Session 6: Avnet Lighting Accelerated

How To Design a Connected Lighting System

Session overview

Understand how to leverage IoT platforms and methodologies, to effectively manage and monitor a holistic horticulture environment. Utilizing lighting systems , sensors, and HVAC, growers can provision and control key systems, while providing persona specific information via KPIs to all involved stakeholders, both internal and external to the environment.

- Providing "screens" based on persona(s) for asset availability and control energy consumption and additional sensor systems (soil, moisture, etc.)
- The concept of systems integration (systems of systems)
- Building actionable solutions based on human, environmental and/or security conditions
- Utilize a single cloud-based platform for monitoring and control of lighting systems.

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Agenda

- The Market

- Lighting

- Automation

- The Art of the Possible

- Demo

- Getting Started

- Q&A

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Understanding the Market

Types of growers & their drivers

Horticulture Business Types

Commercial Greenhouse

- High Wire Crops
- Lettuce and Herbs
- Flowers and potted plants
- Pharmaceutical

Vertical Farming

Indoor Growers

Hydroponics

Urban Farming

Universities and Research Facilities

- Lighting Science
- Horticulture Science

Controlled Environment Agriculture (CEA)

- Aeroponics, hydroponics, aquaponics, aquaculture, etc.

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Horticulture Business Drivers

❖ **Higher and Faster Yields**

❖ **Operational Efficiencies**

❖ **Cost containment**

❖ **Analysis of data on lighting techniques vs. crop yield, crop quality, grow time, etc.**

❖ **Streamlining propagation**

❖ **Control Morphology**

Lighting in Horticulture

Light that matters

PAR: is the Photosynthetic Active Radiation. The wavelengths that make up the PAR are between 400 and 700nm used for photosynthesis.

PPF: The PPF is the photosynthetic photon flux. It is a direct analogy to Lumen. How many photons in the PAR band does my lighting deliver?

PPFD: PPFD is the flux density of photosynthetic photons. How many PAR photons on a surface? Measured in micromoles

Radiometric Efficiency – How many PAR photons are delivered per Watt consumed?

Lighting in Horticulture
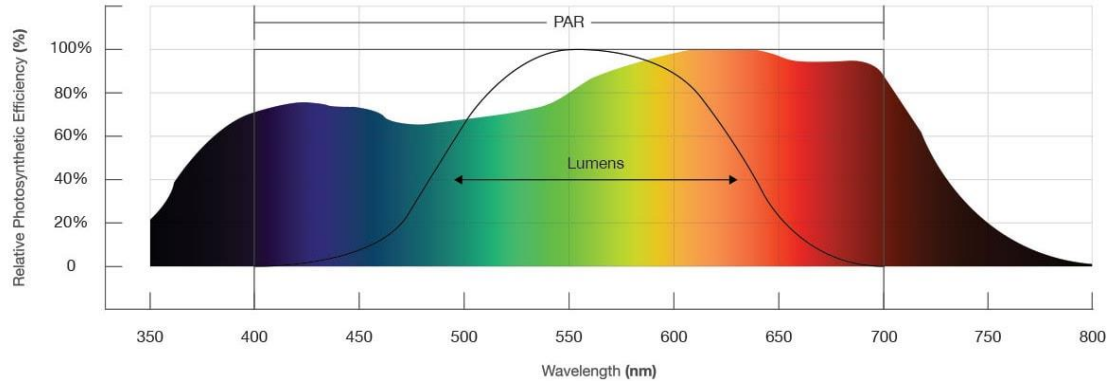
Light	Wavelength	Effects on plant
Blue	400-499nm	Inhibits stem elongation Influences chlorophyll synthesis Assists in regulatory functions
Green	500-599nm	Assists in regulatory functions Penetrates a canopy better than other wavebands of light being photosynthesized at higher rates lower in the leaf structure Needed for visual assessment of plant growth
Red	600-700nm	Encourages stem growth Influences the flowering and fruit production process Influences seed germination Influences chlorophyll process
Far Red	701-750nm	Inhibits branching Promotes stem elongation Effect on photosynthetic control

Sources: Fluence and ams

Automating the Greenhouse

... Think IoT

Lighting OEMs and Where They're Headed

- *Solutions are varied and in early stages of automation*

- *Major OEMs are building out IoT solutions*

- *Integration is key – OEMs, Suppliers, Independent Design Houses (IDH), System Integrators (SIs)*

- *Retrofitting will be important*

- *Collaborations are integral to success*

Collaboration with OEM's: Example

MULTIGROW

MultiGrow is an all-in-one, multiple grow area controller. It runs up to 8 different growing zones, managing climates, reservoirs and irrigation schedules.
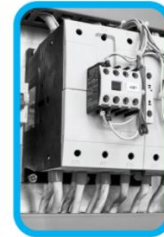
INTELLICLIMATE

IntelliClimate automatically manages all aspects of grow room climate control from temperature to CO2, lighting to humidity, all in one simple controller.

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Automation in Horticulture: Example

Can potentially replace

Partnerships are key…

- On Semiconductor

- Advantech

- Digi

- CartesiumAI:
  https://data.cartesiam.ai/dataset/6037752e5d7dc7d3f3914df3?nr=1

- Canonical – Ubuntu Core

- Nordic

- Microsoft

Controllable Lighting Solution - Example
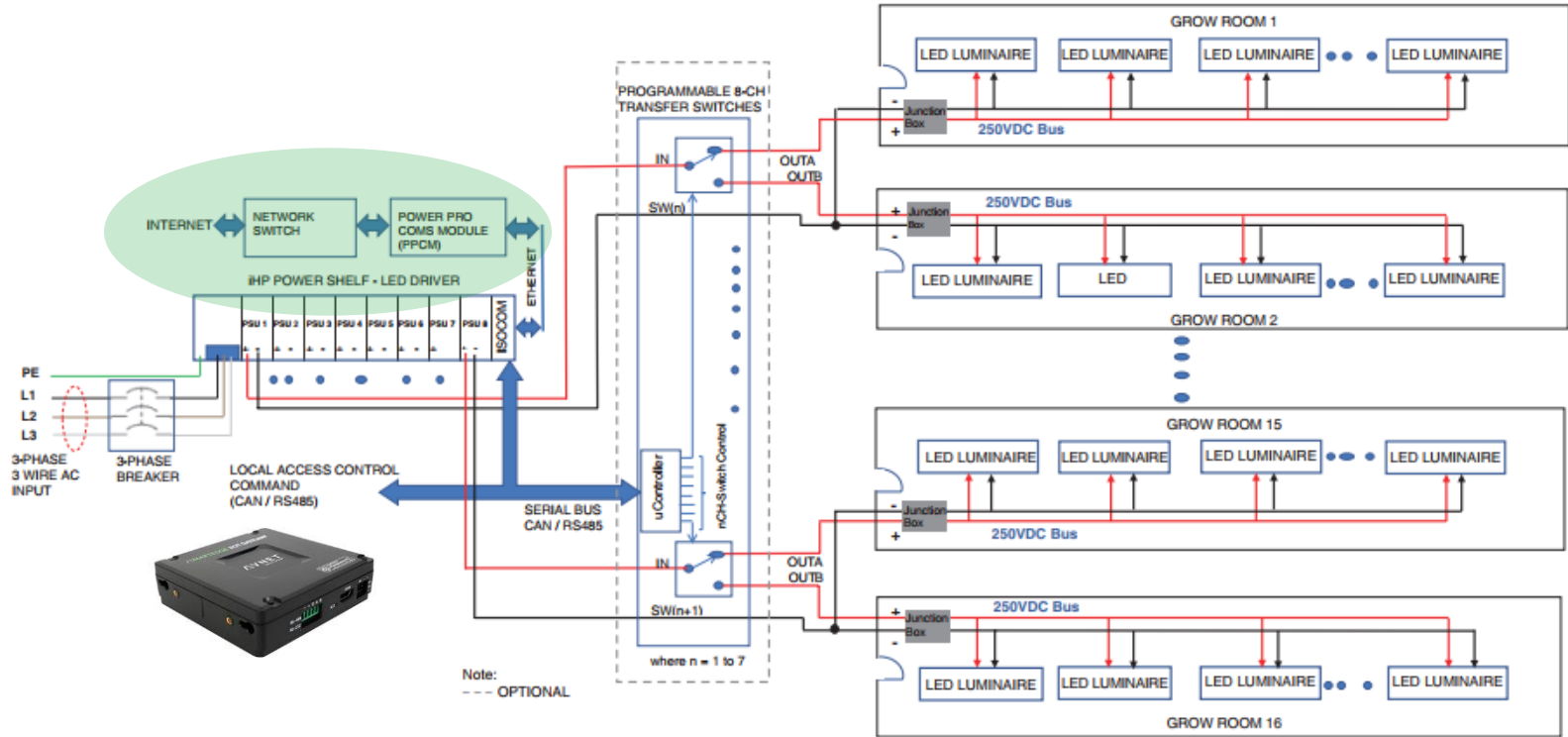
Architecture of iHP Remote Power System for Horticulture LED Lighting

Create a System of Systems
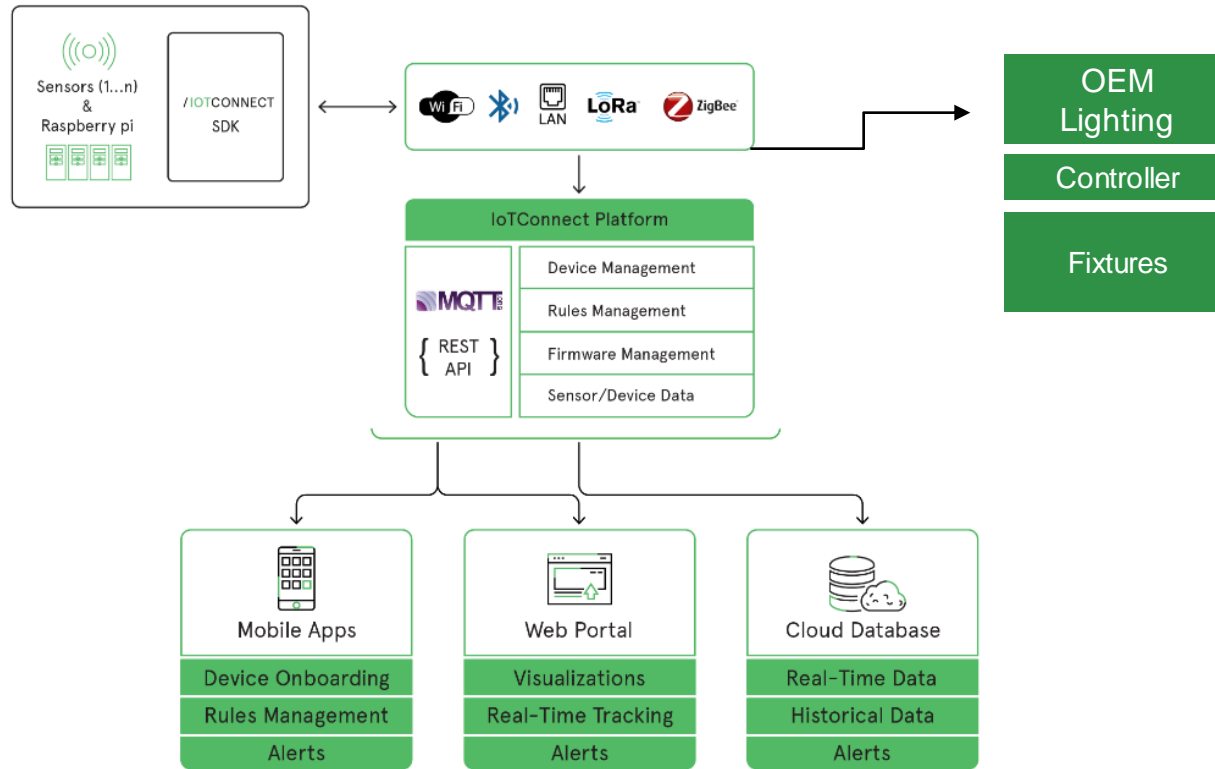
The Art of the Possible

Why consider IoT for a Holistic Solution?

IoT enablement of holistic solutions for growers

Connect different ecosystems = System of Systems concept

- Facility management systems
- Sensors
- Lighting controllers / actuators
- HVACD - heating, ventilation, air conditioning and dehumidification
- Analytics via data aggregation, providing depth analysis of historical light information, correlated with other sensor data

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Sensors used in Horticulture

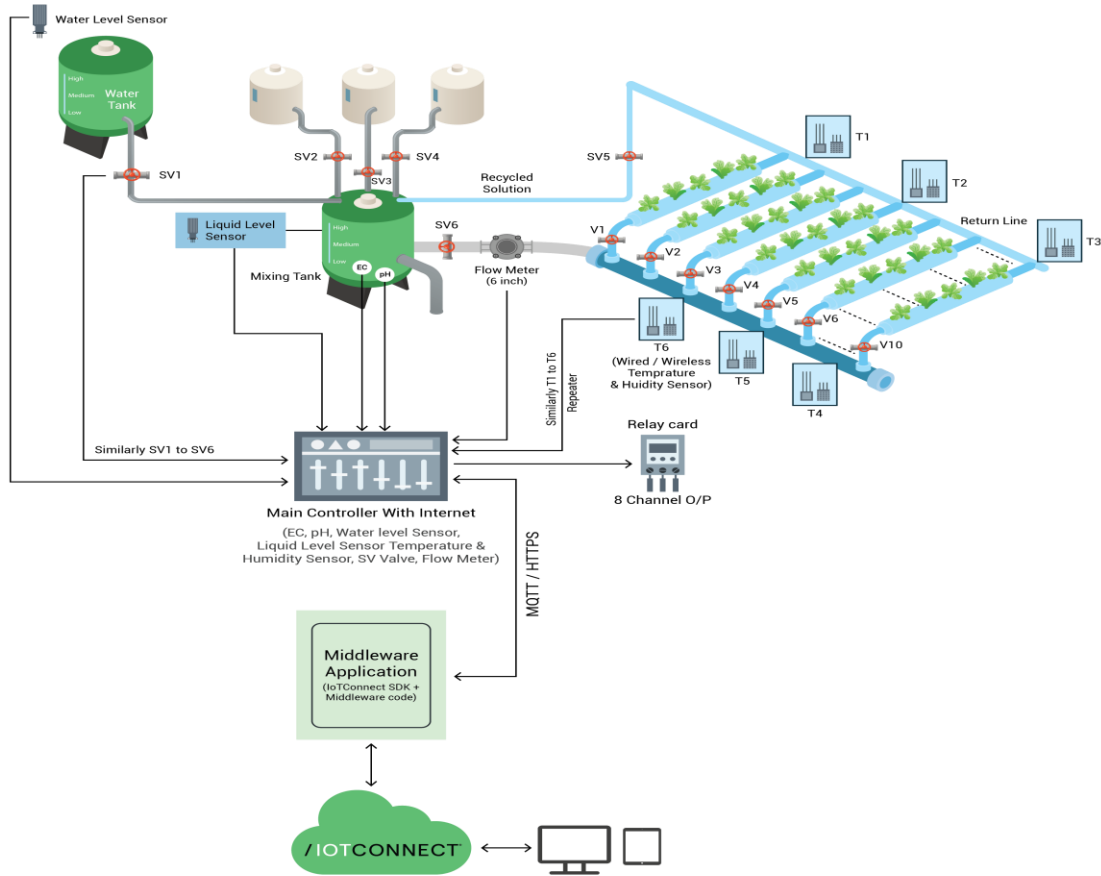|	Alps	Amphenol Telair	AVX	Bourns	Branium	Broadcom	Cirrus Logic	Diodes	Everlight	Infineon	InvenSense (TDK)	ISSI	Kemet	LiteOn	Maxim	microchip	MPS	Murata	NXP	OMRON	OnSemi/Fairchild	OSRAM	Panasonic	PUI Audio	Reseses/IDT	Rohm	Semtech	ST Micro	TDK	TE	TE	Toshiba	Vishay
Air Quality/VOC		C																		C					C					C			
Ozone																									C								
Oxygen		M																												C			
Barometric										C																							
CO2		M								M															C					C			
Dust		M																		C			C										
Environmental (multi)																					M												
Turbidity		M																C															
Humidity	C	M		C	M															C					C				C	C	M		
Moisture		M																															
PH																																	
Temperature		M	C	C	M			C					C		C	C		C	C	C	C		CM			C		C	C	C	M		C
Water level		M																				C								C			
Pressure	C	M	M	C	M					C	C									C			C		C			C	C	C	M		

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Integration Example - Hydroponics

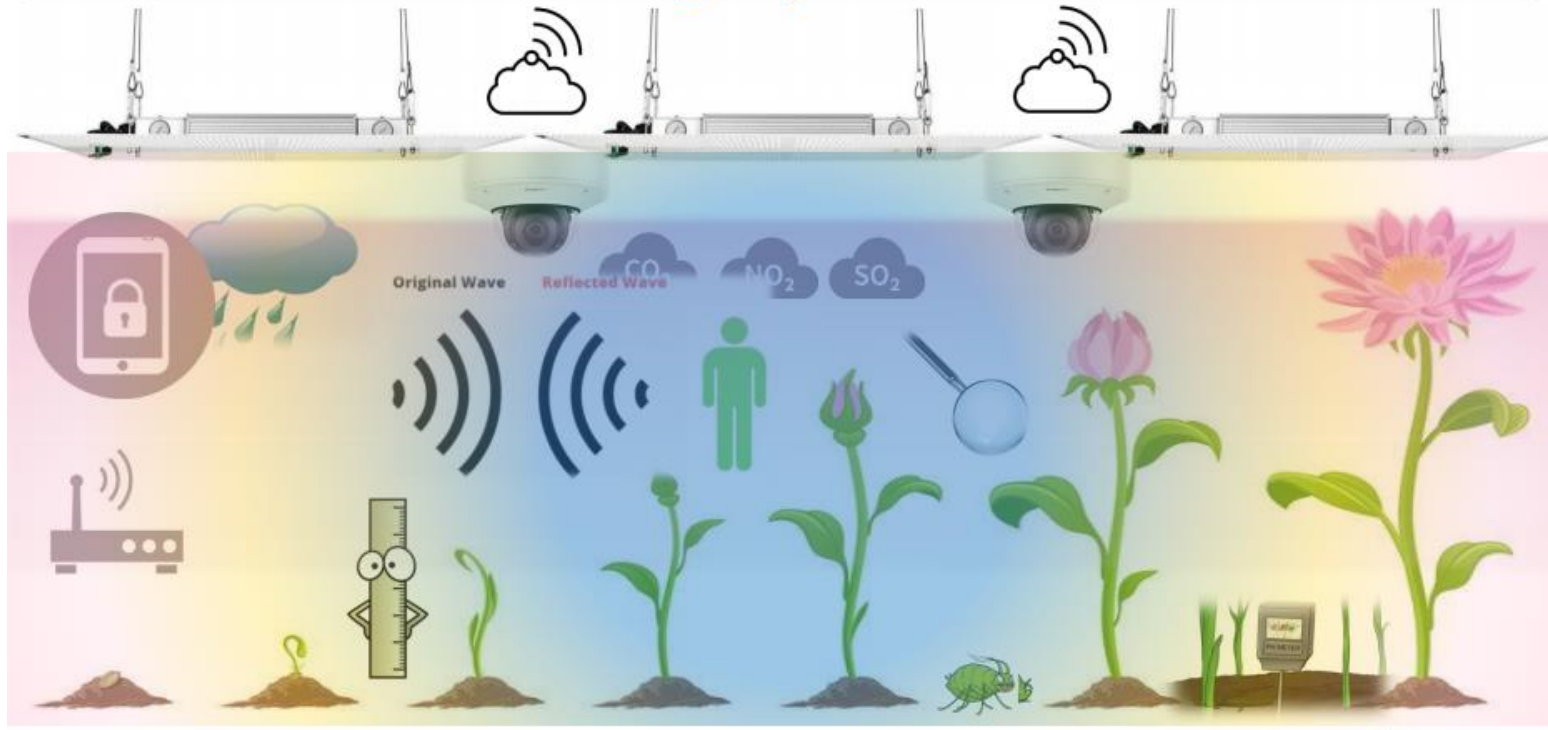# AI in Agriculture: The Future of Sustainable Farming

With the help of Smart sensors/IoT infrastructure, growers can collect an entirely new set of granular factors, including:

- Spectra of light
- Photoperiod (day/night cycles)
- Light Intensity
- Irrigation schedules
- Nutrients
- Airflow
- Temperature
- Humidity
- CO_2
- Others

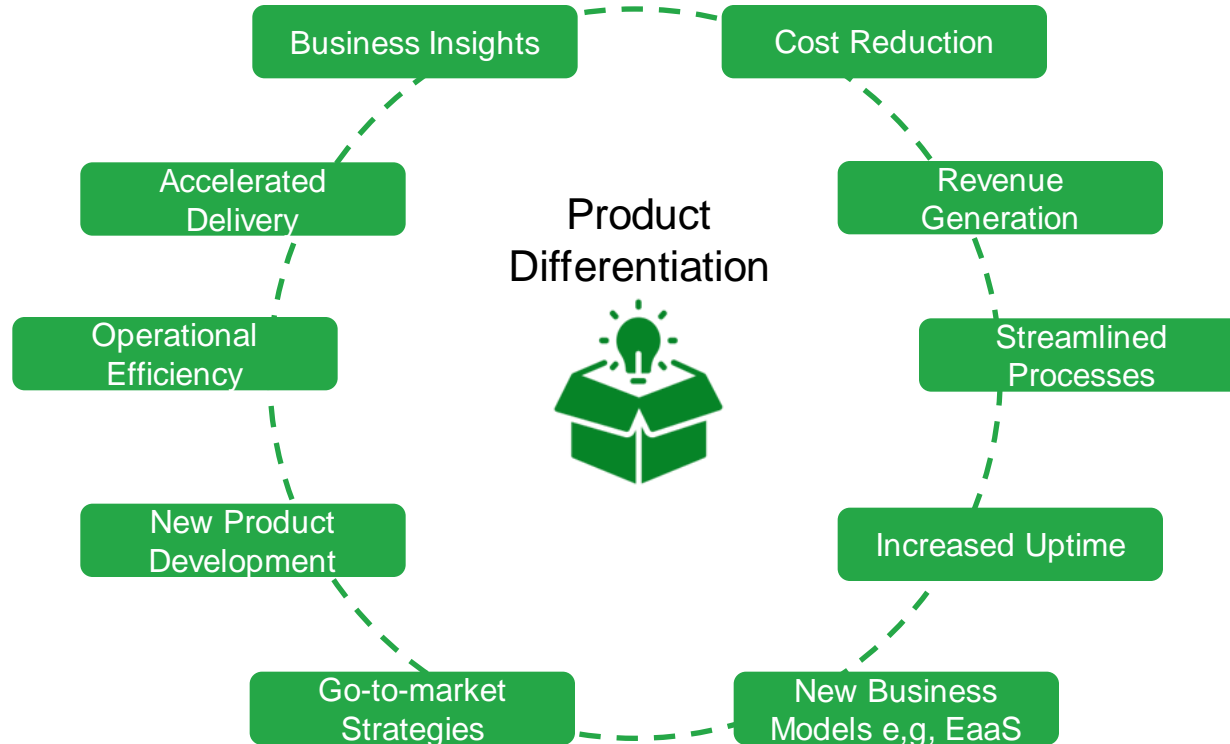# AI in Agriculture: Example

The Future of LED Horticulture Lighting - AI

Product differentiation options made possible by IoT

Business Insights

Cost Reduction

Accelerated Delivery

Revenue Generation

Product Differentiation

Operational Efficiency

Streamlined Processes

New Product Development

Increased Uptime

Go-to-market Strategies

New Business Models e,g, EaaS

Workflow for getting to your IoT product vision

Business strategy

Business initiatives
- Research
- Discovery

Business entities
- Product
- People
- Process
- Premises

Business outcomes and decisions from business stakeholders

Use case and data Sources identification

Business value assessment

Implementation feasibility assessment

Use case prioritization

Business case

IoT roadmap

IoT project
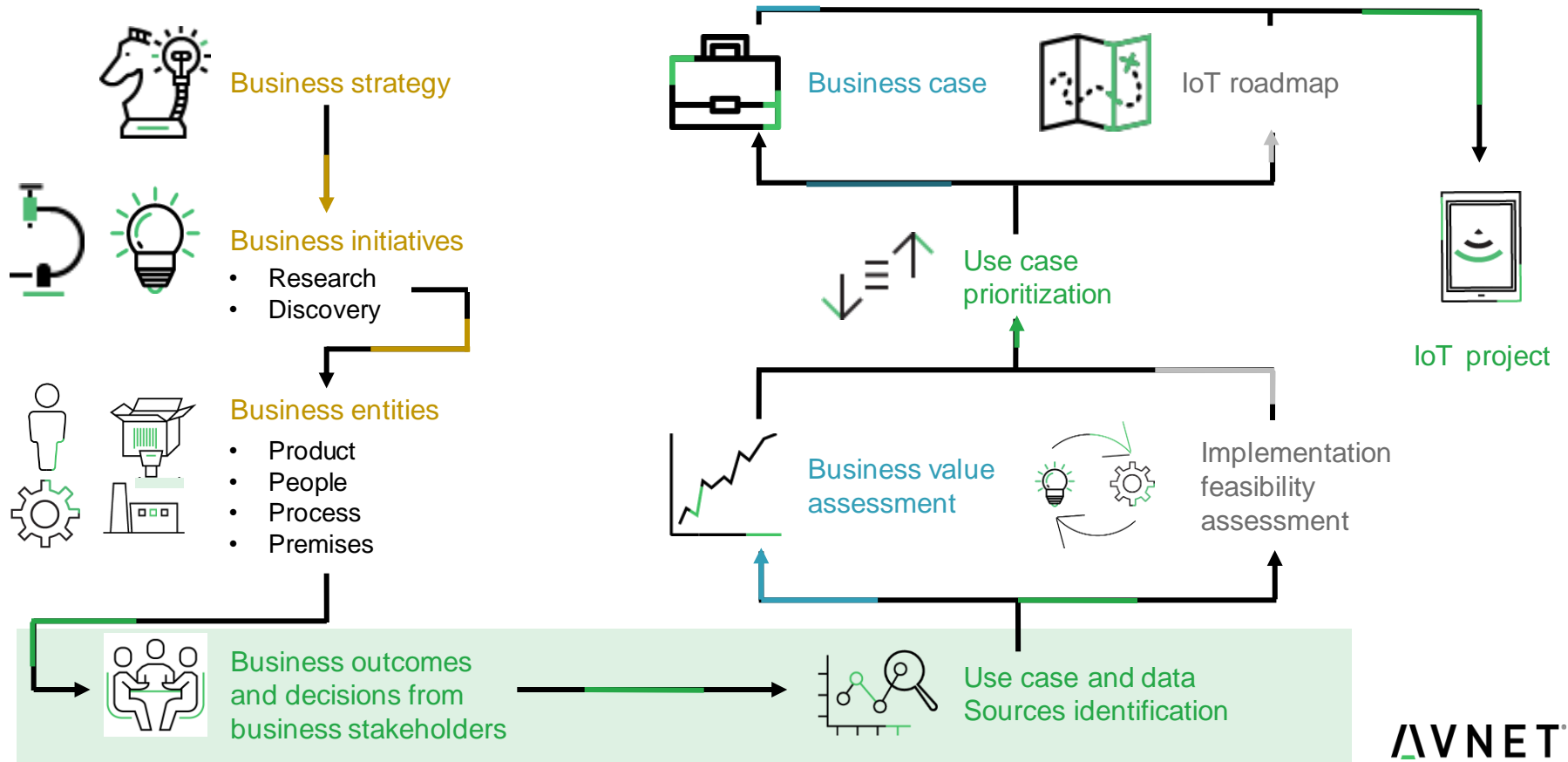
Successful IoT initiatives begin with a decisive Business Case

Capturing & Identifying the true business case leads to successful Smart App deployments → better leadership engagement with accelerated time to market.

Effective process for outcome-based initiatives:

- Identify the key business outcomes of your initiative

Define the business case

Be open to new approaches
- Identify the must-have goals and adoption approaches for the minimum viable product (MVP)

- Getting all stakeholders on board early in the process is critical

Engage leaders in early stages

Start with a series of finite PoVs
- Small use cases, running simultaneously will improve the chances of success

- Short-term ROI allows to build strong business cases

Cap ROI to short-term

Use success for future investment
- Incremental investment will be more successful than large request

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Demo

Getting Started: Key Considerations for Designing a Holistic Greenhouse Solution

Growers - All

- Assess current infrastructure – replace, retrofit, augment
- Talk to your vendors - coming capabilities, enhancements
- Define key business drivers – Monitoring, operational efficiency, cost containment, etc.
- Workshop internally (or with partner help), if starting or stalled
- Start small – POC / Pilot

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Getting Started: Key Considerations for Designing a Holistic Greenhouse Solution

OEMs - lighting designers and product managers

- Opportunities with Avnet (SMEs, Design Services, Partner Program, etc.)
- Talk to Independent Design Houses or like services by suppliers
- Look for opportunities for retrofit
- Research supplier programs - Example Avnet Partner Program
- Get to market quicker
- Build smarter devices to address customer needs

Q&A