Boehringer Ingelheim

PRECISION LIVESTOCK ECOSYSTEMS: *INTEGRATING TECHNOLOGY, PROCESS & CULTURE*

BANFF PORK SEMINAR

JANUARY 7-9, 2020

Dale Polson , DVM MS PhD

PREVENTION WORKS
Shaping the future of swine health

PLF ECOSYSTEMS: OUR OUTLINE…

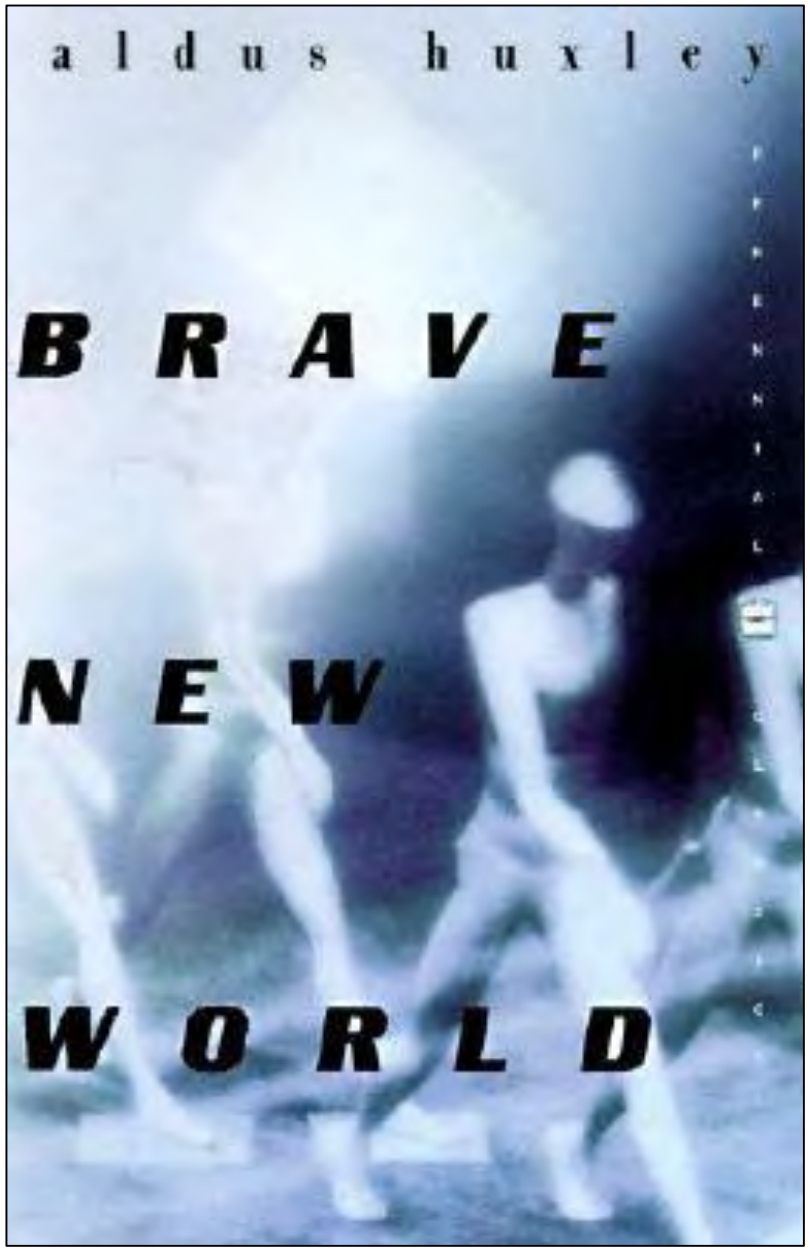
- ***Context***
- *Need*
- *Technology*
- *Structure & Process*
- *Culture*
- *Action*

ALWAYS START WITH CONTEXT…

Always design a thing by considering it in its next larger context - a chair in a room, a room in a house, a house in an environment, an environment in a city plan.

— Eliel Saarinen —

Eliel Saarinen, ***Finnish Architect, 1873-1950***

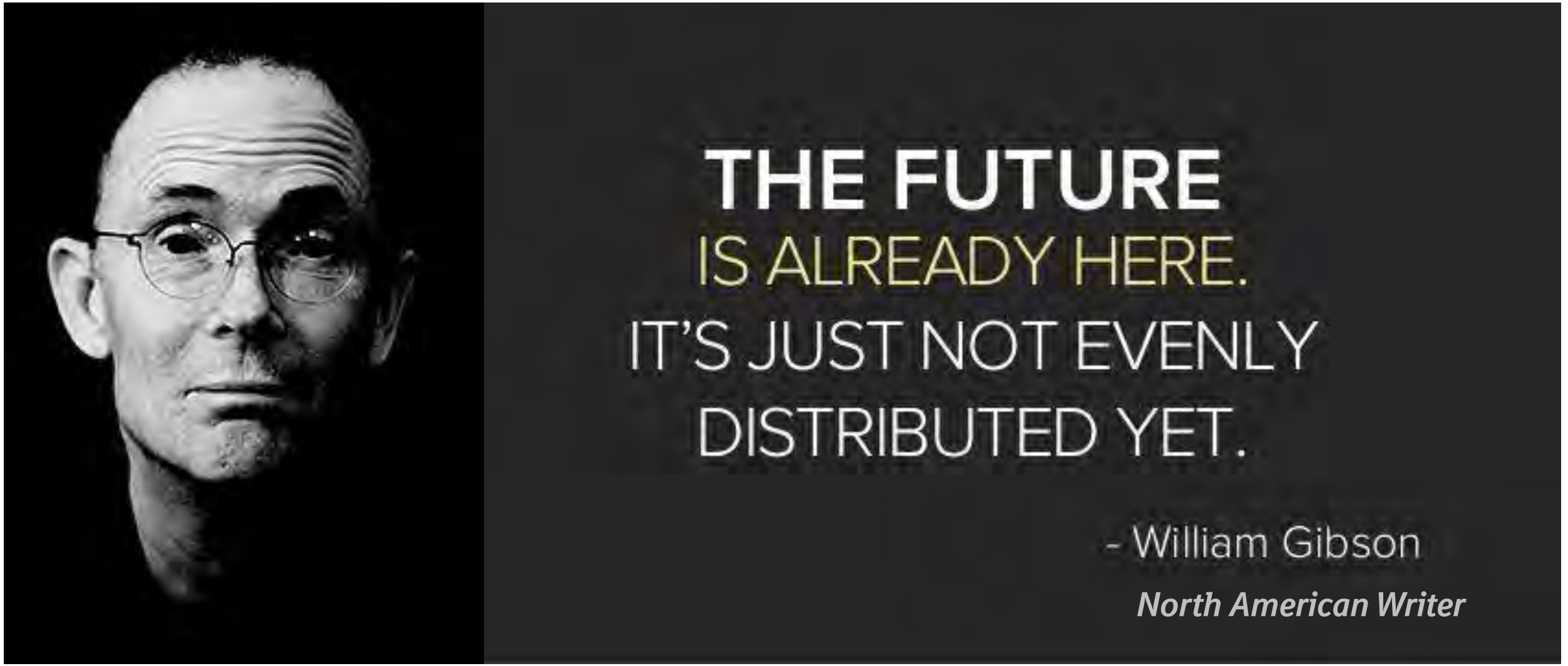


PLF: THE CONTEXT…

Livestock & protein production "tools" will radically change over the next several years…

- The change is coming faster than we think possible
- The magnitude of change will be bigger than we imagine
- The major drivers of that change are coming from outside of traditional livestock arena
- To survive & thrive as producers, veterinarians and allied businesses, we will all need to proactively anticipate and prepare

PLF: THE CONTEXT…



PLF: THE CONTEXT…

The same basic conditions & drivers that already have been radically changing how all people on earth live will radically change how we all do business in livestock production.

PLF: THE CONTEXT…

Our "*Brave New World*"…

…will be ***needs*** driven ("***jobs-to-be-done***")

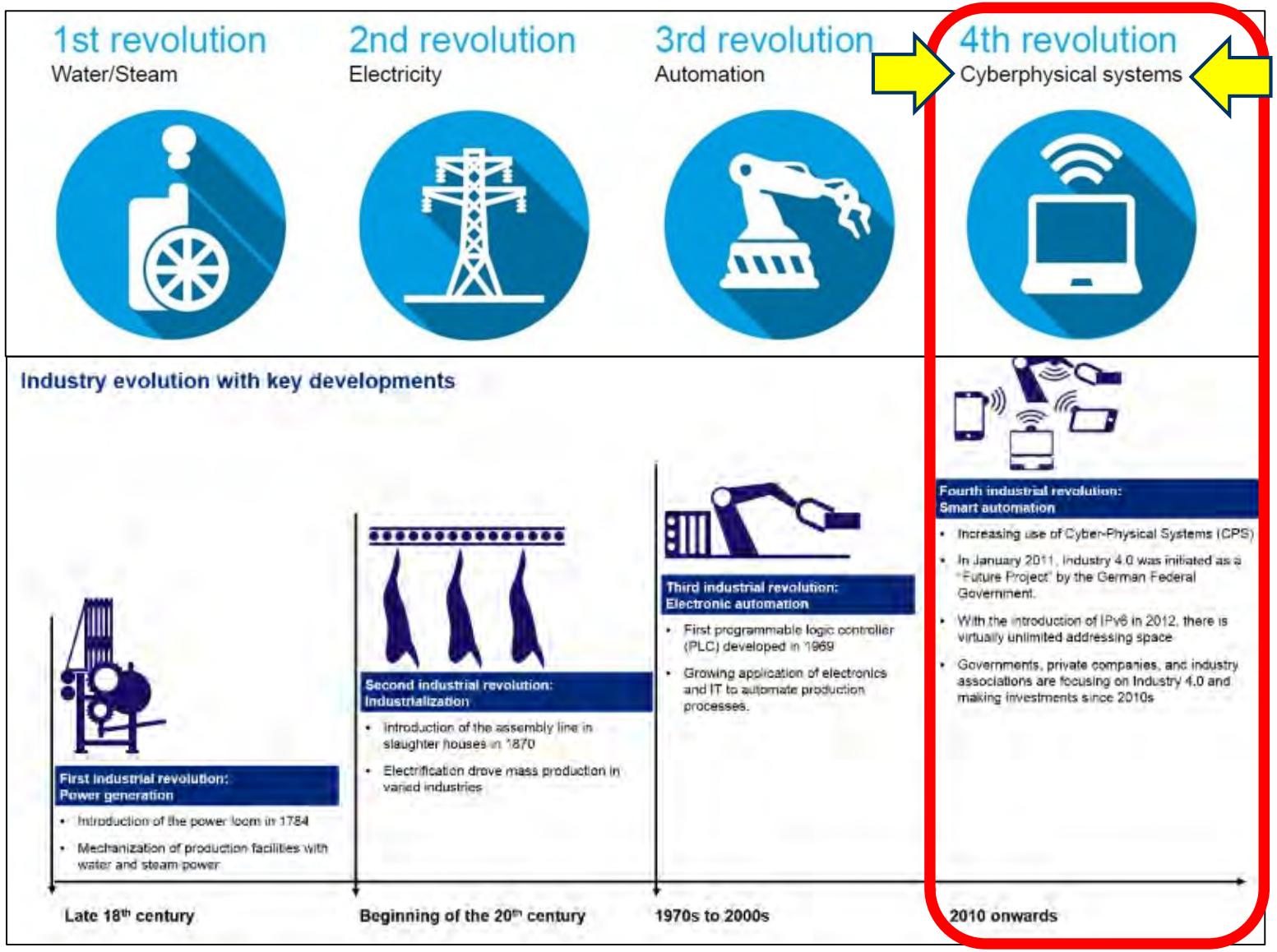
…will be ***technology*** driven

…will be ***value*** (not cost) driven

…will ***fundamentally change*** how we do business

The **4th Industrial Revolution…**

- **SMART automation**
- **Cloud connected**
- **Self-learning…**
  - Machine learning
  - Artificial Intelligence
- **Real-time**
- **Decision-ready**

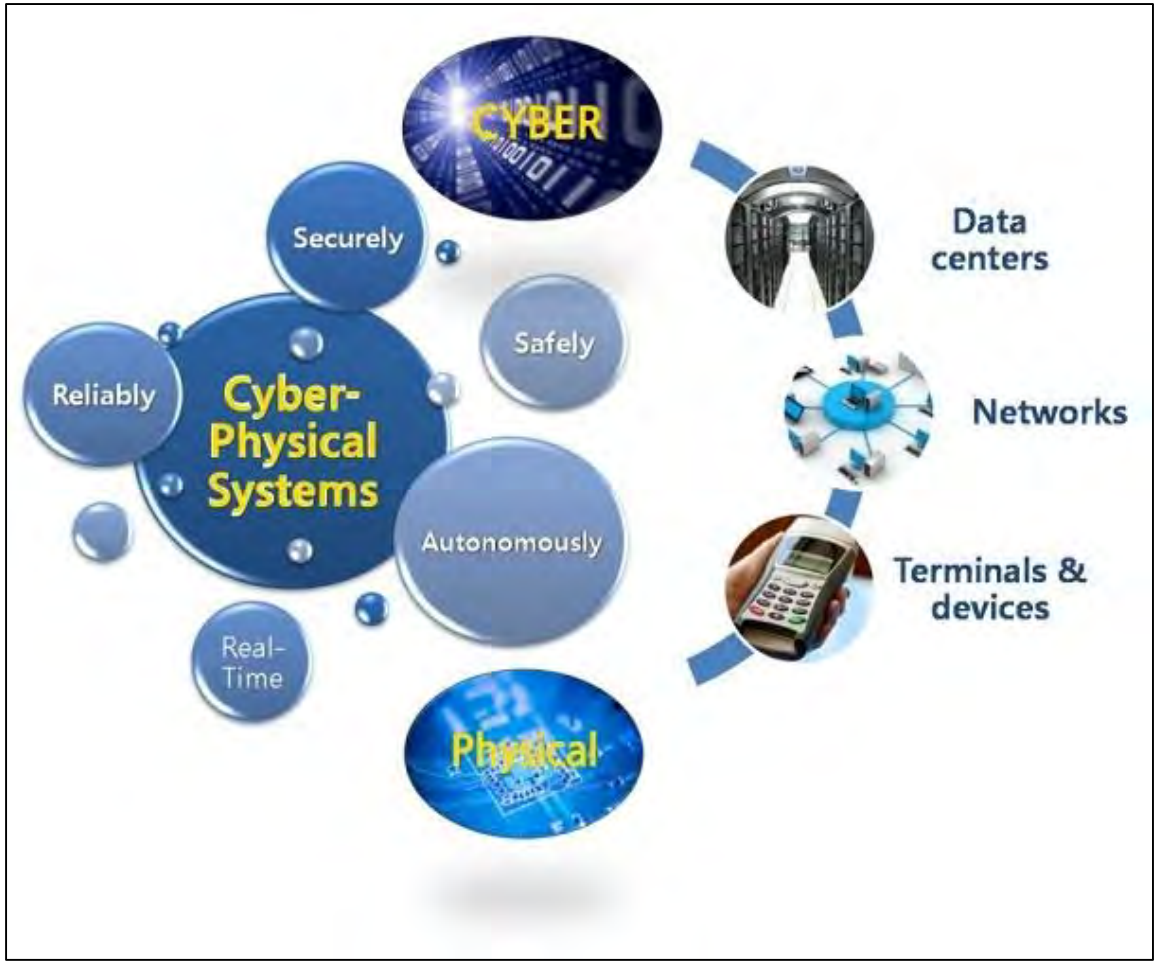


CYBER-PHYSICAL SYSTEMS…

Cyber-Physical Systems (CPS) are the key building block of the 4th Industrial Revolution, connecting:

- Data capture technologies (hardware, software)
- Data synthesis & management
  – software, cloud infrastructure…"big-data"
- Analytics and visualization
  – Machine-learning, Artificial Intelligence

<u>Result</u> > Real-time, decision-ready, actionable information…



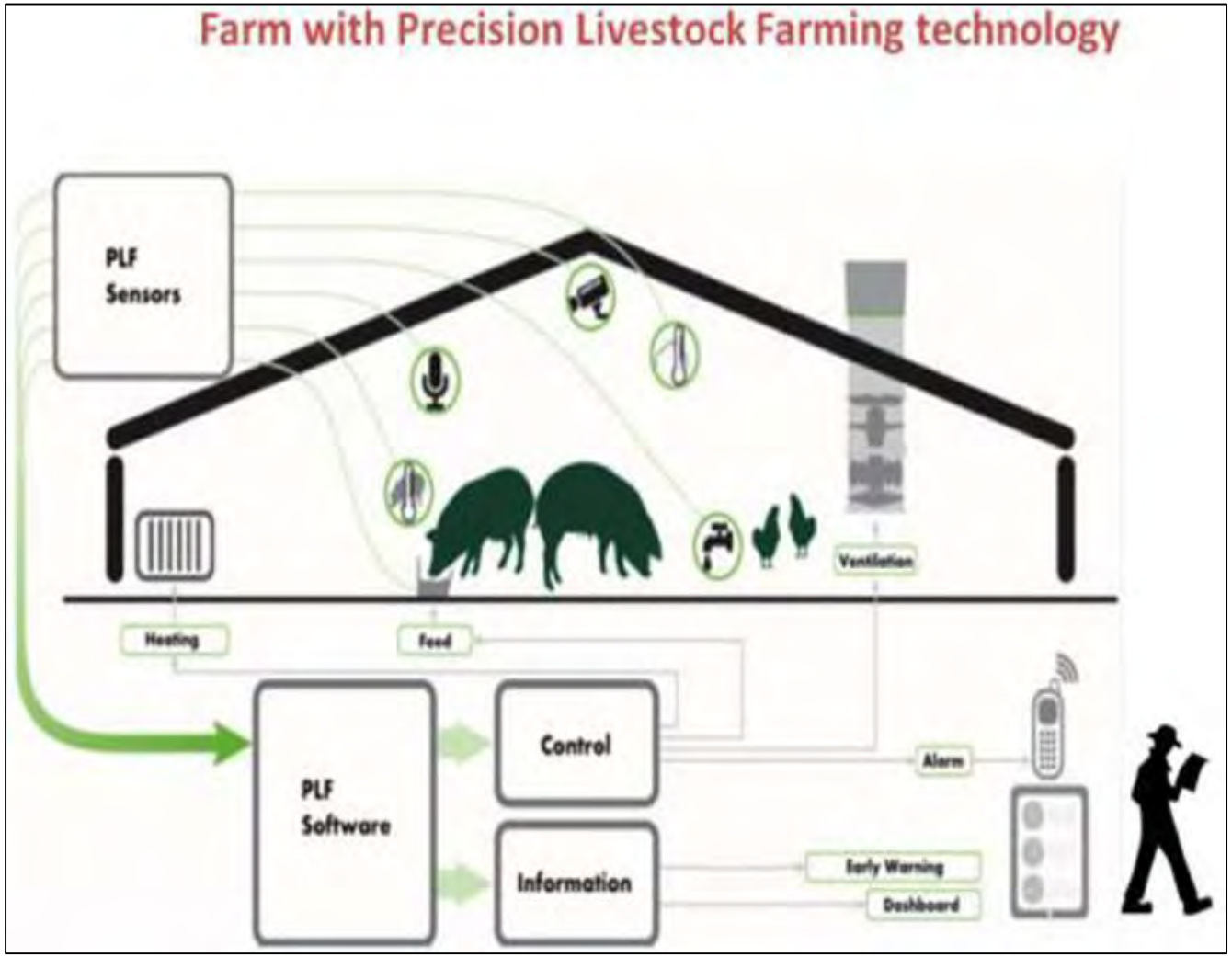
PRECISION LIVESTOCK FARMING (PLF)

In production livestock...

Cyber-Physical Systems (CPS)

=

Precision Livestock Farming
(PLF)



Precision Livestock Farming (PLF)

SRGE

" Management of livestock farming by **continuous automated real-time monitoring/controlling/tracing** of production/reproduction, health and welfare of livestock."

PLF ECOSYSTEMS: OUR OUTLINE…

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- *Action*

PRECISION LIVESTOCK FARMING (PLF)

ALL ABOUT FEED

Latest magazine now online

Mon 22 May

Mycotoxins | New Proteins | Digital magazine | Contact us

5 trends driving precision livestock farming

The need for precision livestock farming is driven by trends in the industry and society at large. This is according to a new report from Dutch bank Rabobank. read more

The need for PLF is driven by trends in the industry and society at large:

1. Farms have become larger and more complex in terms of management, with more animals per employee.
2. There is a need to reduce costs and create more value to improve competiveness.
3. Productivity needs to be improved to meet rising animal protein demand.
4. The environmental footprint of farming needs to be reduced.
5. Farmers need to address societal concerns about animal welfare, improving transparency in the sector.

PLF: THE NEED…

- The **singular value** of ALL measurement is the extent to which it supports *well informed* **decision-making**
- In an industrial/operational setting, for the most effective decision-making, information must be:
  - An accurate reflection of reality
  - Real-time
  - **Decision-ready**

PLF: THE NEED…

The Global livestock production industries need far better tools & methods to enable:

- faster, better informed local farm-level ***decision-making*** for business operations
- better informed overall business-level ***decision-making*** for management and leadership
- faster, more seamless multi-business data and information sharing for industry-level ***decision-making***

PLF: THE NEED…

High quality science supports better ***decision-making***:

- through developing better ways to ***measure***
- by developing better ways to ***analyze***
- by providing more confidence in ***interpretation***

PLF: THE NEED…

Science is good…

…and ***institutional-scale*** science has always & will always make very valuable contributions to its business & professional constituencies

…but institutional science has limitations…

Institutional-scale science can tell us:

What HAS happened (retrospective, observational)

What CAN happen, given a specific and defined condition set (experimental)

PLF: THE NEED…

We need to complement ***institutional-scale*** (cross-sectional / time-limited / static) science with ***industrial-scale*** (operational / continuous / dynamic) science…

…science that can tell us what DOES happen…

…EVERY time it happens…

…and that helps us understand WHY it happens…

PLF: THE NEED…

We need to complement institutional-scale (cross-sectional / time-limited / static) science with industrial-scale (operational / continuous / dynamic) science…

…science that can PREDICT what will LIKELY happen…

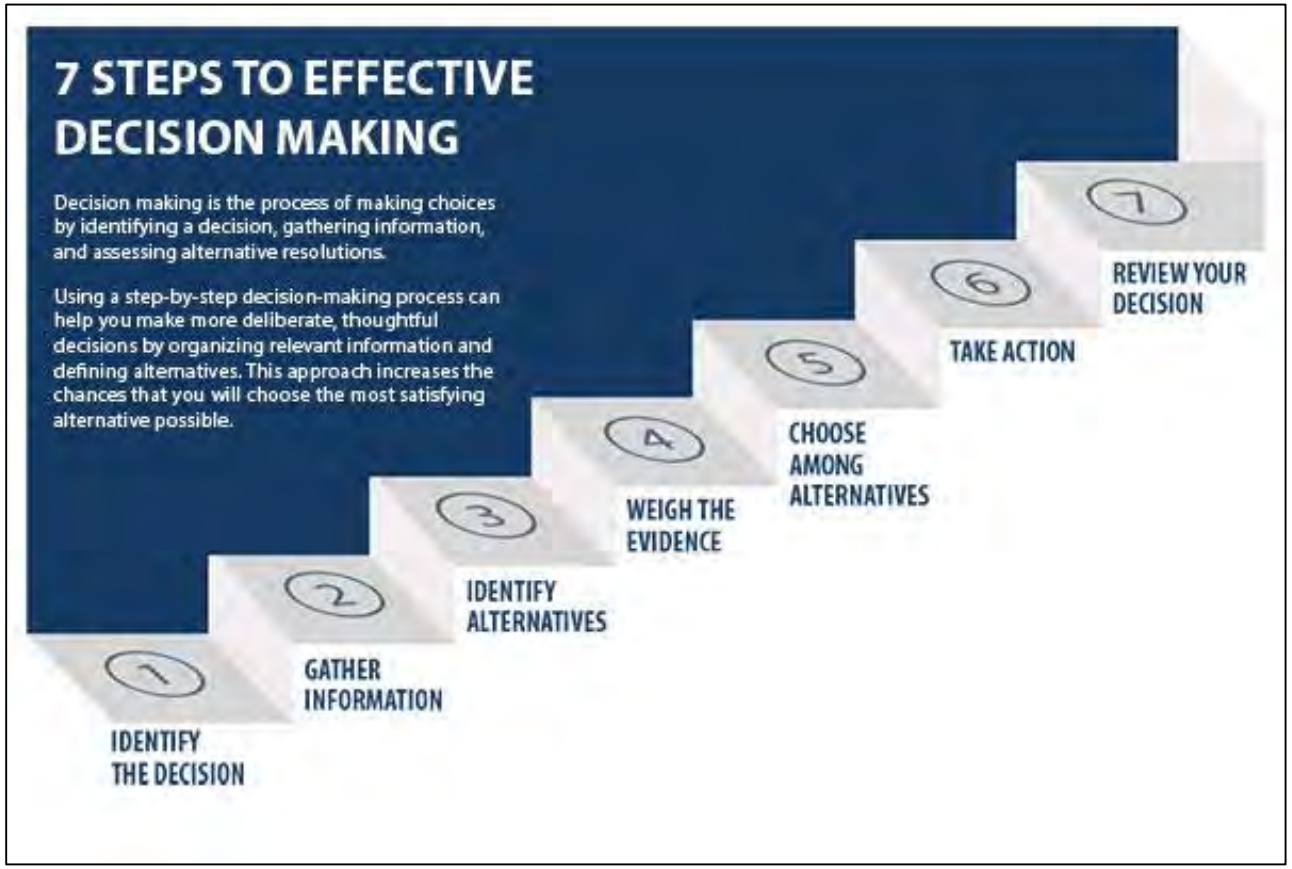
…and PRESCRIBE what we could/should do about it.

In short, we need a continuous stream of "*decision-ready*" actionable information.

PLF: THE NEED…

To *become* **decision-ready**, information must be based on **data** that is:

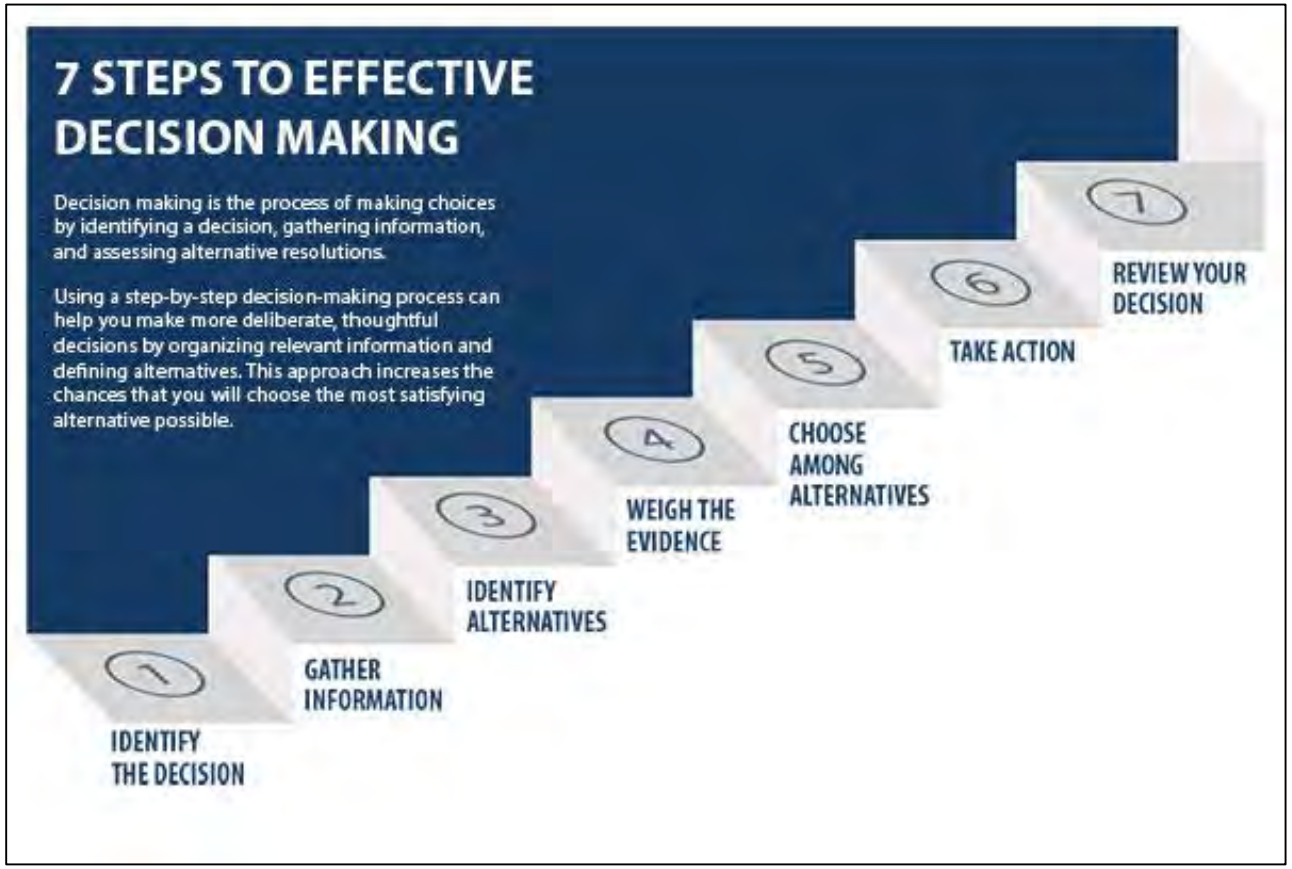
- Broad & Deep
- Comprehensive & Contextual
- Connected & Continuous
- Granular
- Accurate & Precise
- Real-time / near real-time
- Inexpensive to acquire



PLF: THE NEED…

To ***be decision-ready***, ideally information must:

- Be Trusted
- Be On-demand
- Accurately reflect reality
- Be Predictive (probability-based)
- Be Prescriptive



PLF: THE NEED… *"DECISION-READY"*

- **What the SYSTEM does…**
- **What PEOPLE do…**

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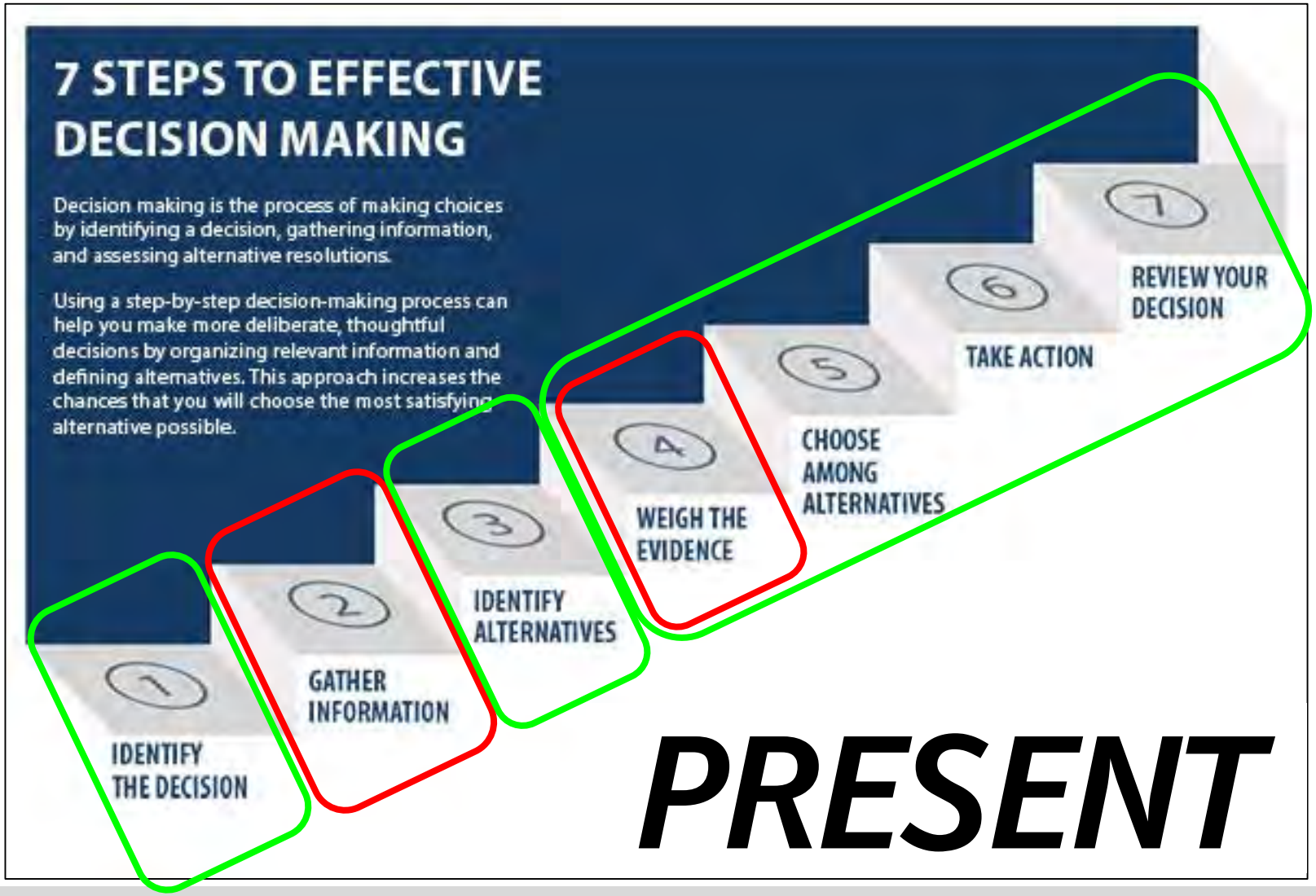

PLF: THE NEED… *"DECISION-READY"*

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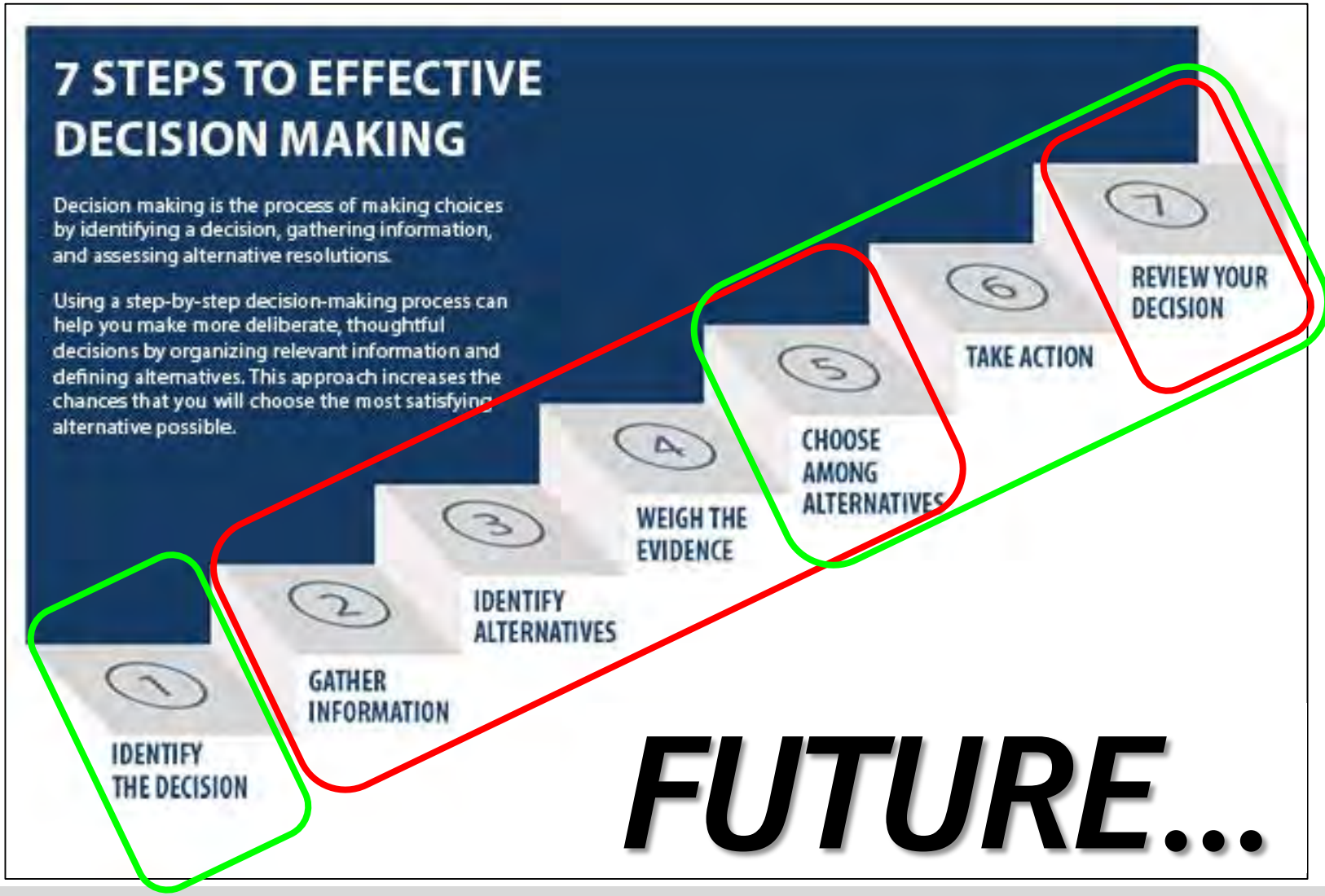

FUTURE…

PLF ECOSYSTEMS: OUR OUTLINE…

- *Context*
- *Need*
- ***Technology***
- *Structure & Process*
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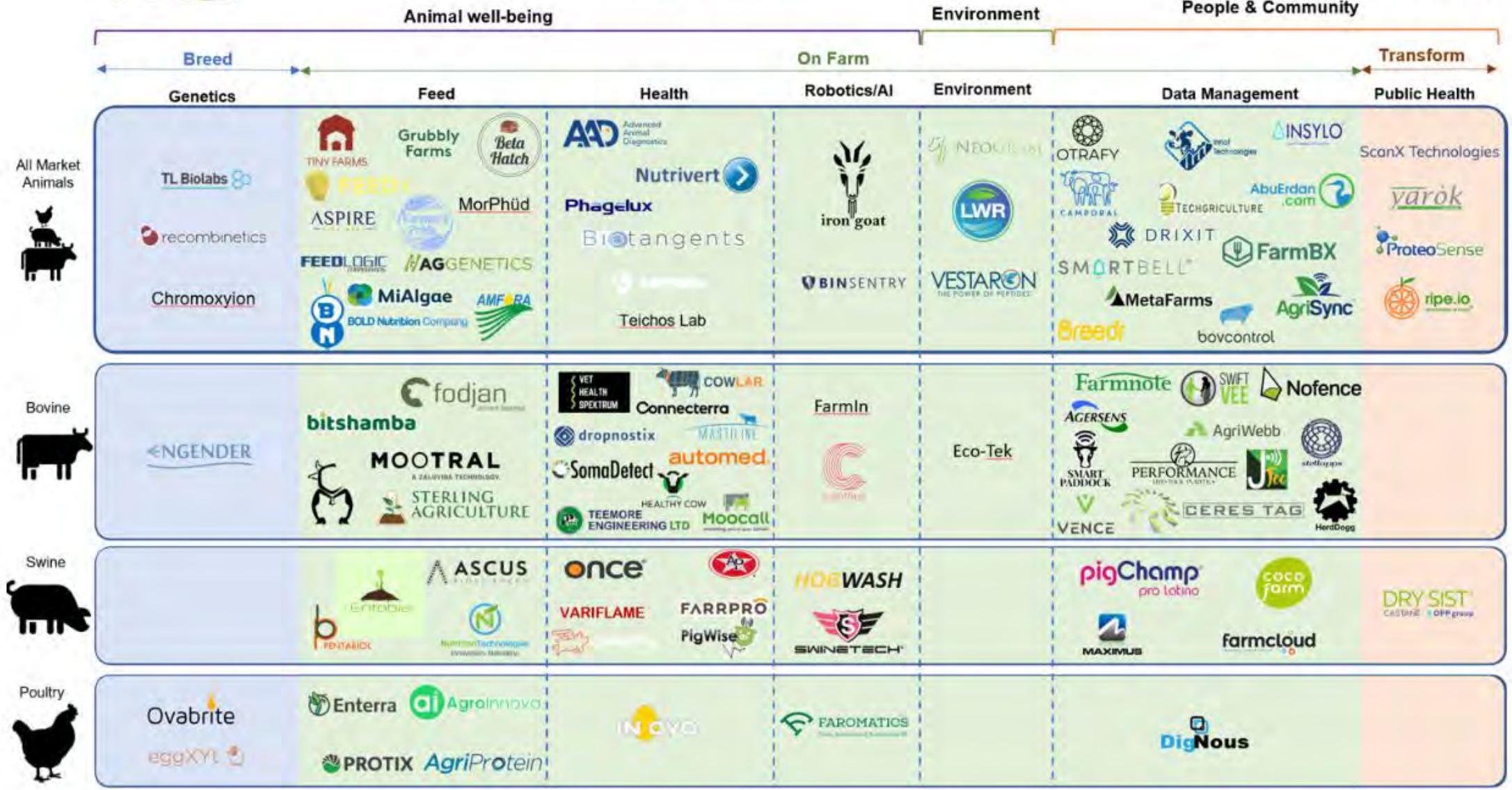
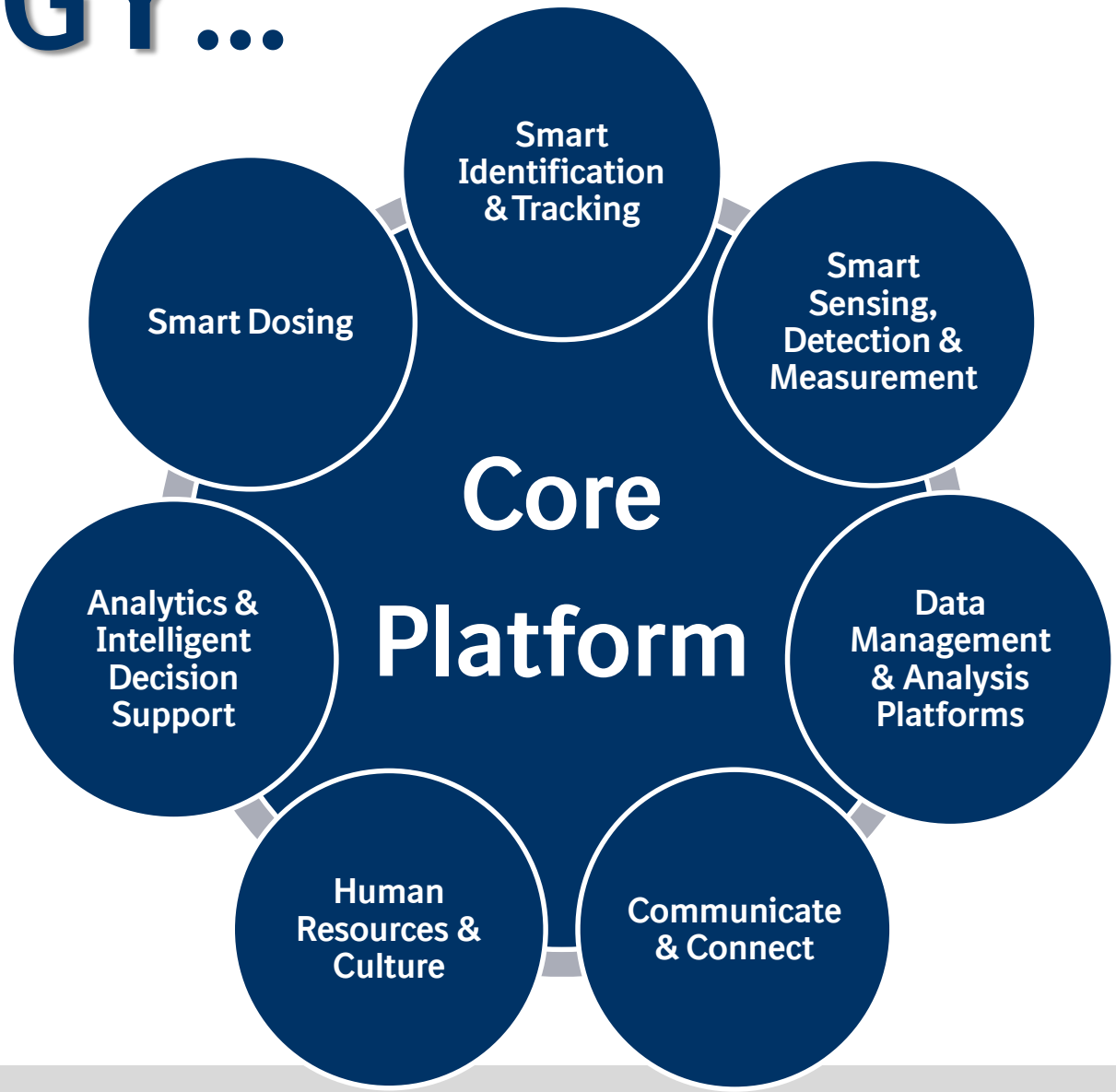
Co-founder & CEO, BOX – an enterprise cloud platform

THRIVE Animal AgTech Landscape Map 2019



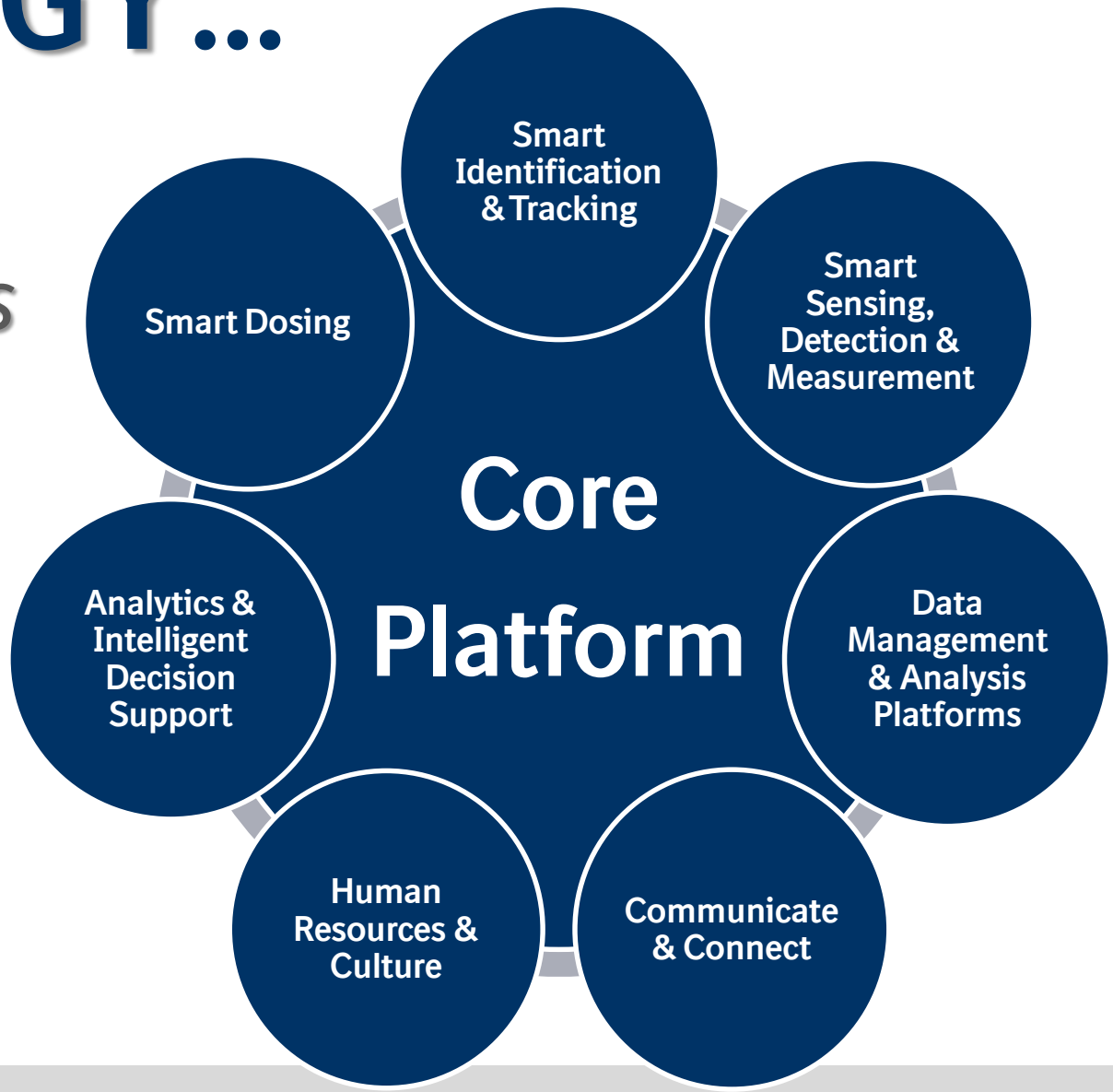
PLF: TECHNOLOGY…

PLF ECOSYSTEM SEVEN KEY TECHNOLOGY AREAS…



PLF: TECHNOLOGY…

- **Connectivity**
- **Technology:** *4 Dimensions*
  - *Devices*
  - *Diagnostics*
  - *Digital platforms*
  - *Data analytics*
- **Processes**
- **Integration**



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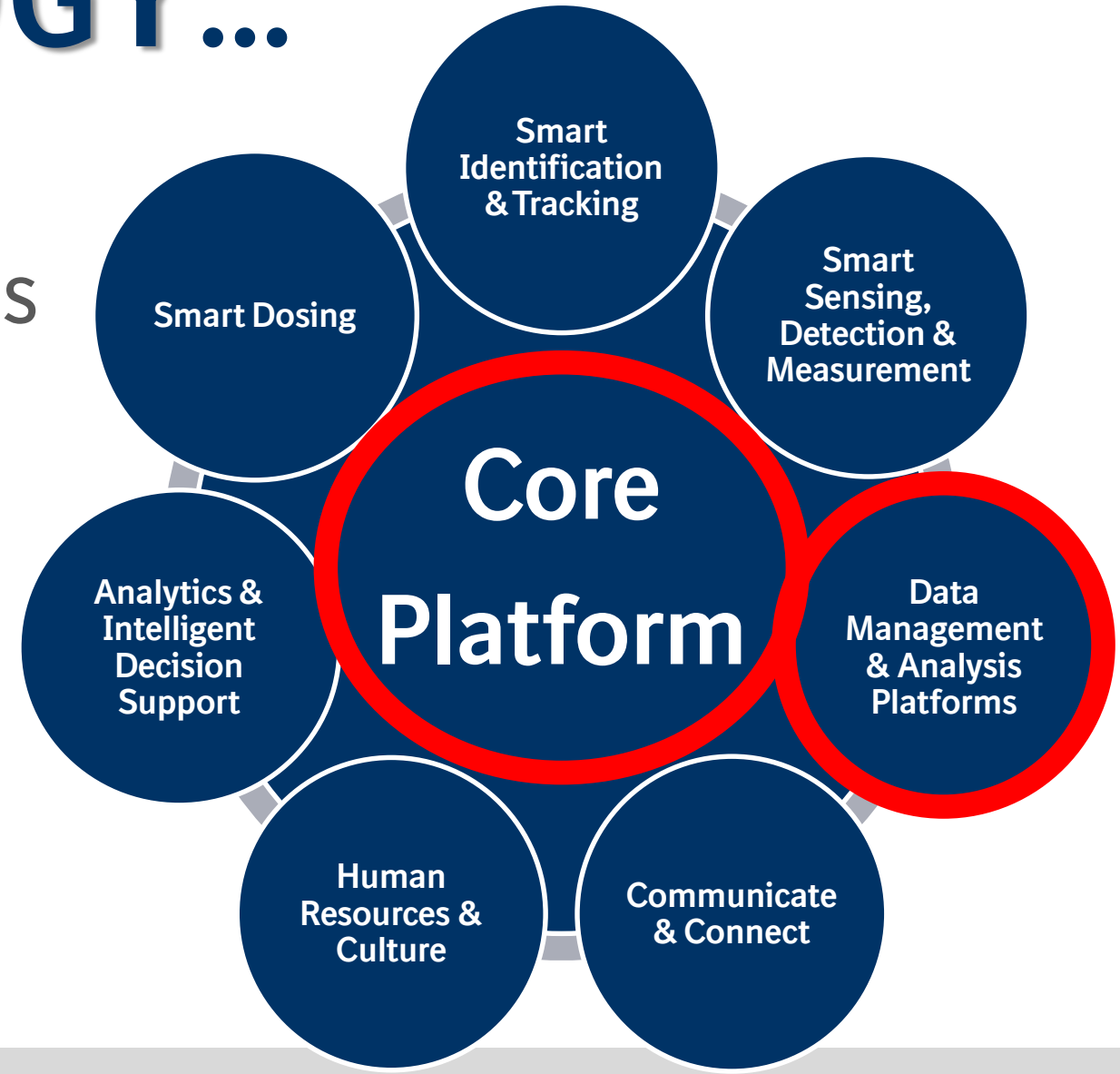

FARMERA IS A DIGITAL PLATFORM THAT GENERATES INSIGHTS TO REDUCE THE TIME TO IDENTIFY AND MITIGATE HEALTH & PRODUCTION RELATED PROBLEMS

Key Capabilities:

- Monitors mortality (*user input*)
- Monitors treatment (*user input*)
- Reports cough scores (*via SoundTalks API*)
- Reports temperature (*via Controller, SoundTalks API*)
- Reports humidity (*via Controller, SoundTalks API*)
- Reports feed consumption (*via Barn Controller API's*)
- Reports water consumption (*via Barn Controller API's*)

...and more to come.

PLF: TECHNOLOGY…

- **Connectivity**
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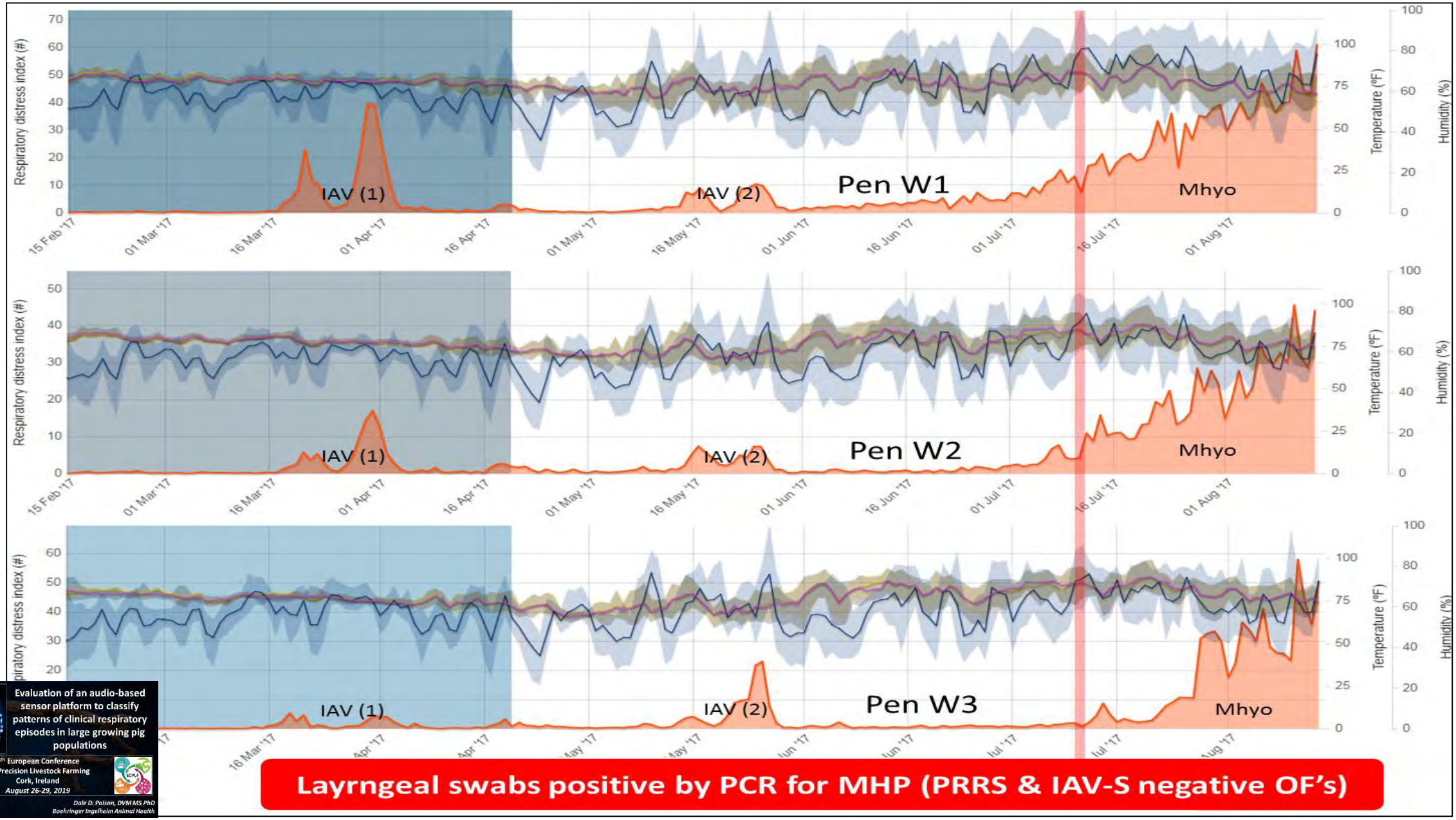
SOUNDTALKS

- Monitors
- Gateway
- App
- Web Dashboard



Layrngeal swabs positive by PCR for MHP (PRRS & IAV-S negative OF's)

Determining the optimal placement and configuration of an audio-based sensor platform in large growing pig sites

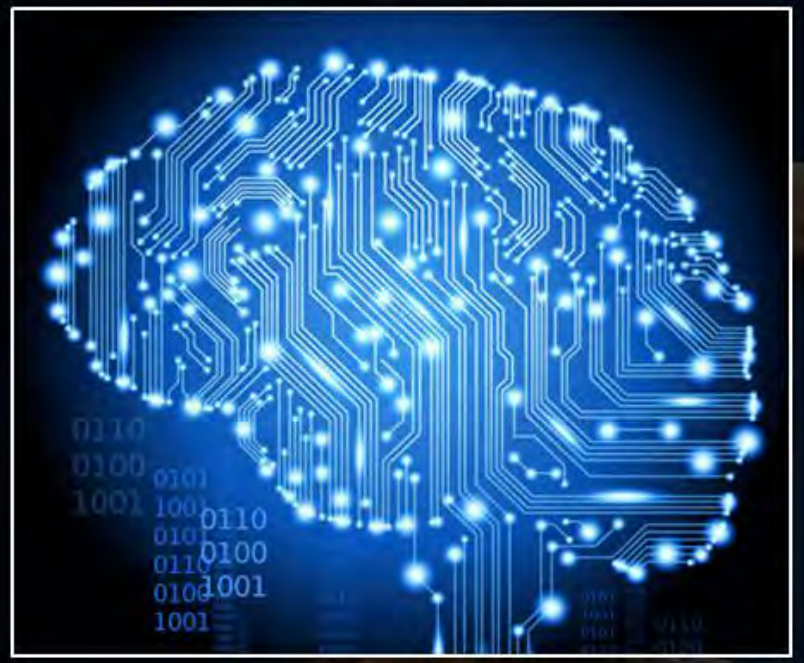
UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

9th European Conference
On Precision Livestock Farming
Cork, Ireland
August 26-29, 2019

ECPLF

Boehringer Ingelheim

Dale D. Polson, DVM MS PhD
Boehringer Ingelheim Animal Health



Evaluation of an audio-based sensor platform to classify patterns of clinical respiratory episodes in large growing pig populations

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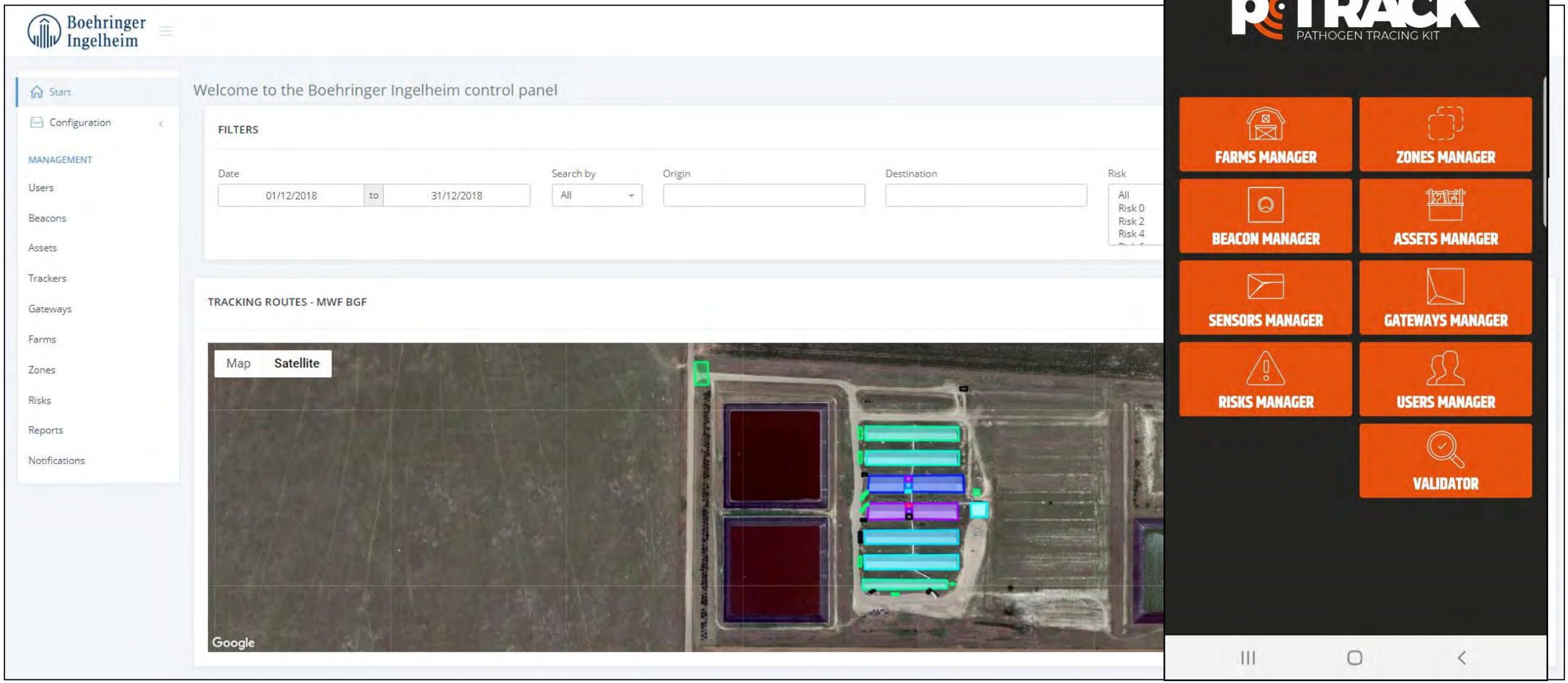
PTRACK: CONTROL PANEL

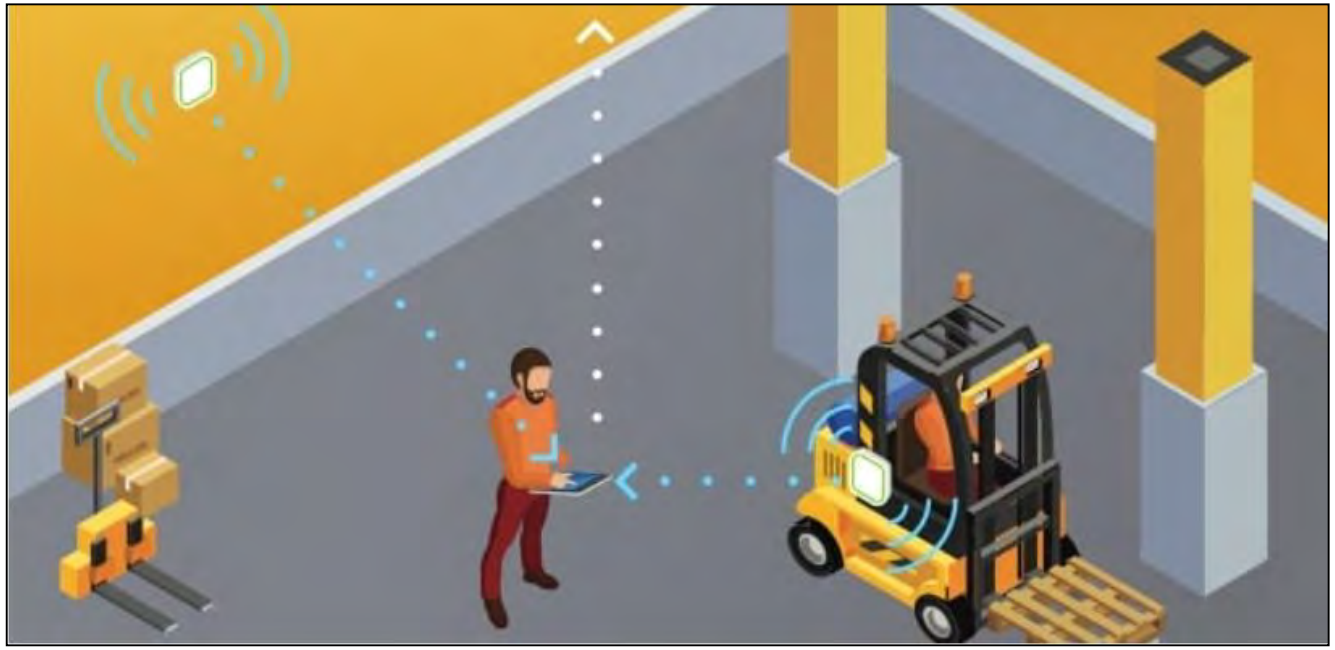


BLE BEACONS…

"Beacons gave app developers a new way to understand where users were in a physical space."

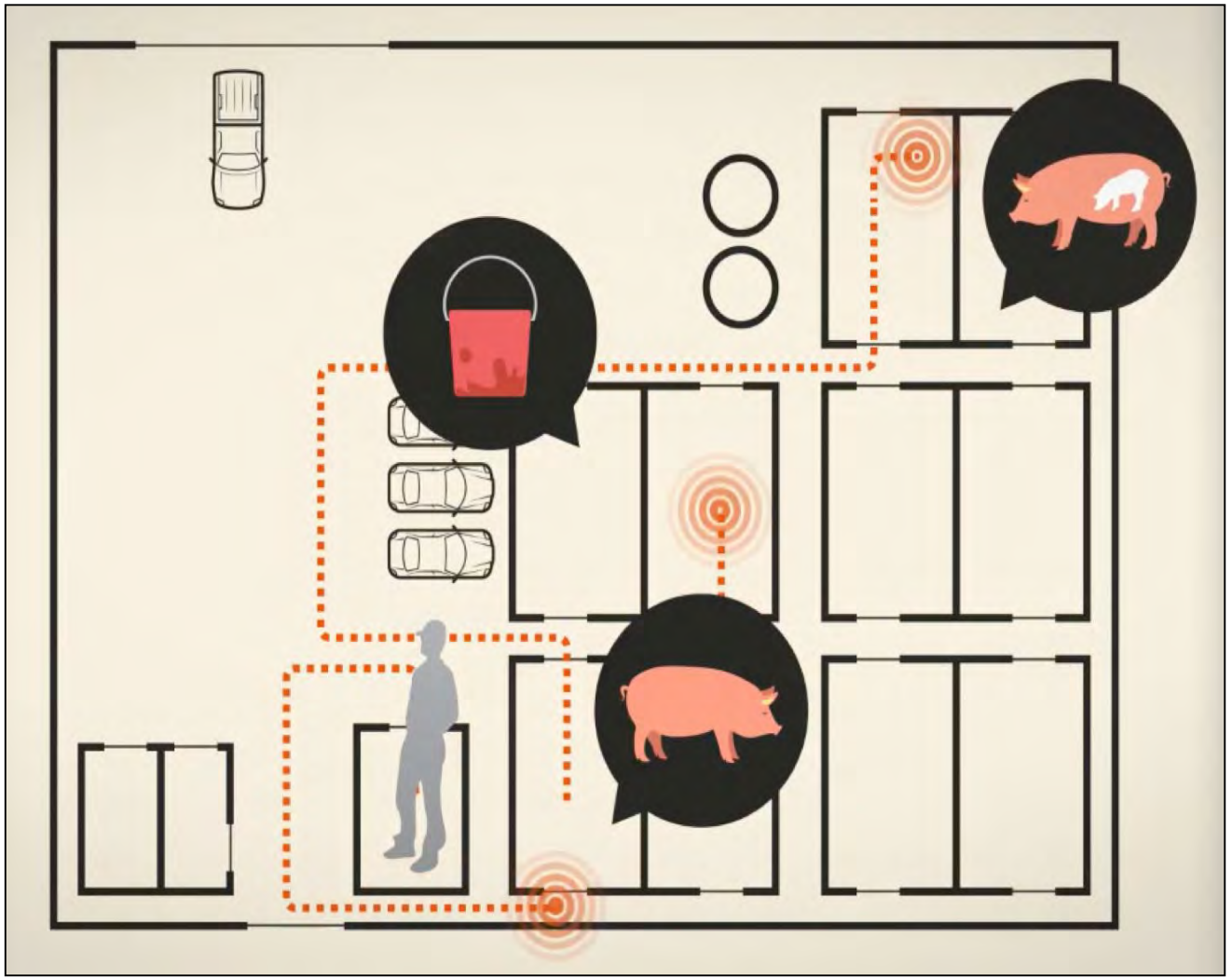
https://blog.lighthouse.io/exploring-new-ways-to-use-beacons-for-people-and-asset-tracking/

iBeacon was developed by Apple & introduced in 2013.

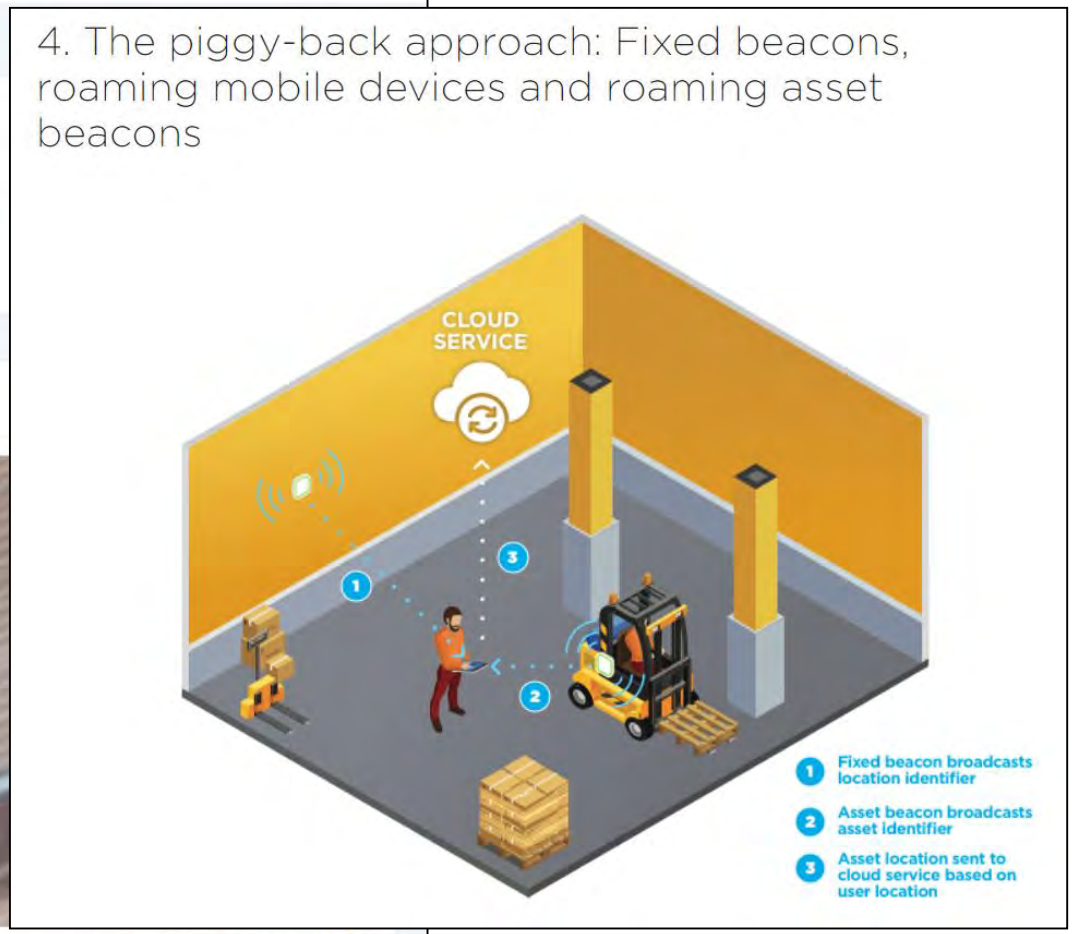


WE ARE ADAPTING BLE BEACONS FOR LIVESTOCK APPLICATIONS…

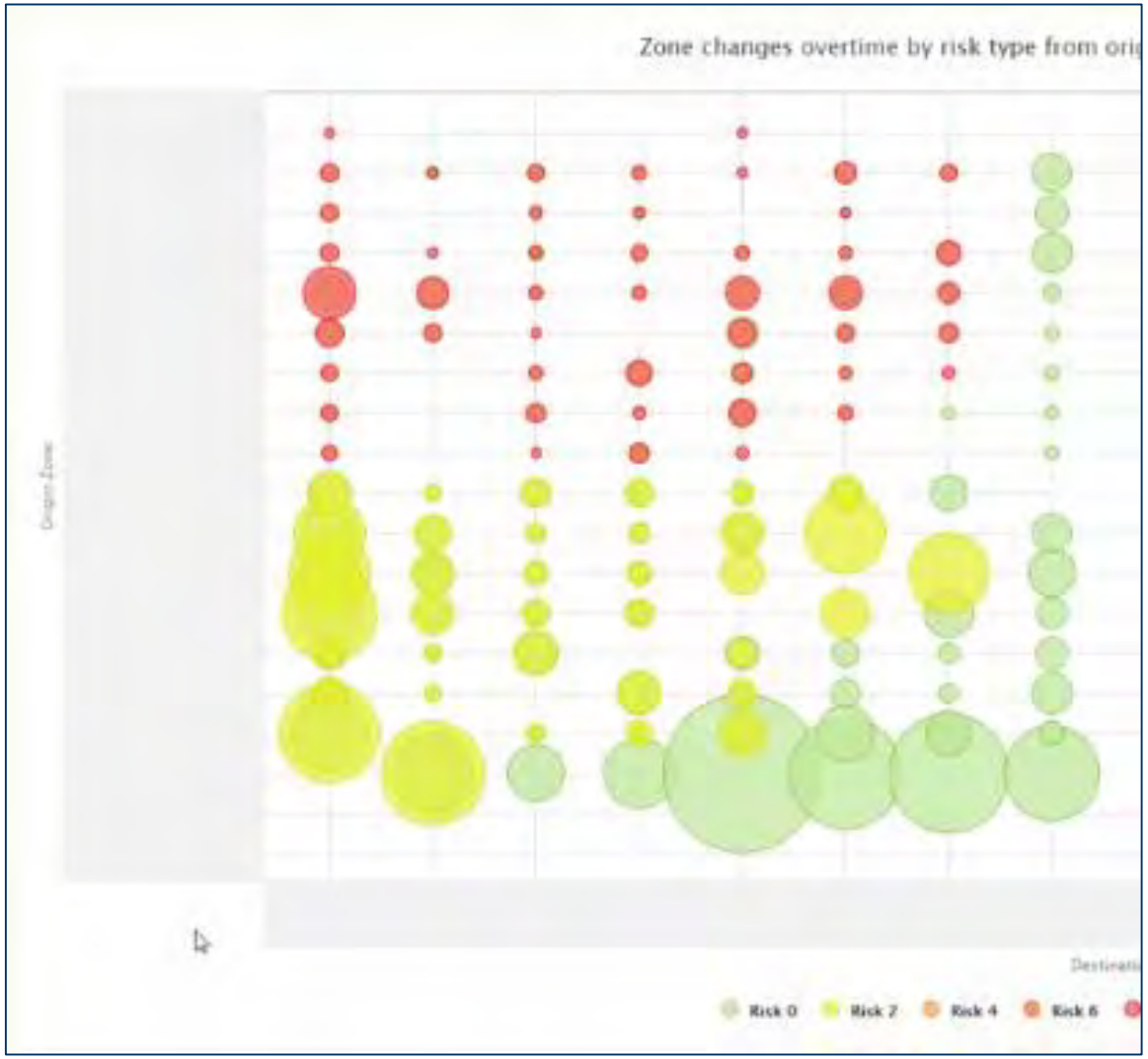
- A **Cyber-Physical System (CPS) > Precision Livestock Farming (PLF)** technology
- Designed to help producers & veterinarians measure & manage farm site **internal risks** & **external risks**

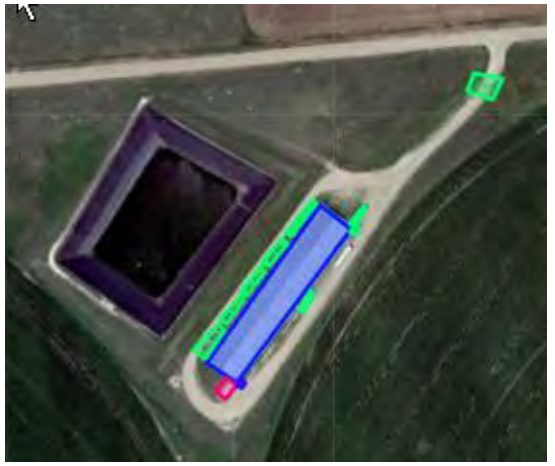


We 1st used BLE Beacons in 2017 to capture personnel & “asset” movement events <u>within</u> pig farms for risk management…



We are now testing BLE Beacons to capture personnel & “asset” movement events within & between farms and other sites…





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IMPLEMENTATION & PRELIMINARY EVALUATION OF A TECHNOLOGY PLATFORM USING BLUETOOTH LOW ENERGY (BLE) BEACONS, SENSORS & A CLOUD-BASED PLATFORM TO MEASURE NEAR-REAL TIME MOVEMENT IN A PIG PRODUCTION NETWORK

9TH EUROPEAN CONFERENCE ON PRECISION LIVESTOCK FARMING
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TECHNOLOGY: RURAL CONNECTIVITY

TECHNOLOGY: RURAL CONNECTIVITY

"5G" is not the answer *(for now...)*

TECHNOLOGY: **CONNECTIVITY**

Unlicensed…

sigfox

LoRa®

Licensed…

NB-IoT

LTE™

TECHNOLOGY: **CONNECTIVITY**

NB-IoT

LoRa

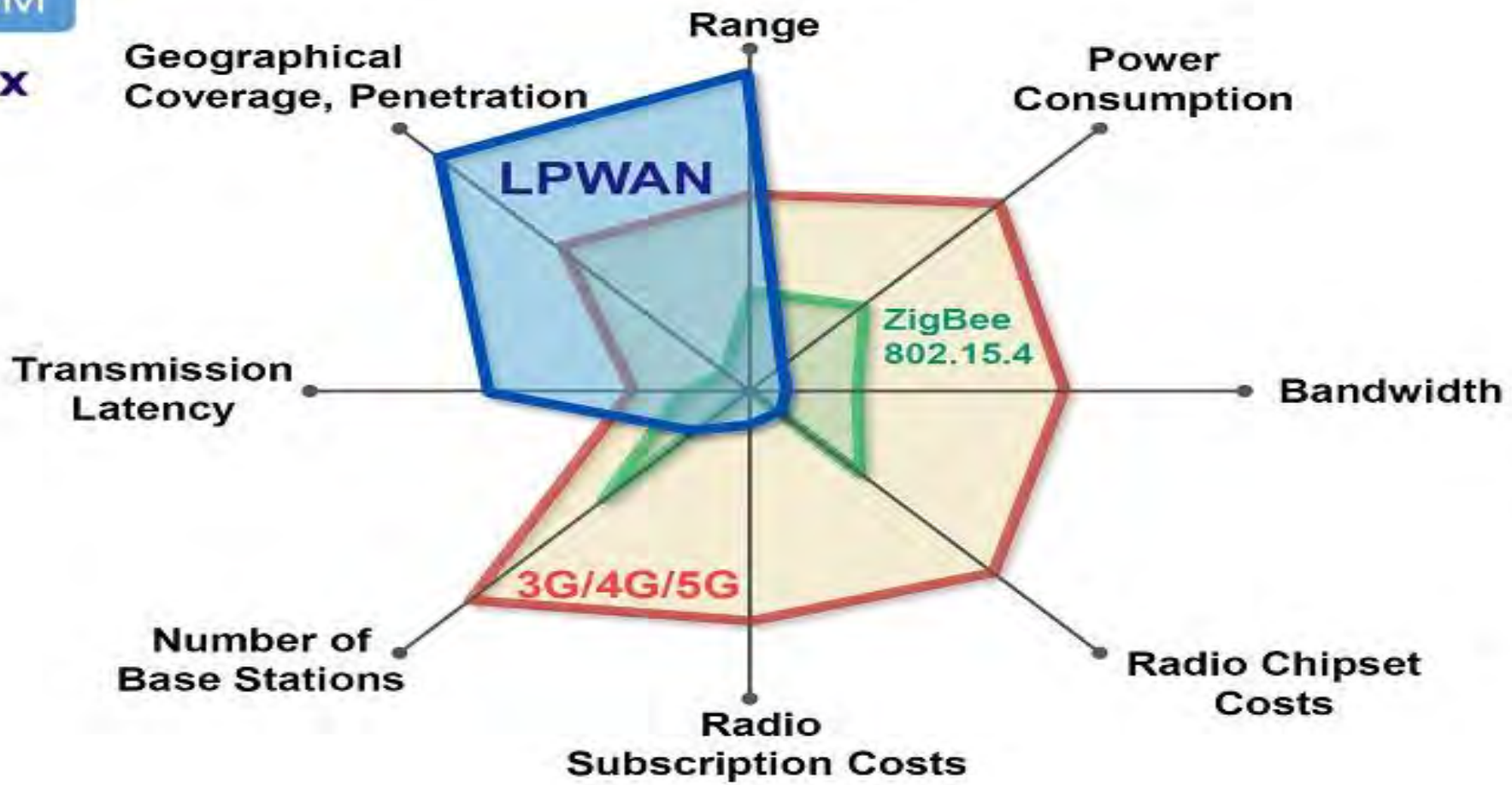
LTE-M

sigfox

INGENU

WEIGHTLESS

waviot

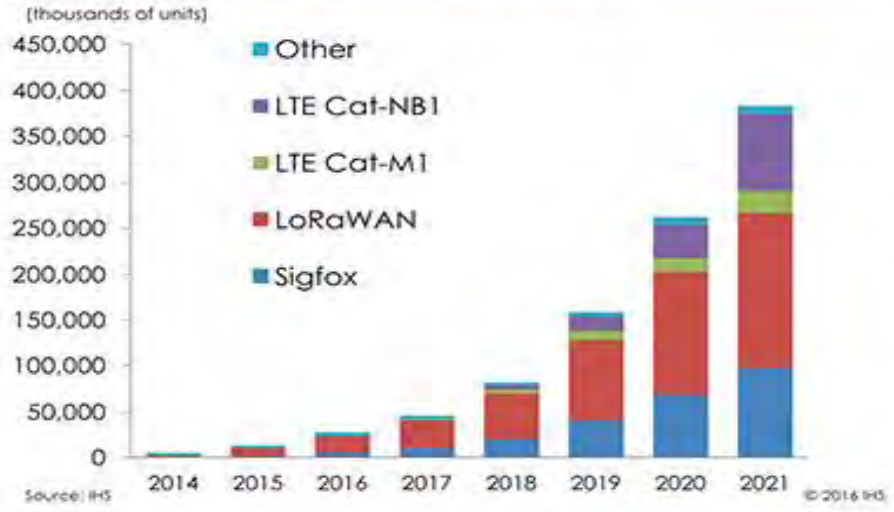


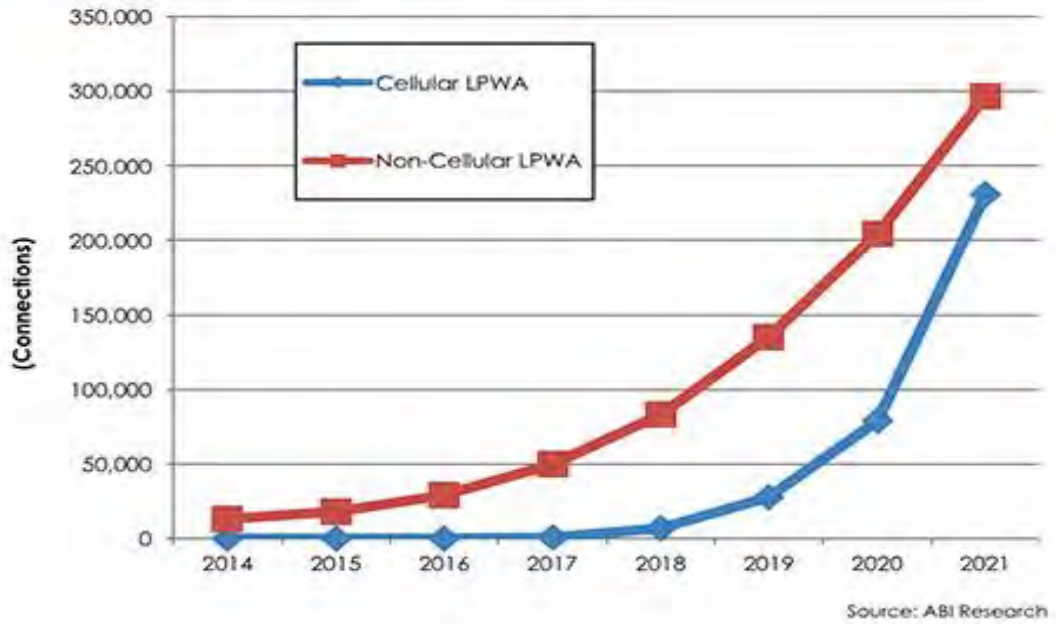
TECHNOLOGY: **CONNECTIVITY**

MULTITECH

Wireless LPWA Growth Trends

LPWA module annual unit shipment forecast, by technology, global market, 2014 - 2021



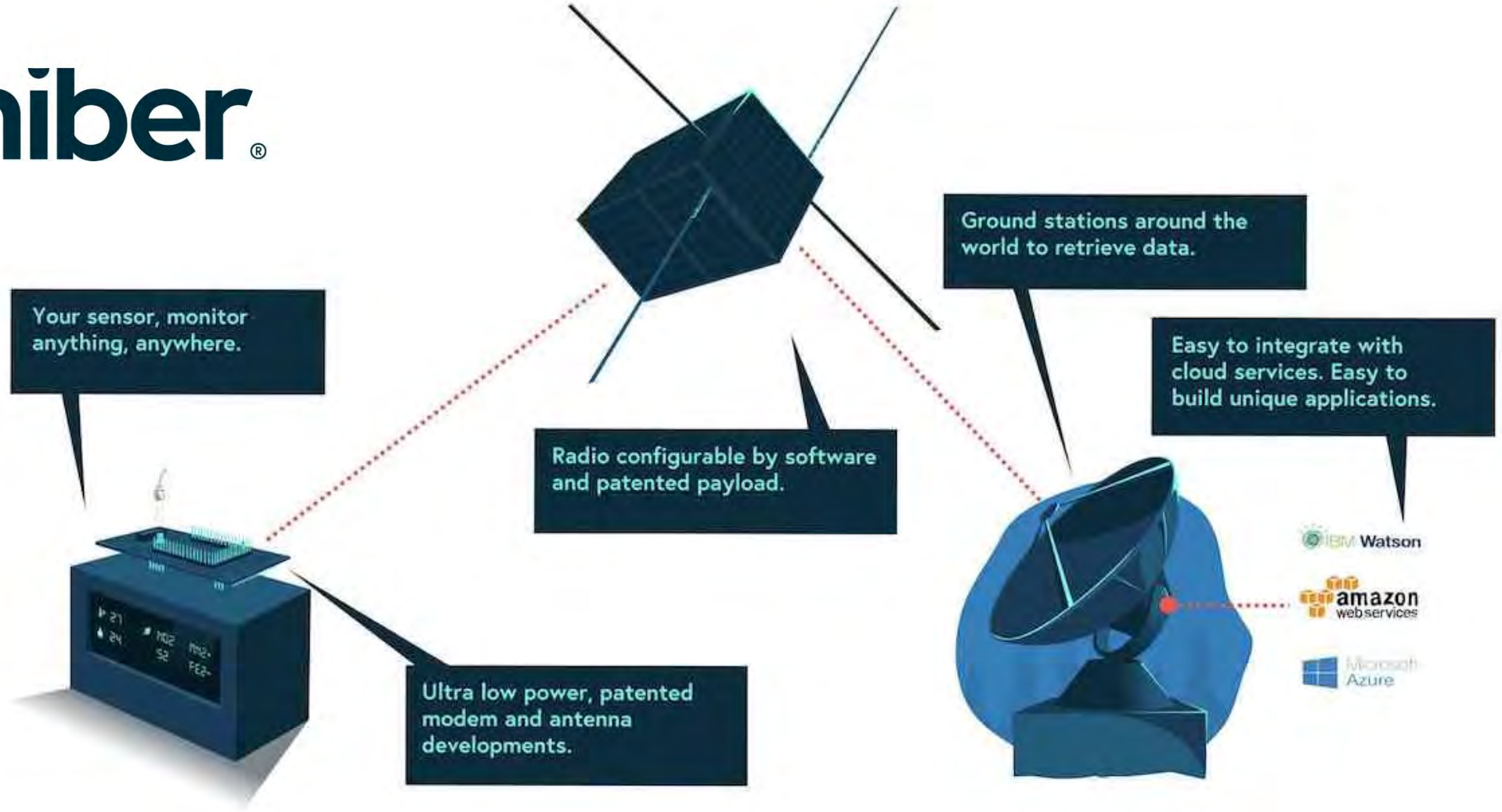


- Cellular ecosystem moves quickly on 3GPP LPWA – Asset Management
- LoRa estimated at over 100M units per year 2020s – Constrained Devices & Sensors

TECHNOLOGY: **CONNECTIVITY**

TECHNOLOGY: **CONNECTIVITY**

hiber®



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PLF: THE NECESSARY STRUCTURE…

"Fools ignore complexity. Pragmatists suffer it. Some can avoid it. Geniuses remove it."

Alan Perlis

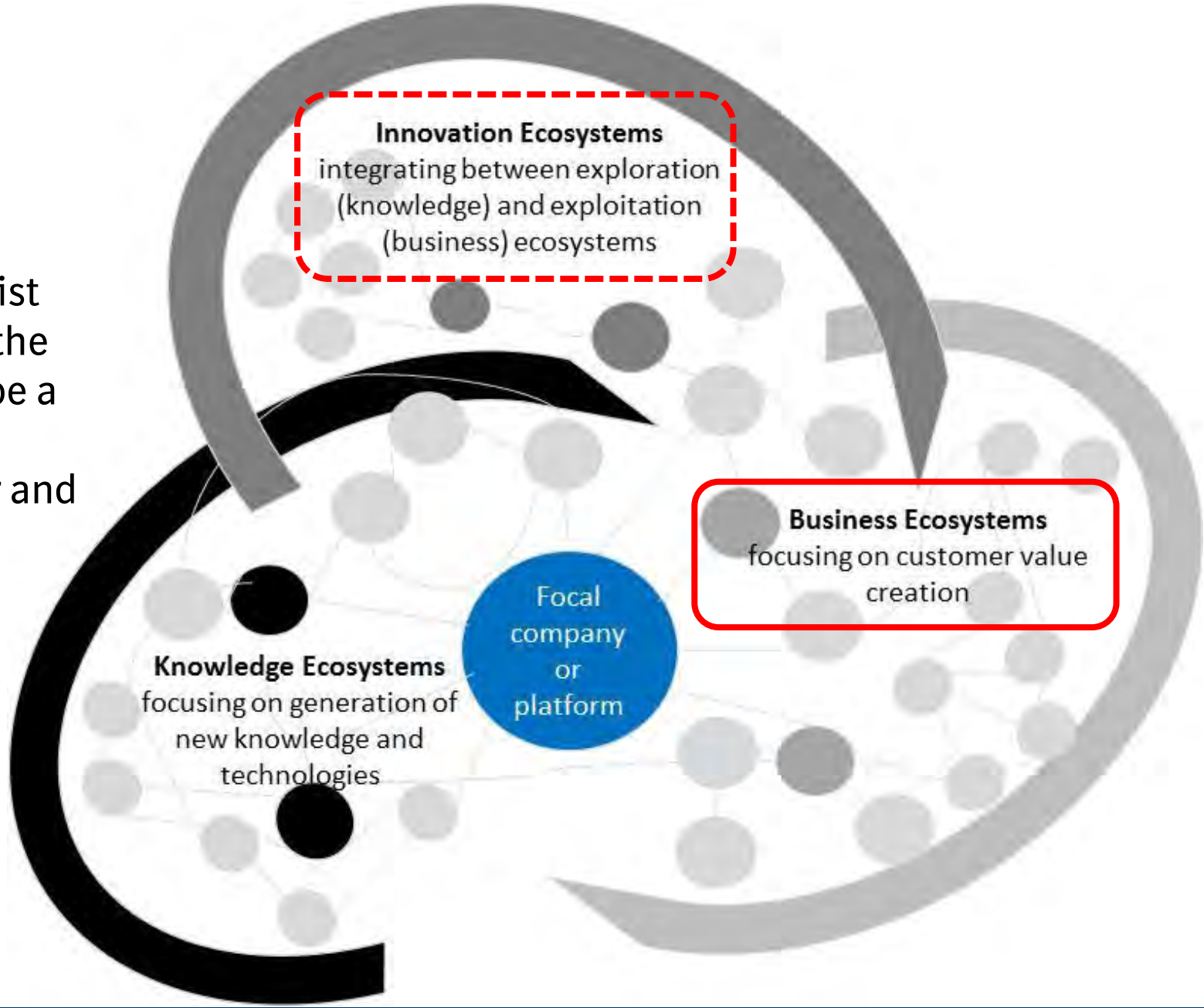
American Mathematician & Computer Scientist, 1922-1990

BUSINESS ECOSYSTEM…

In the **1930s**, British botanist **Arthur Tansley** introduced the term ***'ecosystem'*** to describe a community of organisms interacting with each other and their environments…

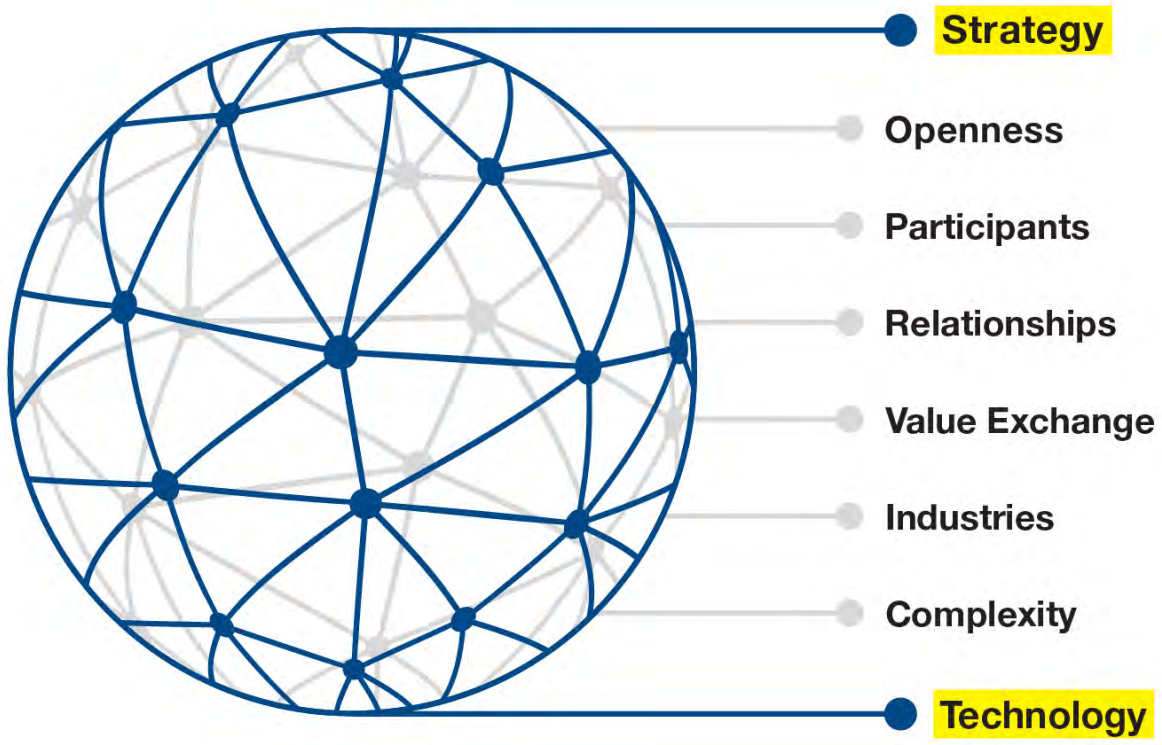
Business strategist **James F. Moore** adopted this biological concept in his **1993** Harvard Business Review article "***Predators and Prey: A New Ecology of Competition***"…

https://www.investopedia.com/terms/b/business-ecosystem.asp



BUSINESS ECOSYSTEMS…

Eight Dimensions of Business Ecosystems

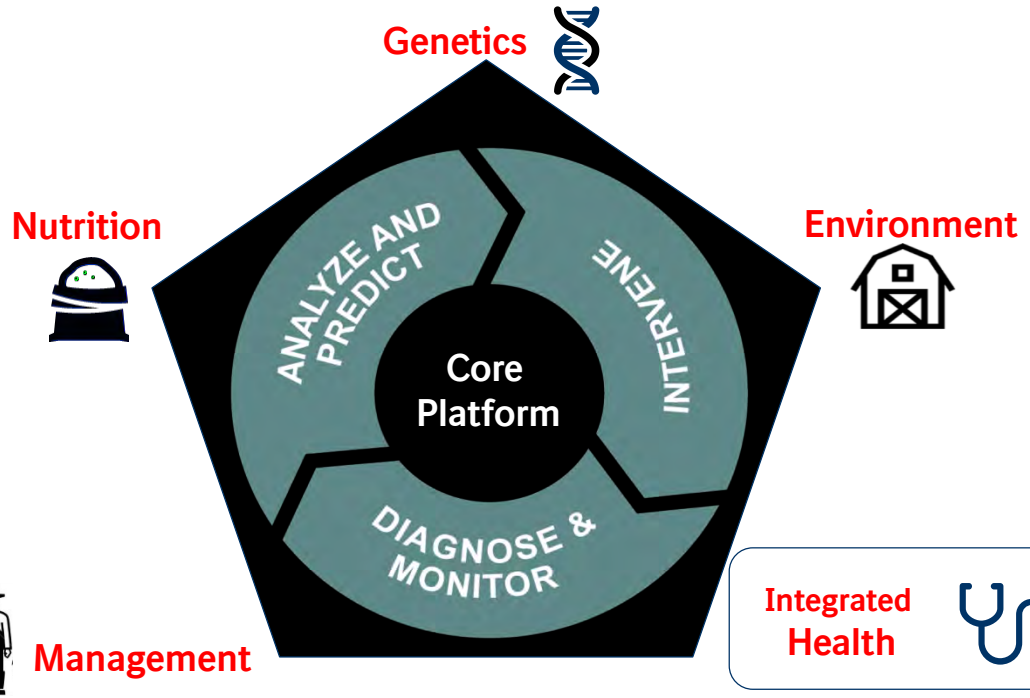


Ecosystem:

An ***adaptive*** network of ***interdependent*** entities that grows by developing and ***maintaining innovative*** solutions and technologies through ***collaboration*** and ***coordination***…

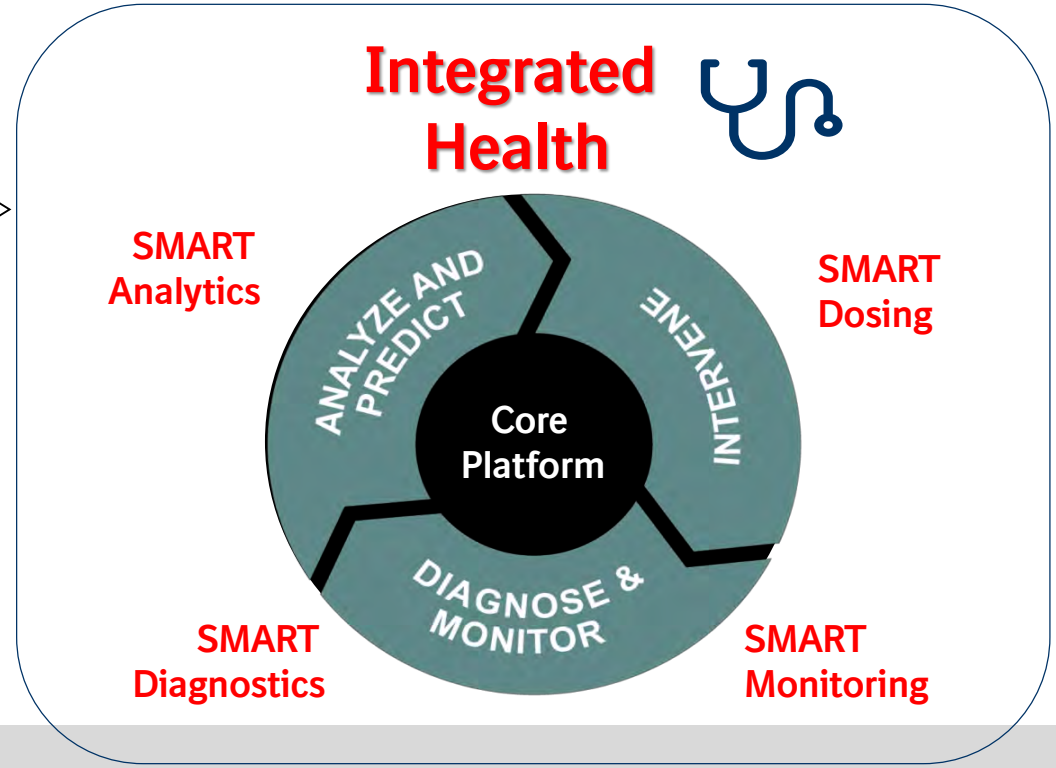
https://www.accenture.com/_acnmedia/PDF-3/Accenture-Business-Ecosystem-vs-Business-Ecosystem.pdf

PRECISION LIVESTOCK FARMING ECOSYSTEM…

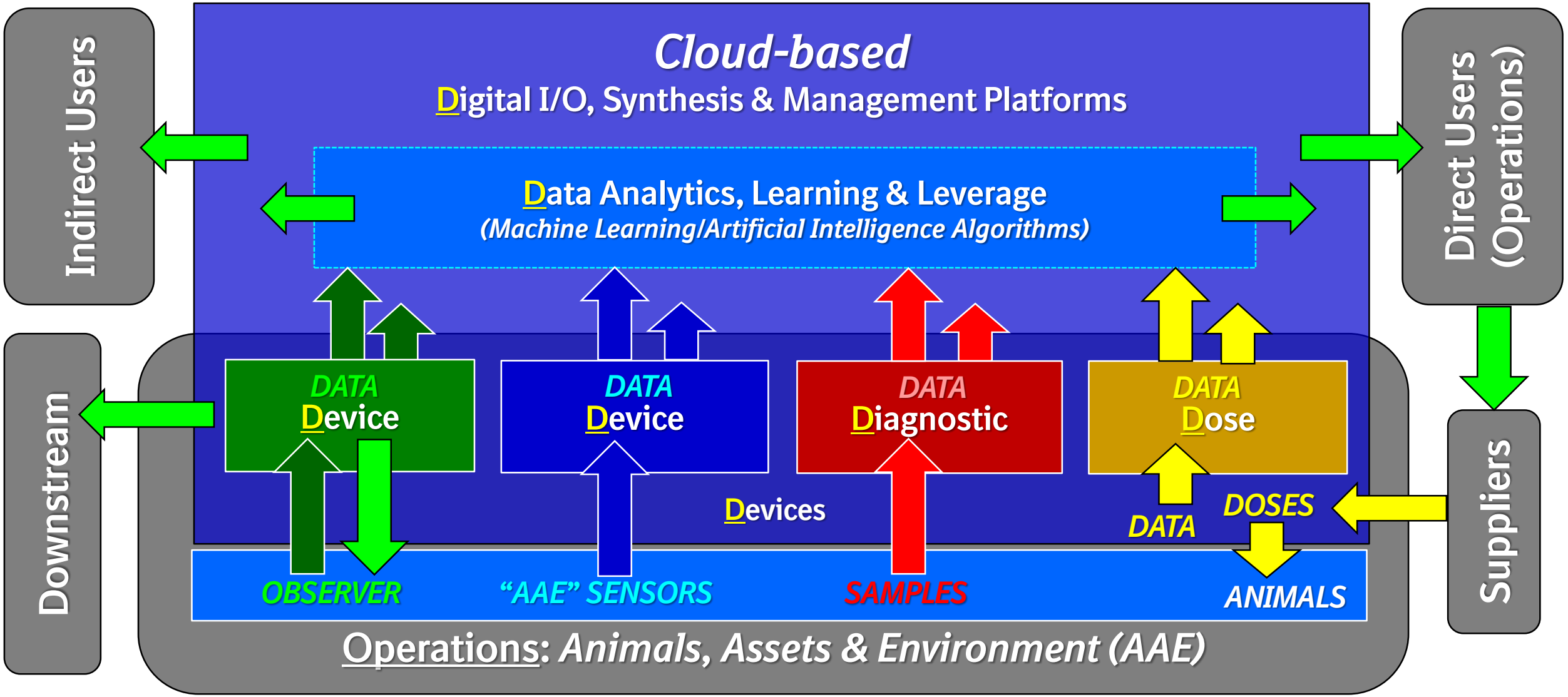


A **Business Ecosystem** is the **network of organizations** (*suppliers, distributors, customers, competitors, government agencies,* …) involved in the **delivery of products and/or services** through **both competition and cooperation**.

A **PLF Ecosystem** is the **network of organizations** (*suppliers, distributors, customers, competitors, government agencies,* …) involved in the **delivery of products and/or services** through **both competition and cooperation**.



PRECISION LIVESTOCK FARMING (PLF): ECOSYSTEM MODELS



PLF: THE NECESSARY STRUCTURE…

Design Specifications:

- End-to-end automation
- Integration of best-in-class tools & methods
- Real-time, decision-ready information
- Continuous & dynamic learning
- Pre-defined “best-practice” contingencies

PLF: THE NECESSARY STRUCTURE…

Design requirements:

- Definitions
- Standards
- Access
- Security

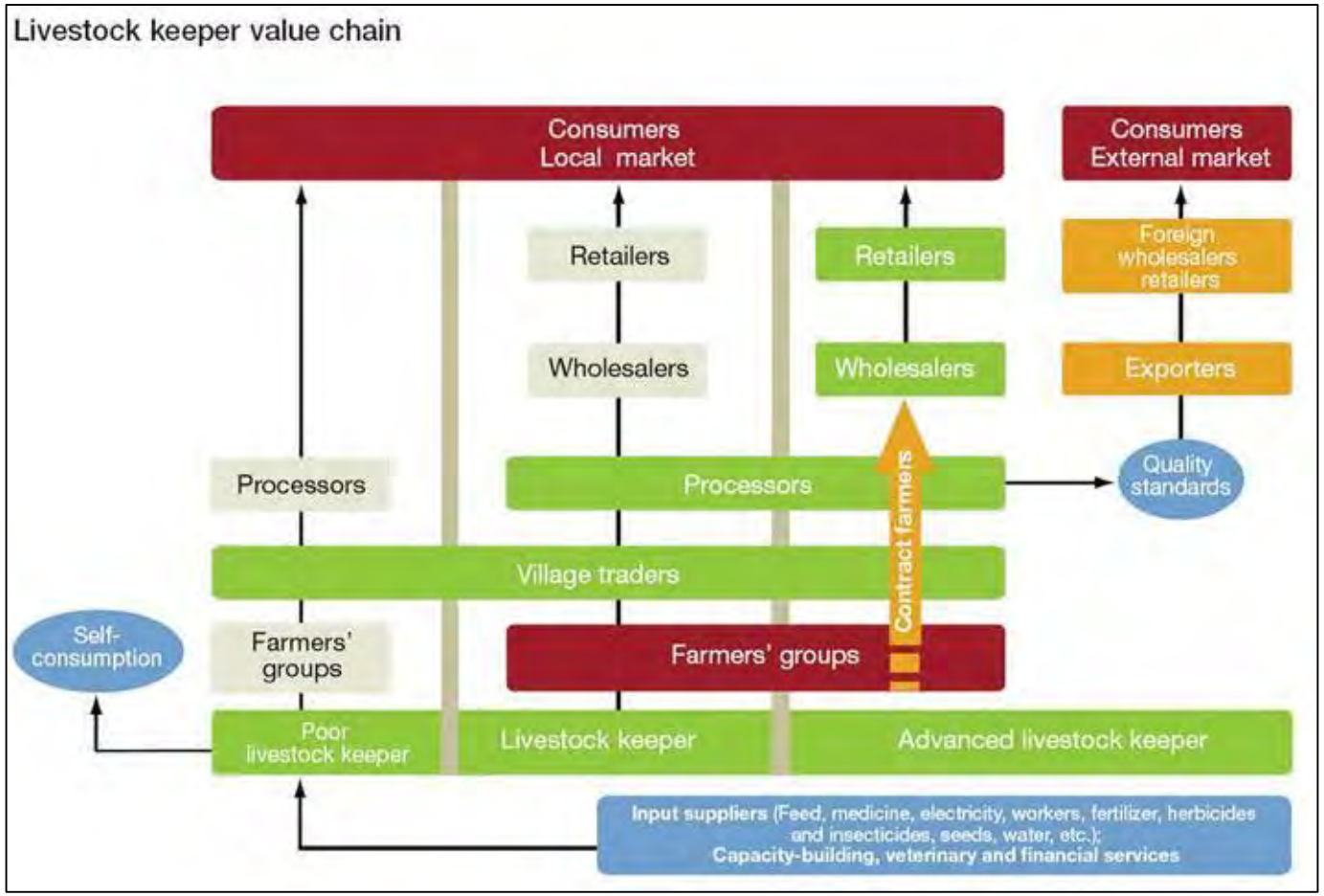
PLF: SUSTAINABILITY…

- Relatively ***inexpensive*** to implement & operate
- ***Simple*** & ***easy*** to use perpetually
- Deliver ***ongoing value*** to all participants

PLF: SUSTAINABILITY…

[3] delivers ongoing value for participants (via a ‘value chain’)

- Consumers
- Harvest & post-harvest
- Producers
- Veterinarians
- Testing laboratories
- Industry organizations
- Allied industry



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PLF: THE NECESSARY CULTURE…

Lud·dite

/ˈlədˌīt/

noun

plural noun: **Luddites**

1. DEROGATORY
   a person opposed to new technology or ways of working.
   "a small-minded Luddite resisting progress"

PLF: THE NECESSARY CULTURE…

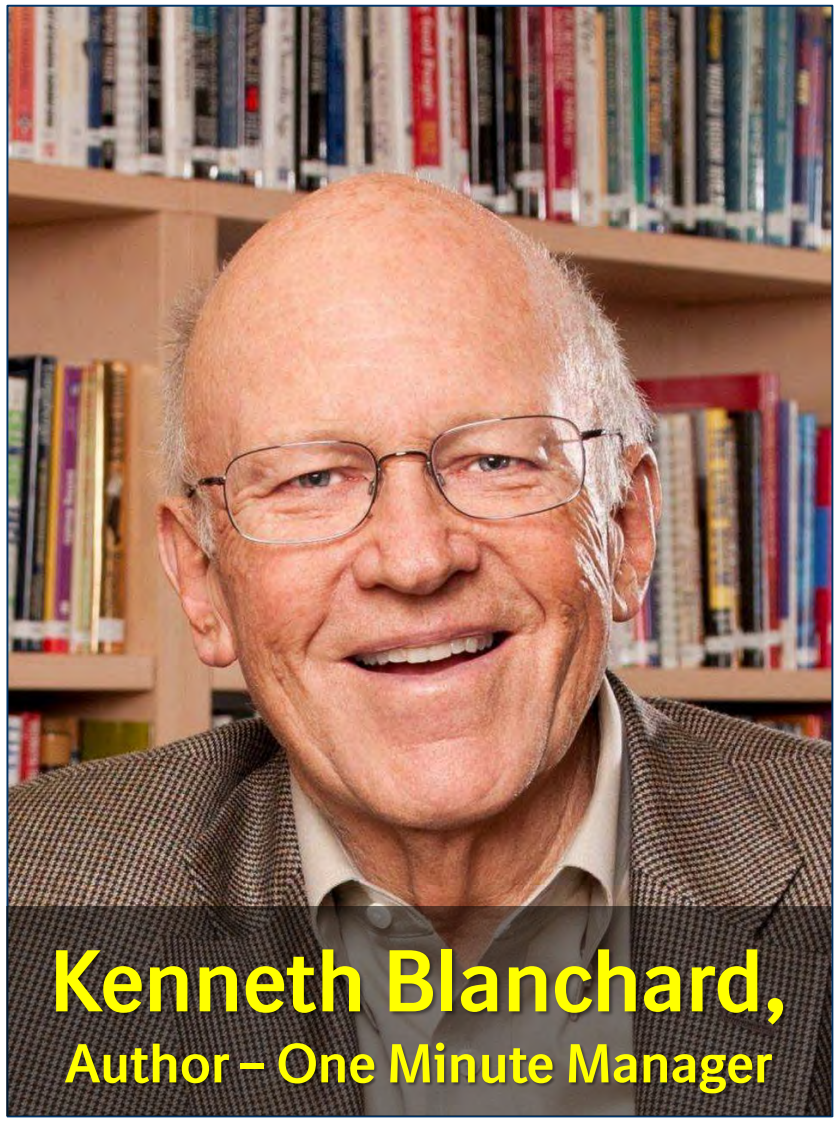
CURRENT MODEL:

- ***Primary*** R&D and hypothesis testing are done elsewhere / **off-line**
- Resulting products & services or learnings are delivered "fully-baked" and ready to apply

NEW MODEL:

- Primary R&D, Proof-of-Concept & Piloting iterations are done **on-line**
- **Producers actively participate in the development & testing process**

PLF: THE NECESSARY CULTURE…



PLF: THE NECESSARY CULTURE…

ACDC = **A**rea **C**oordinated **D**isease **C**ontrol

NCDC = **N**etwork **C**oordinated **D**isease **C**ontrol

ACDC / NCDC is…

*…producers & veterinarians **working together** with their neighbors and business partners so that **together** they **achieve greater sustained improvement** in health and productivity in their neighborhood than any one can achieve on their own.*

PLF ECOSYSTEMS: OUR OUTLINE…

- *Context*
- *Need*
- *Technology*
- *Structure & Process*
- *Culture*
- ***Action***

PLF: ONGOING ACTION…

"Don't have good ideas if you aren't willing to be responsible for them."

Alan Perlis

http://www.cs.yale.edu/homes/perlis-alan/quotes.html

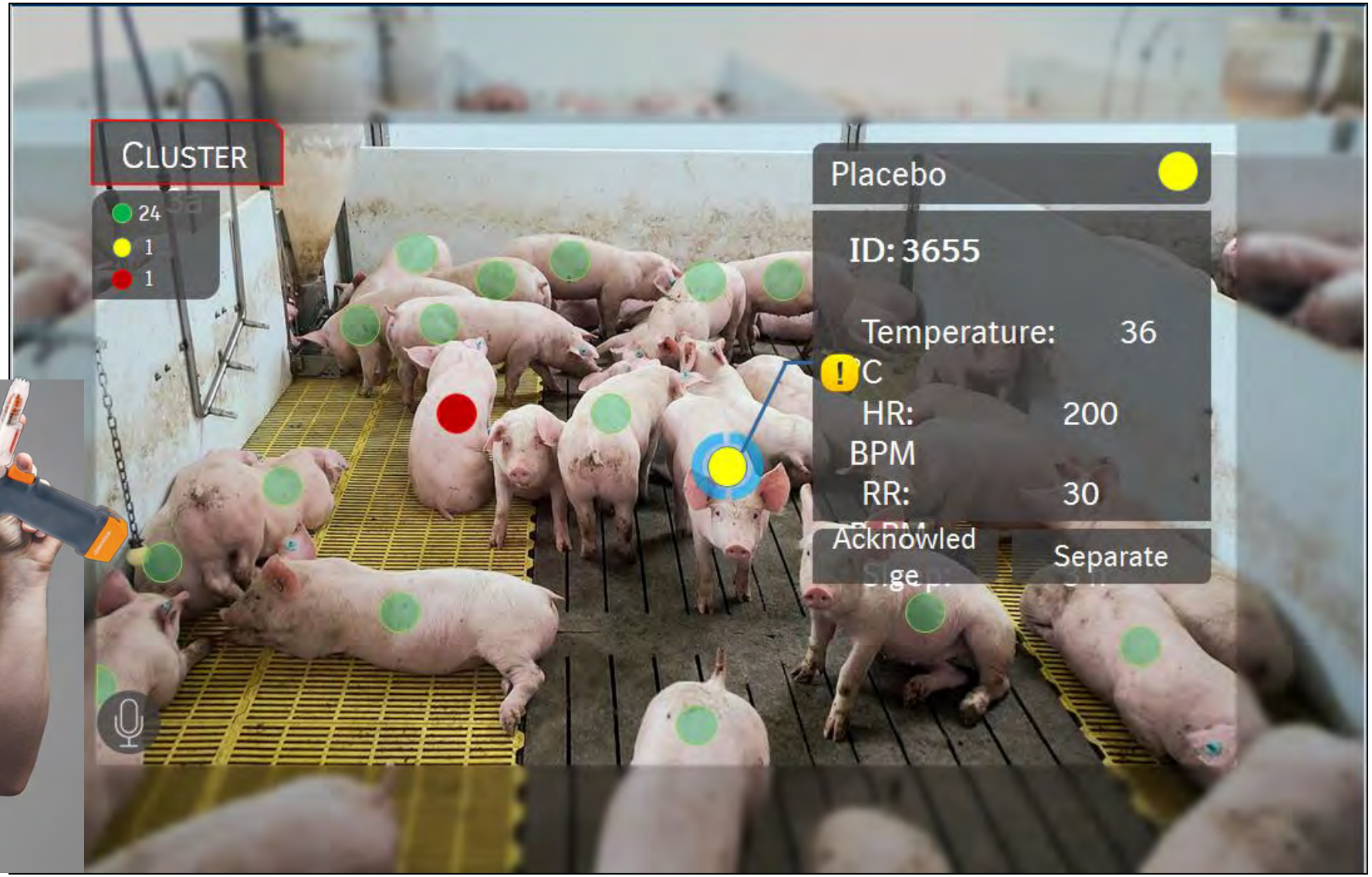
PLF: ONGOING ACTION…

- PLF technologies hold the potential to revolutionize livestock production, welfare and health.
- ***But for that potential to be realized, both the current structural and behavioral/cultural constraints need to be resolved.***

PLF: ONGOING ACTION…

- Producers
- Veterinarians
- Allied Industry
- Organizations
- Researchers
- Agencies

PLF ECOSYSTEMS: *TO CONCLUDE…*

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A Synthesis of Technology, Process and Culture
50 International Animal Health Journal
Volume 6 Issue 3

THANK YOU!

"A year spent in artificial intelligence is enough to make one believe in God..."

Alan Perlis