable Rate – Map Based	Well Supported
Task Data Logging - Application	Well Supported
Task Data Logging - Harvest	Well Supported
Section Control	Well Supported
Multiple Product Variable Rate – Map Based	Supported – with qualifications
Task Data Logging – Crop Assurance	Supported – with qualifications
Task Planning – Auto Steering	Not Supported
Single Product Variable Rate – Sensor Based	Not Supported

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Auto-Steering

2007

- ISO 11783 – 10: NOT SUPPORTED

Today

- ISO 11783 – 10: Guidance Data Elements
- GuidanceAllocation
- Guidance Group
- GuidanceShift

Product Identifiers

1. Multiple Product Variable Rate
2. Task Data Logging – Crop Assurance

2007

- ISO 11783 – 10: Identified by user defined strings uniqueness of “file” scope

Table D.42 — Product attributes

Attribute	XML	Use	Type	Length/range	Comment
ProductId	A	r	xs:ID	min. 4 to max. 14	Unique identifier of product Format: (PDT|PDT-)([0-9])+ Records generated on MICS have negative IDs
ProductDesignator	B	r	xs:string	max. 32	Product designator/name

- The same ruled applied to all entities or coding data (grower, farm, field etc.)

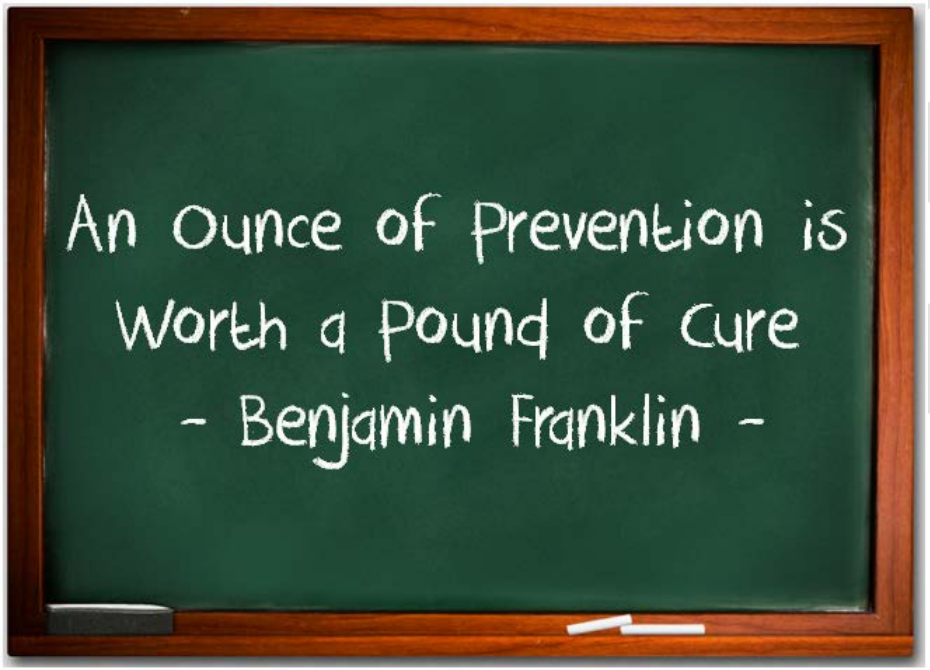
Today

- ISO 11783 – 10 (2014) : Annex E
  - Allows for multiple unique identifiers for all coding data (products, grower, farm, field, worker etc.)
  - Uniqueness defined by business…potentially global
- AgGateway ADAPT: ContextItem & CompoundIdentifier
  - Aligns with Annex E
  - Development of Geo-political Context Item Service

Level 2: Preventing the problem

There are two ways of looking at this:

- ***Static**: Use the precautionary principle to evaluate OK2S under worst-case conditions*
- ***Dynamic**: Evaluate OK2S under current conditions*



Resolvable URI Product Identifiers

ISO 11783-10 Annex E defines four types of identifiers:

1. UUIDs (ISO/IEC 9834-8)
2. Manufacturer Proprietary (GLN, ManufacureGLN)
3. Unique Resolvable URIs (Link to GS1)
4. Informational Resolvable URIs

```
<LGP A="LGP01" B="4" E="Roundup">
   <LNK A="PDT1" B=" http://roundup.ca/en/labels-msds "/>
</LGP>

<LGP A="LGP02" B="4" E="Corn Details">
   <LNK A="CTP1" B=" https://contextitem.org/2000?value=A2 "/>
</LGP>
```

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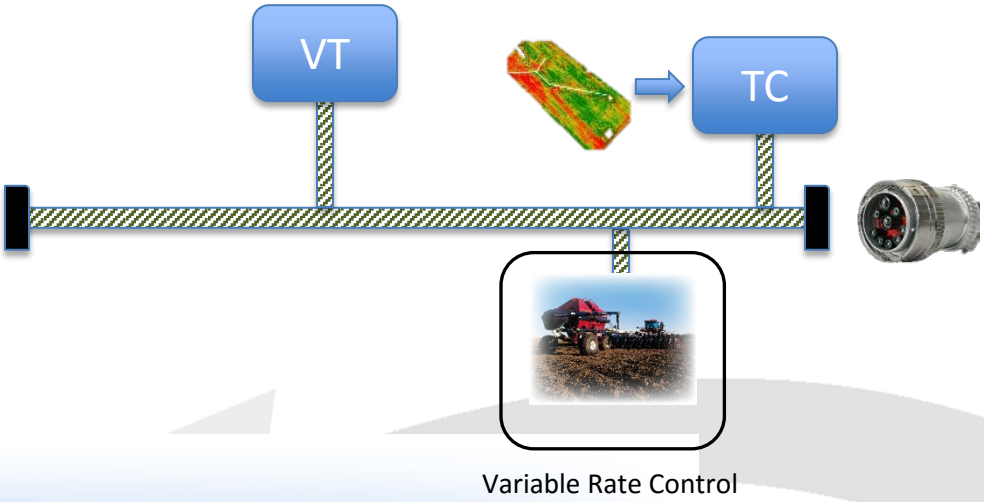
Opportunity for Innovation

- Data Standards Defines
  - Structure for linking unique identifiers to entities (products, grower, farm, field, etc.)
  - File transfer format
  - xml format for URI
- Opportunities
  - Reference data providers
    - Provide reference data and other useful content supported by the ISO 11783 Annex E and/or ContextItem format
  - FMIS
    - Efficient easy to use system for managing multiple unique identifiers
  - MICS (Terminal)
    - Wireless internet connection
    - Method to display and navigate URI content

Sensor Based Control

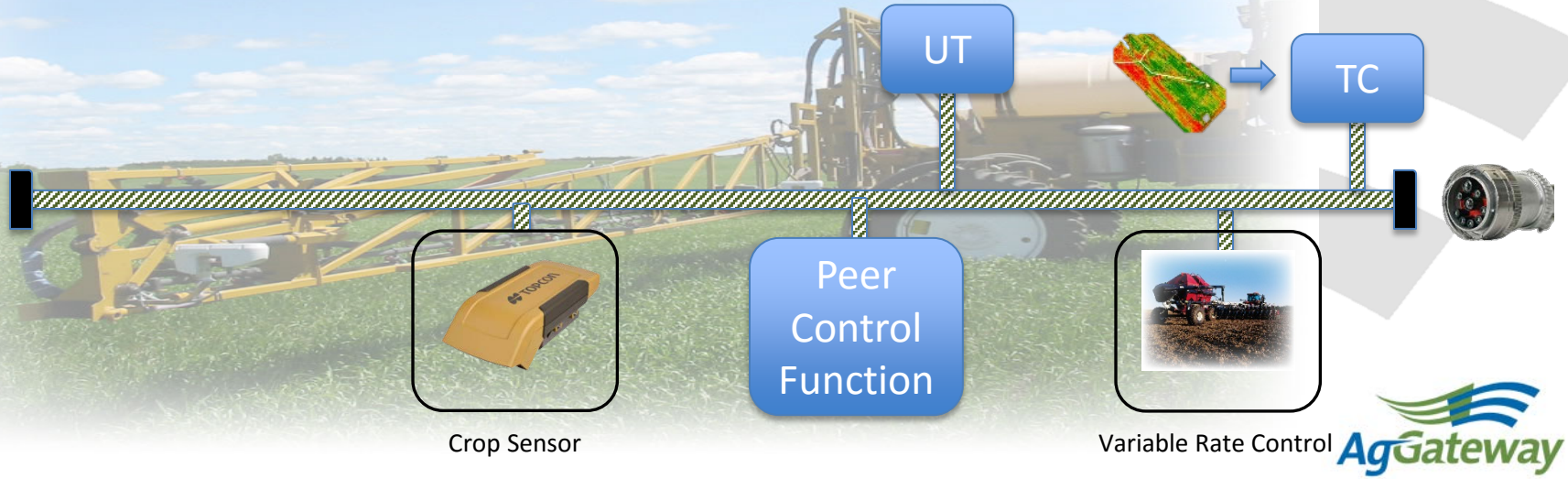
2007

- ISO 11783 – 10: NOT SUPPORTED
  - Control limited to manual control and maps.



Today

- ISO 11783 – 10: Peer Control



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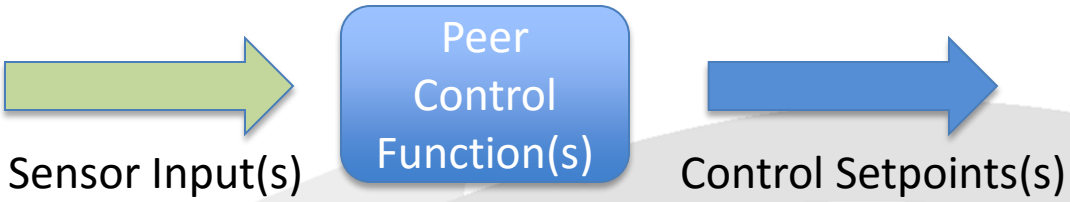
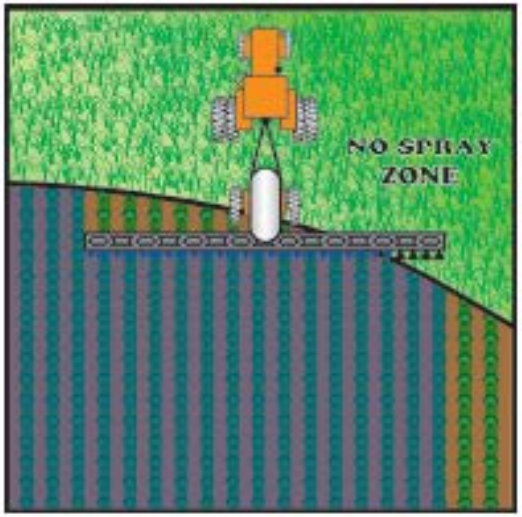
Opportunity for Innovation

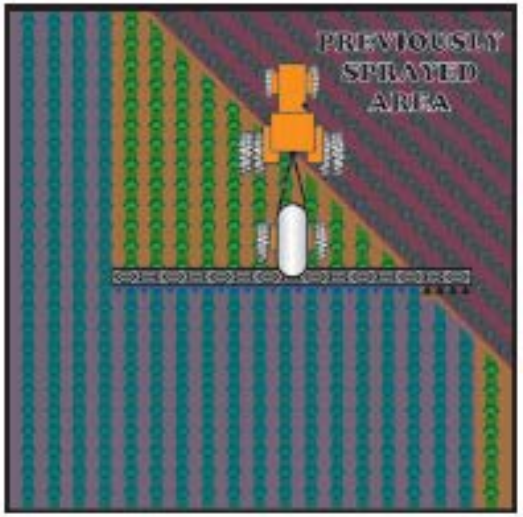
- Data Standards Defines
  - Integration of Peer Control Function in ISOBUS
  - Sensor input formats
  - Setpoint formats



- Opportunities
  - Sensor Development
  - MICS
    - Proprietary Peer Control Function

Section/Dispense Point Control





- Pre-Planned Control Areas
  - Field boundaries
    - Inclusions (holes)
    - Exclusions (islands)
  - “No Spray” (Buffer) zones

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Level 2a: Preventing the problem statically

- Show how OK to Spray * Precautionary Principle → Buffer zone
- Deliverable (in the form of buffer zones) is available during the planning stage
- Show what PAM is doing
- Pro: Easy
- Con: Restrictive, potentially inefficient, potentially not enough

Introduction

Pesticide Application Manager

Field Presentation Münchweiler, 25.06.2015

Martin Scheiber

ZEPP – Central Institute for Decision Support Systems in Crop Protection

Background

- **Title**: PAM (Pesticide Application Manager): Decision Support in Crop Protection based on Terrain, Machine, Business and Public Data

- **Project Partner:**

- **Duration:** 1. May 2013 – 30. April 2016

- **Supported by:**

Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages
Projektträger Bundesanstalt für Landwirtschaft und Ernährung

PAM – Decision Support System

1 GNSS/GPS – Survey

Data Input 2

3 Calculation of Legal Bufferzones

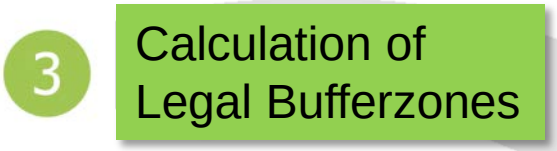
4 Creation of Application Map and Transfer to Terminal

5 Verification

6 Application and Documentation

Opportunity for Innovation

- Data Standards Defines (In development)
  - Protocol for requesting a buffer zone
  - Format of buffer zone for import into MICS
  - Controlled vocabulary for buffer zone label (smart boundaries)
- Opportunities
  - Web Service
    - Proprietary algorithm for calculation of the buffer zone
    - Real/near real time delivery



Spray Drift Explained

The Physics and Chemistry of Spray Drift

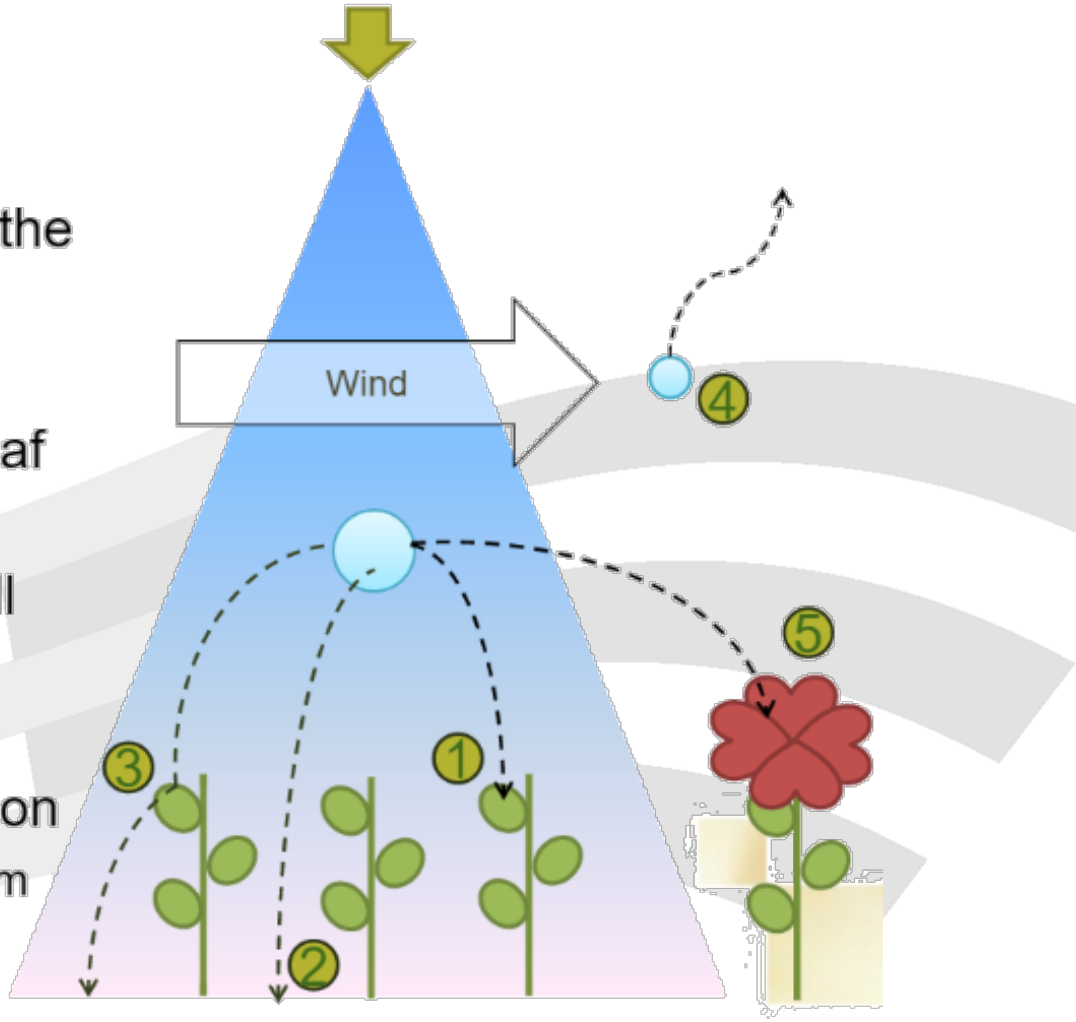
DRIFT MITIGATING ADJUVANTS – HOW THEY WORK

2016 Annual TPSA Conference

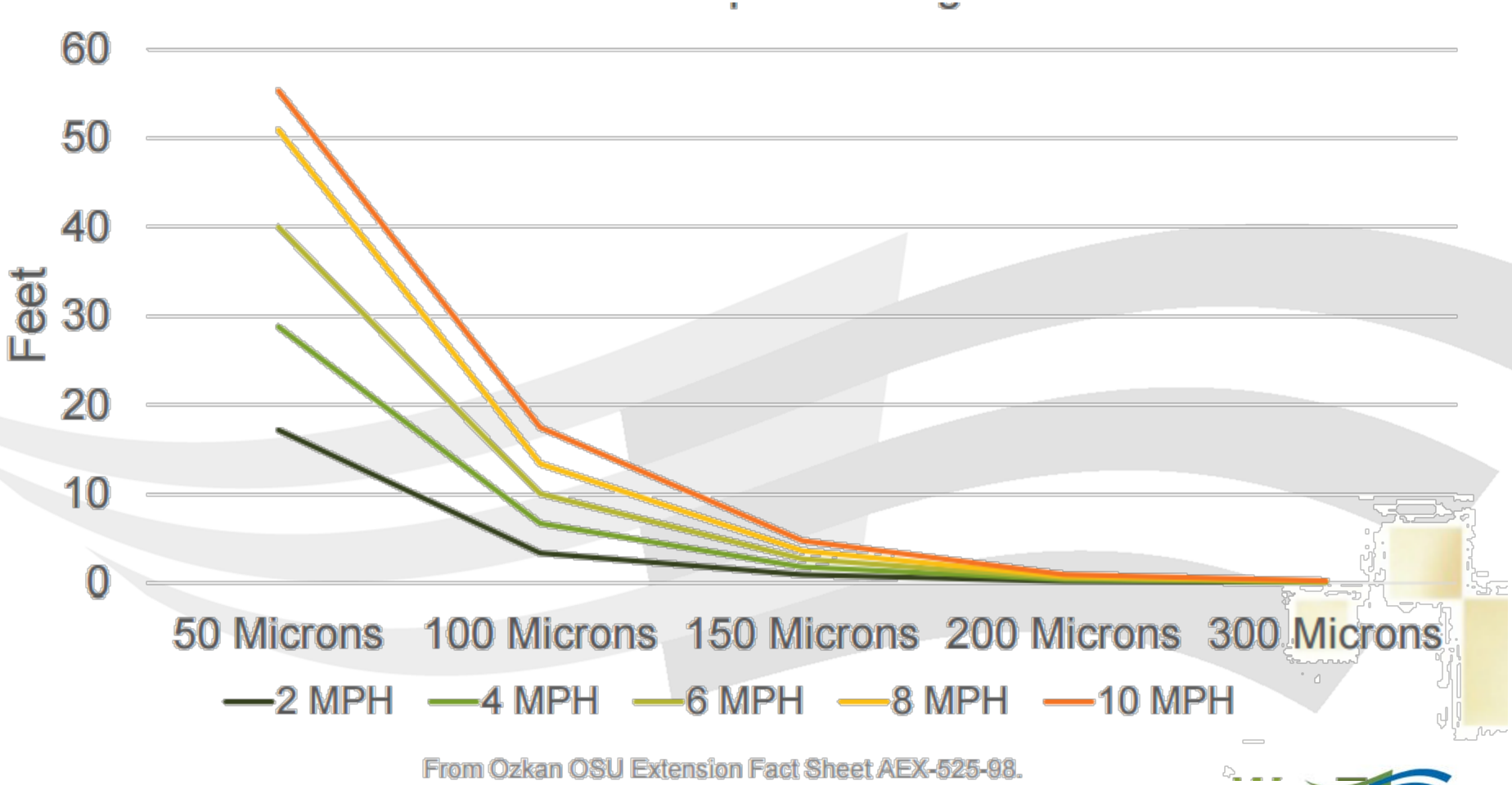
Presented by Ray Pigati, WinField

Droplet Fate

1. On-Target application: the goal is 100%!
2. Missing the target
3. Run or bounce off of leaf
   - Big Droplets: > 600 µm
4. Evaporation: very small droplets
   - Tiny Droplets: < 50 µm
5. Drift: off-target deposition
   - Small Droplets: 50-200 µm

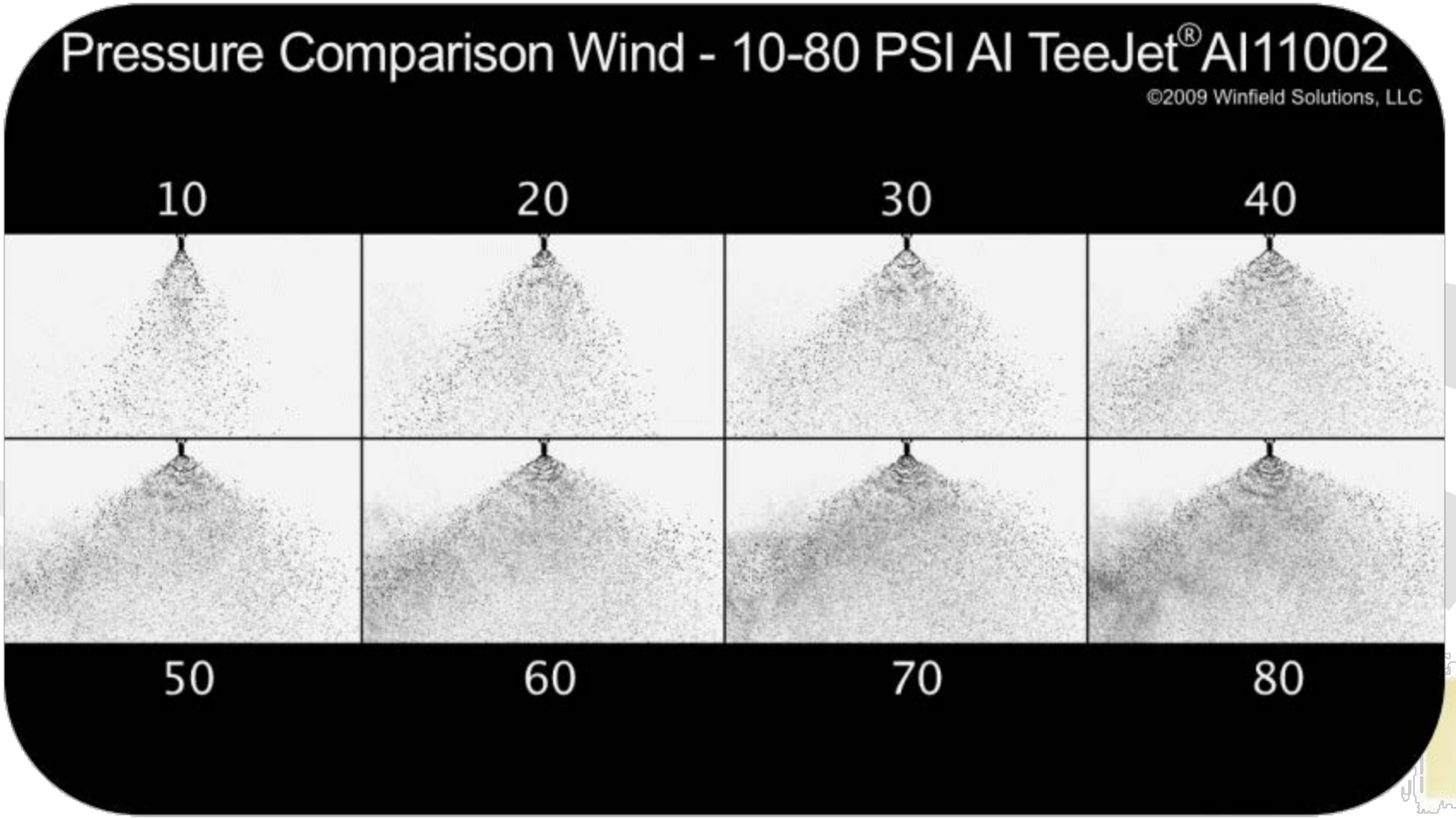


The Effect of Wind Velocity and Droplet Size on Distance Traveled from Point of Origin

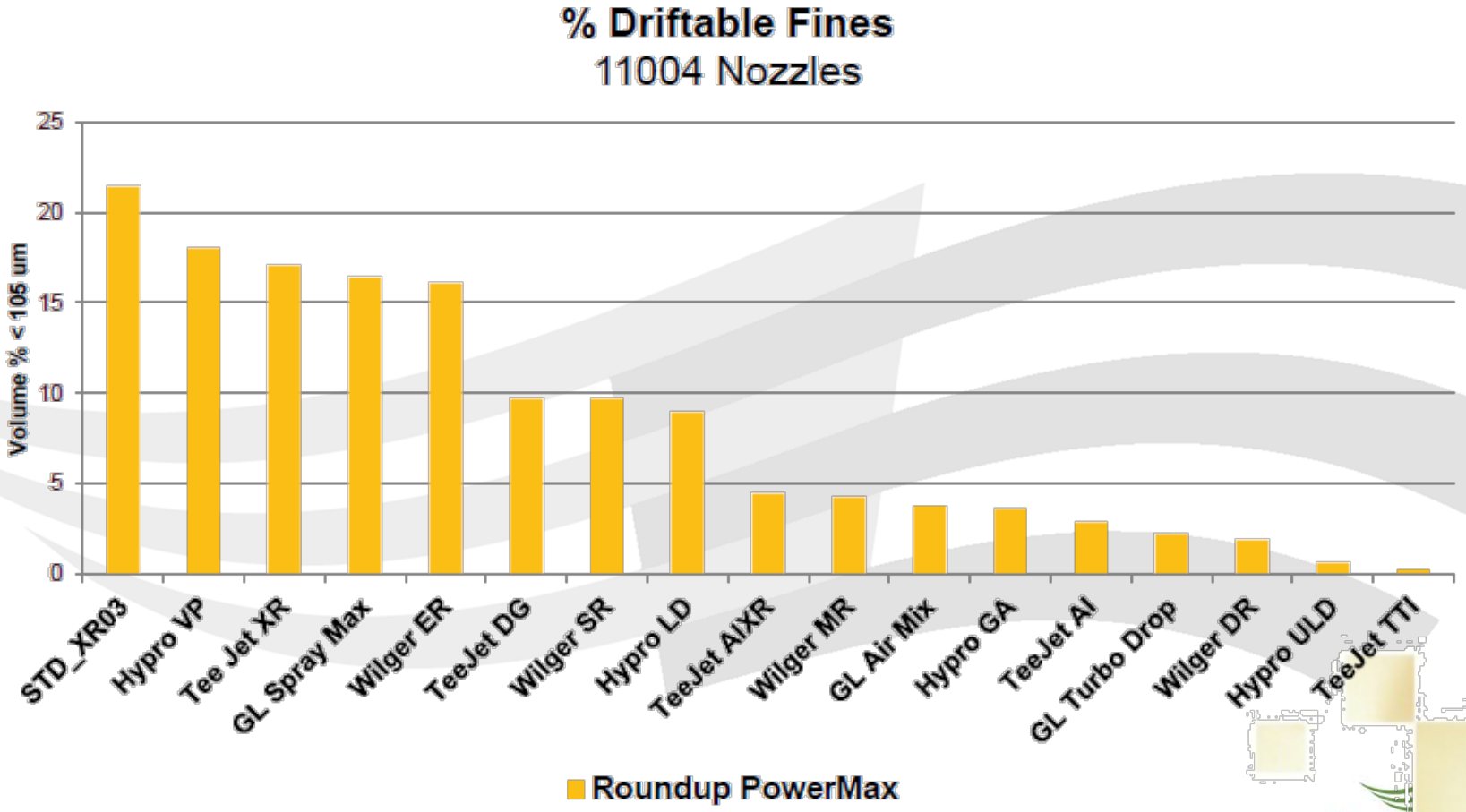


From Ozkan OSU Extension Fact Sheet AEX-525-98.

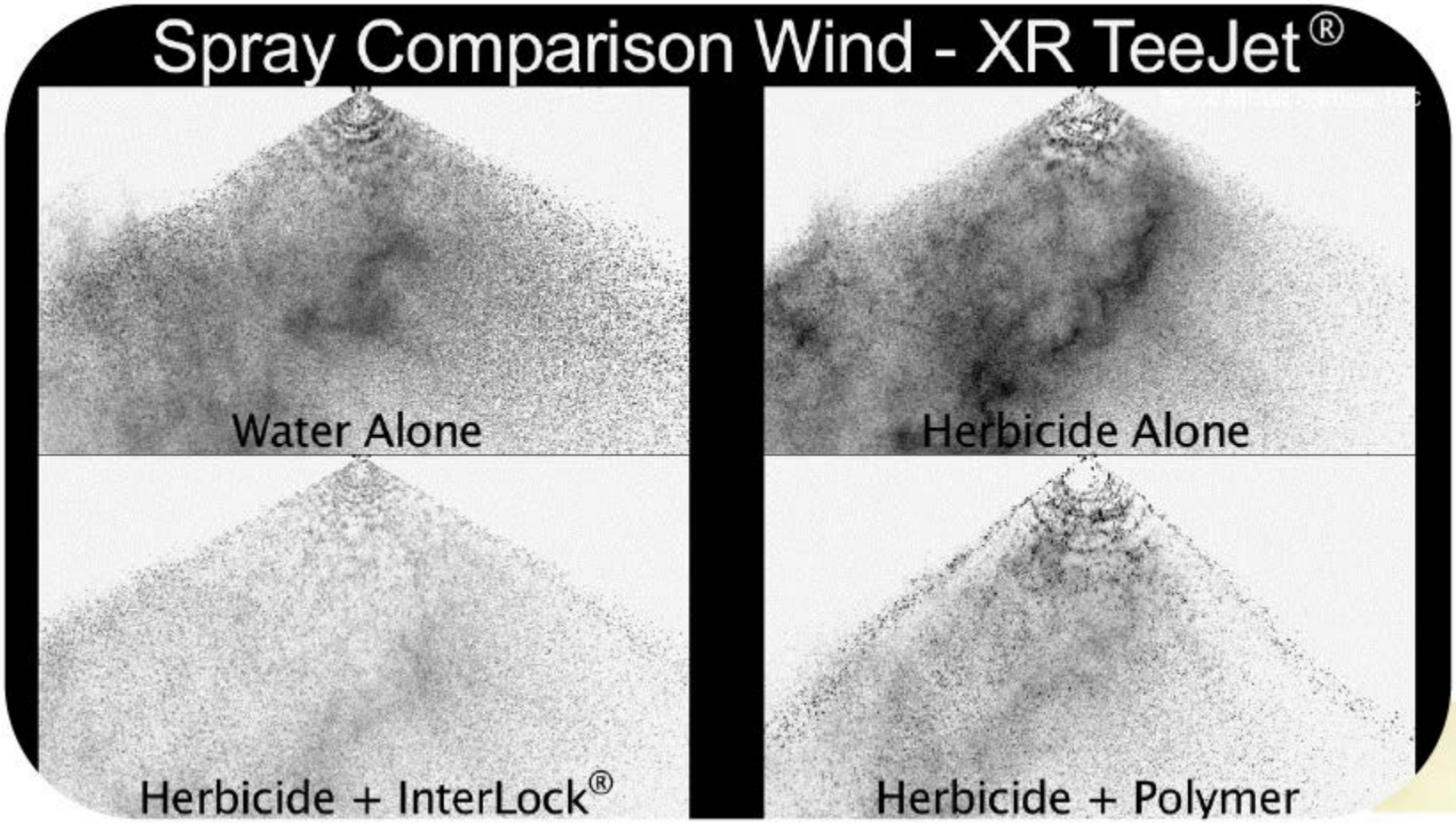
Impact of Pressure on Droplet Size



Impact of Nozzle Selection on Drift



Impact of Adjuvants



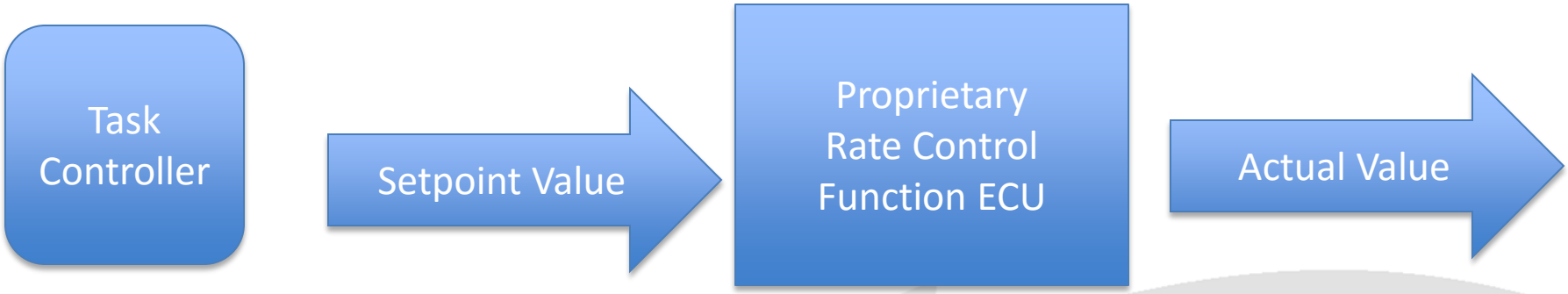
Spray Drift

Spray Drift = $\mathcal{F}$ (droplet size, wind, boom height,…)

Droplet Size = $\mathcal{F}$ (pressure, nozzle, contents, adjuvants)

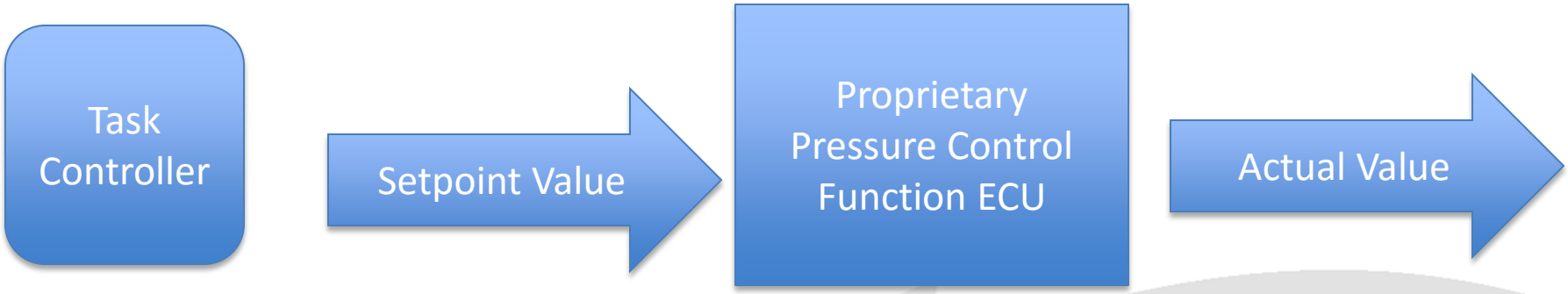
Machine Control Systems Supported by ISO 11783 -10 Relevant to Drift Mitigation

Variable Flow Rate Control System



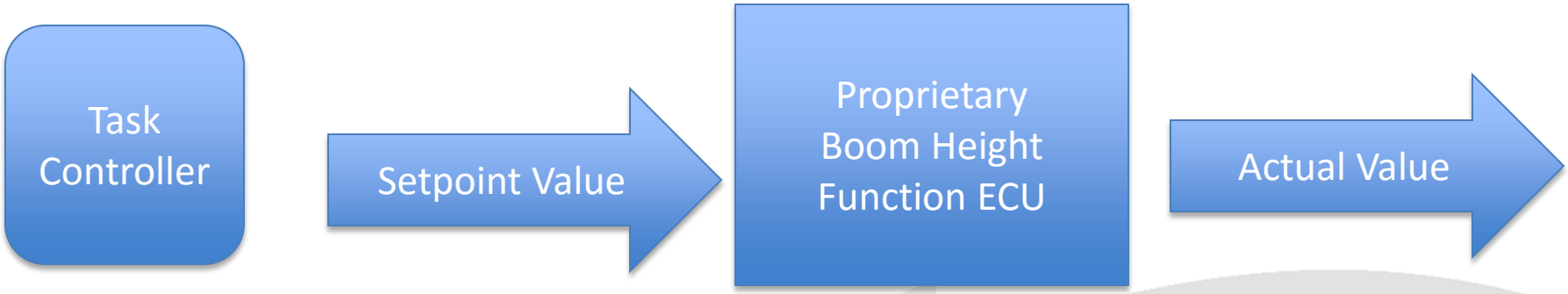
DDI	DDEName	Description	Units
1	Setpoint volume per area application rate	Setpoint Application Rate specified as volume per area	mm^3/m^2
2	Actual volume per area application rate	Actual Application Rate specified as volume per area	mm^3/m^2

Variable Pressure Control System



DDI	DDEName	Description	Units
193	Setpoint Product Pressure	Setpoint Product Pressure to adjust the pressure of the product flow system at the point of dispensing.	Pa
194	Actual Product Pressure	Actual Product Pressure is the measured pressure in the product flow system at the point of dispensing.	Pa

Boom Height Control System



DDI	DDEName	Description	Units
61	Setpoint working height	Setpoint Working Height of Device Element above crop or soil	mm
62	Actual working height	Setpoint Working Height of Device Element above crop or soil	mm

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Drift Mitigating Adjuvants

- Tank Mixes
- Direct Injection – limit to high risk areas

DDI	DDEName	Description	Units
1	Setpoint volume per area application rate	Setpoint Application Rate specified as volume per area	mm^3/m^2
2	Actual volume per area application rate	Actual Application Rate specified as volume per area	mm^3/m^2

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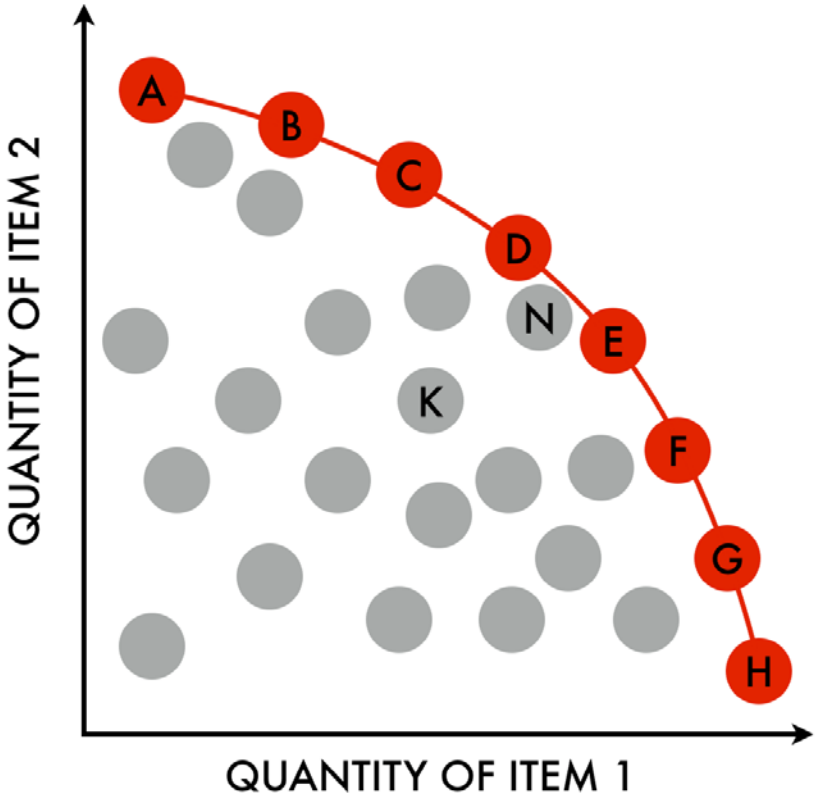
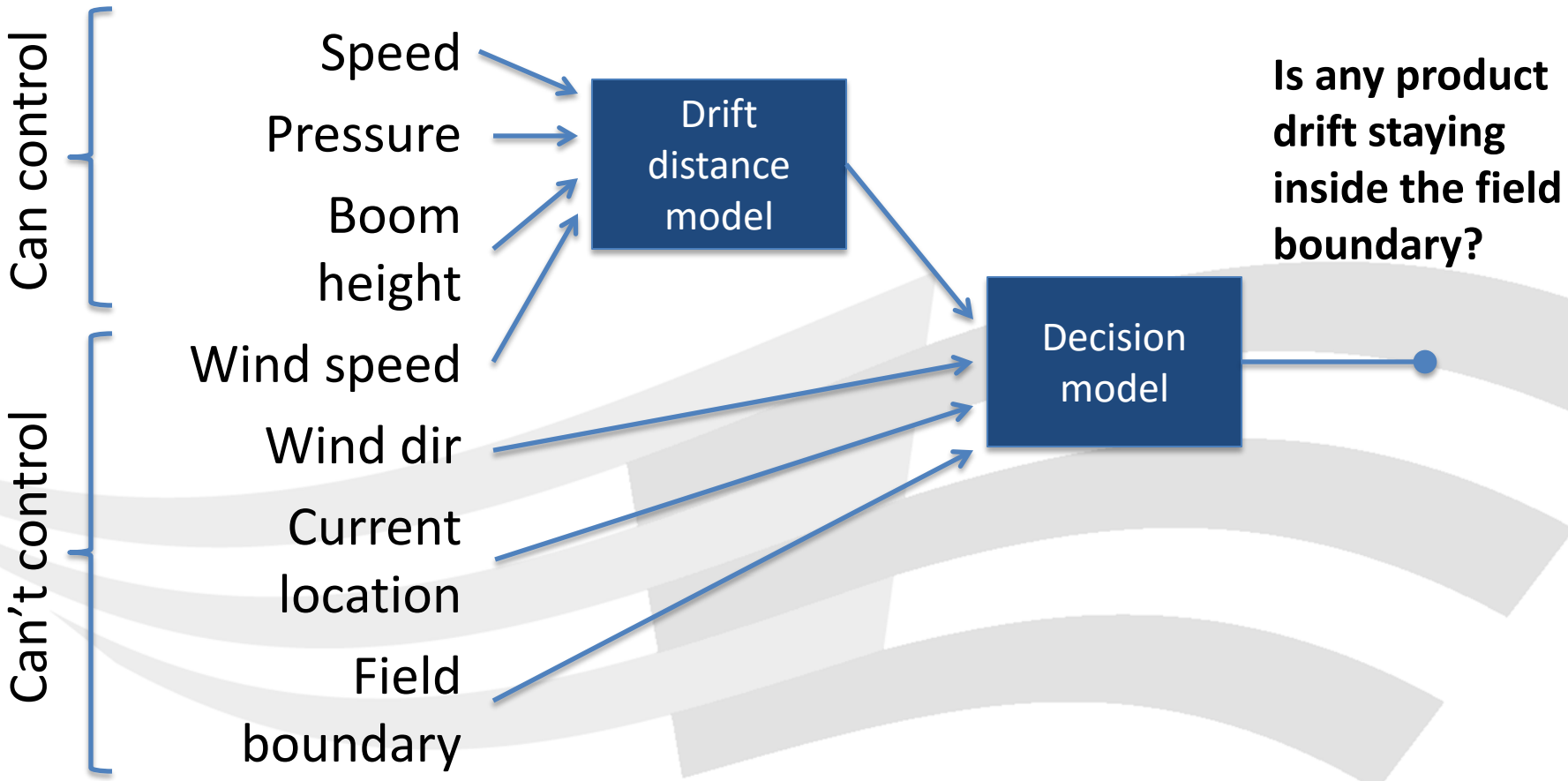
Level 3: Managing the problem

*An **OK2S standard** plus **interoperable real-time data sources** could enable machinery to **dynamically adapt** to changing conditions to **remain OK2S** under a wider set of conditions.*

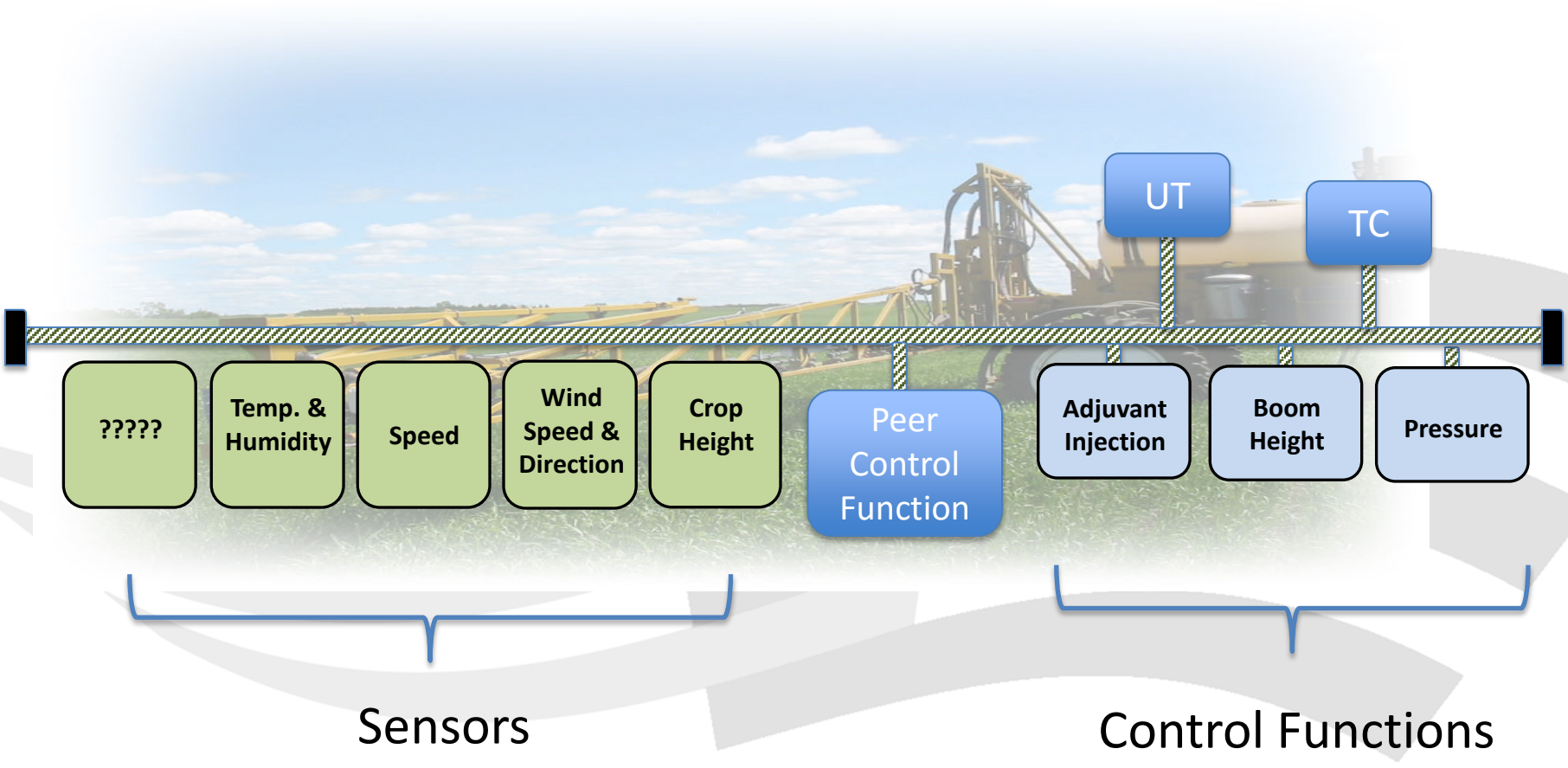


Multi-objective optimization problem, constrained by the need to remain OK to Spray at all times.

The optimization problem

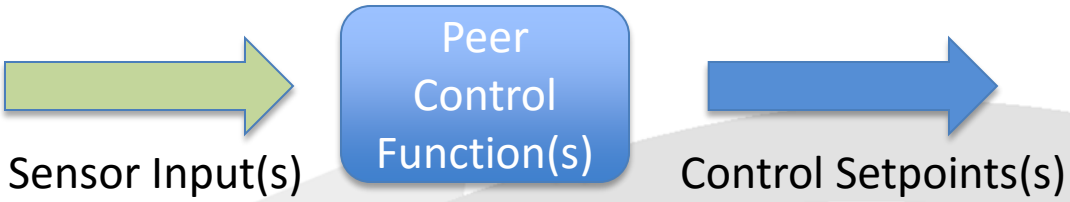


Dynamic Drift Mitigation Control



Opportunity for Innovation

- Data Standards Defines
  - Integration of Peer Control Function in ISOBUS
  - Sensor input formats
  - Setpoint formats



- Opportunities
  - New Sensor Development ??
    - Droplet size
    - Drift Measurement
  - MICS
    - Proprietary Peer Control Function
      - Reads specified sensor input(s): wind speed, temp, crop height, etc.
      - Outputs setpoint (s): pressure, boom height, adjuvant rate, etc.

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Summary

- Many of the machine control functions required to address drift are currently supported by ISO 11783
- ISO 11783 enhancements
  - Nozzle selection
  - DDI for nozzle classification
  - DDI for boom height
- Opportunities for Innovation
  - URI linked content linked to chemical products
  - Services for buffer zone creation & delivery
  - Sensor development
  - Peer Control Functions for “Adaptive Sprayers”

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Collaboration for eConnectivity

THANK YOU

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