

McCLOUD
**INNOVATE: INTRODUCING
NEW TECHNOLOGY**
McCloud Pest Invasion 2019

WE KILL IT
SO YOU DON'T HAVE TO THINK ABOUT IT

Remote
Monitors

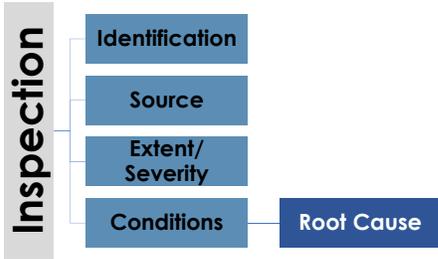




**MONITORS ARE ESSENTIAL
BUT LESS THAN 1% WILL
HAVE CAPTURES**

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INSPECTION IS THE FOUNDATION OF OUR PROGRAM



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Reduced Monitor
Inspection
Frequency

Increased
Inspection Time
or other services



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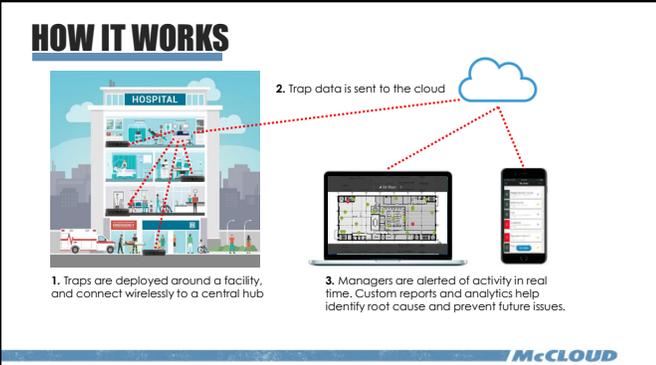


WHO IS DEVELOPING/ MARKETING?

- Bayer
- Bell Laboratories
- Brandenburg
- Corleva
- Kness
- Pest West
- VM Products
- Woodstream/ Victor
- Insects Limited

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HOW IT WORKS



1. Traps are deployed around a facility, and connect wirelessly to a central hub
2. Trap data is sent to the cloud
3. Managers are alerted of activity in real time. Custom reports and analytics help identify root cause and prevent future issues.

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TYPES OF SENSORS

Motion

Infra-red

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TYPES OF EQUIPMENT: SNAP TRAPS



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Multi-catch

WILDLIFE LIVE TRAPS



Picture by Xignal



Picture by Kness

McCLOUD



Exterior Rodent Stations

Picture courtesy of Bell Labs



Not tied to trap (motion sensor)

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Doors

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Short Range Systems: Must be Onsite to Connect



SENSOR



REPORT

BLUETOOTH BASED (BELL LABS)

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SHORT RANGE MONITOR FEATURES



TIME STAMP AVAILABLE



REDUCES FREQUENCY OF MONITOR/ TRAP CHECKS



NO 24/7 REAL TIME DATA

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ON SITE DETECTION (BLUE TOOTH)

Immediate response not an option

Limited equipment choices



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SHORT RANGE FACILITY CANDIDATES



Facilities with weekly inspections and low pest pressures for ongoing monitoring



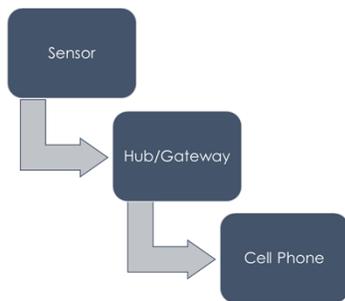
Difficult to reach areas



Sites with intensive trapping efforts

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24/7 SENSORS



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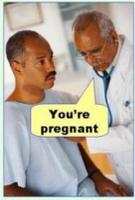
24/7 LONG-RANGE SYSTEMS

-  24/7 Measurements
-  Ability to respond immediately
-  Potential reduced inspection frequency
-  Integration of multiple devices
-  Increased equipment choices

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DEFINITIONS

Type I error
(false positive)



Type II error
(false negative)



FALSE POSITIVES (TRAP ALERTS, NO CAPTURE)

- Human Disturbance
- Wildlife (Raccoons, birds, loads...)
- Vibrations (equipment)



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FALSE NEGATIVES (TRAP DOES NOT ALERT BUT RODENT CAPTURED)

- Equipment Malfunction (Major Problem)



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CHALLENGES AND CONSIDERATIONS

False Positives	Signal Strength
High Traffic/ Cleaning Operations	Motors
Water	Metal
Dust	Water (tanks, pipes)

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FORKLIFT DAMAGE



Photo: Anna Berry

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**THINK PEST PRONE/
THINK LOW HUMAN DISTURBANCE**

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SPECIAL USES: HARD TO ACCESS AREAS



HARD TO REACH:

- INTERSTITIAL SPACES
- ROOFS
- CHRONICALLY BLOCKED TRAPS
- ELEVATED BEAMS
- UNDERNEATH GONDOLAS

Mass trapping and pre-baiting programs



WHAT WE HAVE LEARNED

- Time of trap alert = ask why?
- How fast a trap may be rendered ineffective or less effective

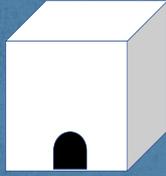


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Root Cause: Trap Door



BOX AVOIDANCE
(EXTERIOR STATIONS, MULTI-CATCH TRAPS)



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THIRD PARTY AUDITORS?

FUTURE

- Improvements in existing systems and new systems expected
- Experience will optimize use
- Still require skill in placement
- Integration of systems will provide greatest benefit



OTHER PESTS?

- Insect Light Traps
- Pheromone traps
- Temperature and Humidity
- Bed bugs



Picture courtesy of Tom Mueller

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McCloud Pest Invasion

Digital Innovation & Assessments



Scott Broaddus
Business Lead Bayer
Digital Pest Management



Disruption on Display



//// //// //// //// //// //// //// //// *Disruption on Display*

When an RMS device captures a rodent, it automatically alerts a pest control technician via text or email, enabling a fast and efficient response. In addition to real-time capture alerts, RMS provides regular status reports and a graphic floor plan displaying the status and battery life of devices. **“We’ve designed a digital solution where mousetraps are actually Internet of Thing (IoT) devices,”** says Daniel Hartert, Chief Information Officer of Bayer AG, a global enterprise with core competencies in the life sciences fields of health care and agriculture.



Transformation is upon us...

Harvard Business Review

47 The Big Idea
The HBR List of Best-Performing CEOs 2014 edition

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Brian K. Richter

HOW THE INTERNET OF THINGS CHANGES BUSINESS MODELS

THE INTERNET OF EVERYTHING
Smart, connected products will transform your business PAGE 64

Forbes

How the **Device as a Service** Model Tackles Today's Biggest IT Challenges

Microsoft / Transform

Bayer just built a better mousetrap – to our food supply

The well-worn wisdom of Ralph Waldo Emerson may seem like an odd place to start a tech story. That is, until you look deeper at a new service from Bayer – a cloud-connected, rodent-defense system that food we store, sell and eat.

Bill Briggs

Jul 9, 2018

QA Issues Contents

and one of that writer's most enduring gems: "Build a better mousetrap, and the world will have merged En

SUPPLIER SPOTLIGHT

THE FUTURE IS TODAY

By PCT Staff

An innovative digital pest management services platform ushers in a new era at Bayer.

IoT

GLOBAL FOOD REPORT

A Transformational Change in Pest Management

The majority of people affected by hunger live in rural areas of developing countries, but the factors that have a negative impact on food security are global.

The Internet of Things (IoT) provides significant opportunity for many industries, including that of pest management in food facilities. "We believe that the impact of digital transformation will be enormous because it's all around us already," said Chris Pienaar, Bayer Environmental Science global lead for transformational innovation. "Beyond the technology of connected devices, what we see is these innovations in technology spurring transformation in business models."

RESTI



Consumers are demanding
**FOOD SAFETY &
TRANSPARENCY**
...and they are willing to pay for it.



There is significant
national attention around
FOOD SAFETY
- both in the newsroom and
in the boardroom

**WHAT IS
DRIVING
THE MARKET?**



The Food Industry is facing
**THE GREATEST
REGULATORY
SHIFT IN OVER
70 YEARS**



The demand for a
**FRESH,
PLANT-BASED DIET &
"CLEAN" FOOD**
is changing the way every
segment is doing business

RESTRICTED

Traditional Rodent Control

A close-up photograph of two brown mice on a wooden surface. One mouse is in the foreground, facing right, with its long tail curled. The second mouse is positioned behind it, looking upwards and to the right. The background is a blurred, textured grey wall.

Up until now rodent control has been:

- // *A once-a-week monitoring procedure*
- // *Time-consuming*
- // *Reactive*
- // ***Diverts focus from inspection***



What's the *RISK* in traditional rodent control?

Bayer Rodent Monitoring System:

World examples of some expensive food outbreaks/recalls [4,10].

Year	Contamination/Food Product	Estimated Economic Loss	Region/Country
2013	<i>Clostridium botulinum</i> /Whey concentrate	Unknown	New Zealand
2009	<i>Salmonella</i> /Peanut products	\$70 million	USA
2008	<i>Salmonella</i> /Tomatoes	\$250 million	USA
2008	Mad cow disease/Meat	\$117 million	USA
2007	<i>Salmonella</i> /Peanut butter	\$133 million	USA
2006	<i>E. coli</i> /Spinach	\$350 million	USA
1992	<i>E. coli</i> /Hamburgers	\$160 million	USA

- // Pathogens are the #2 reason for food recall in the food industry
- // Rodents are significant carriers of Salmonella, Listeria, Vibrio Cholera and other bacteria
- // Costs associated with recall, facility shutdown, law suits, etc.
- // Have been known to cost companies millions of dollars
- // Not to mention the costs associated with a damaged reputation

Hussain, Malik Altaf, and Christopher O Dawson. "Economic Impact of Food Safety Outbreaks on Food Businesses." Foods (Basel, Switzerland) vol. 2,4 585-589. 12 Dec. 2013, doi:10.3390/foods2040585

FDA Investigated Multistate Outbreak of Salmonella Braenderup Linked to Shell Eggs from Rose Acre Farms

On April 13, **Rose Acre Farms** voluntarily issued a **recall** of 206,749,248 **eggs** (approximately) that were potentially contaminated with *Salmonella braenderup*. Three days later Cal-Maine Foods, which purchased **eggs** from **Rose Acre**, announced a voluntary **recall** of 23,400 dozen **eggs** for the same concerns.

May 12, 2018



Observation 1:

When your monitoring indicated unacceptable rodent activity within a poultry house, appropriate methods were not used to achieve satisfactory rodent control.

Specifically, a review of your pest control records from September 2017 to present indicate an ongoing rodent infestation. The corrective actions taken by your firm have not been effective at reducing the rodent levels within your poultry houses to an acceptable level that is below the threshold established in your SE Prevention Plan.

Additionally, the following conditions were observed in the poultry houses:

On 03/26/2018:

- House 9 - one (1) live apparent rodent in manure pit while swabbing about halfway down row two (2) in the pit, and one (1) live apparent rodent observed running across the upper level floor last row 10; two (2) dead apparent rodents observed on the ground, 10+ feet from the front of the houses; daylight observed through an area with spray foam creating a potential pest entrance in the manure pits around the closed roll up door at the front of the house near row four (4).
- House 13 - multiple live apparent rodents running around the staging area in pit, and burrowing in and out of manure piles; five (5) live apparent rodents observed in the manure pits.

Digitization

A Simple View of an IoT Solution



Things



Insights



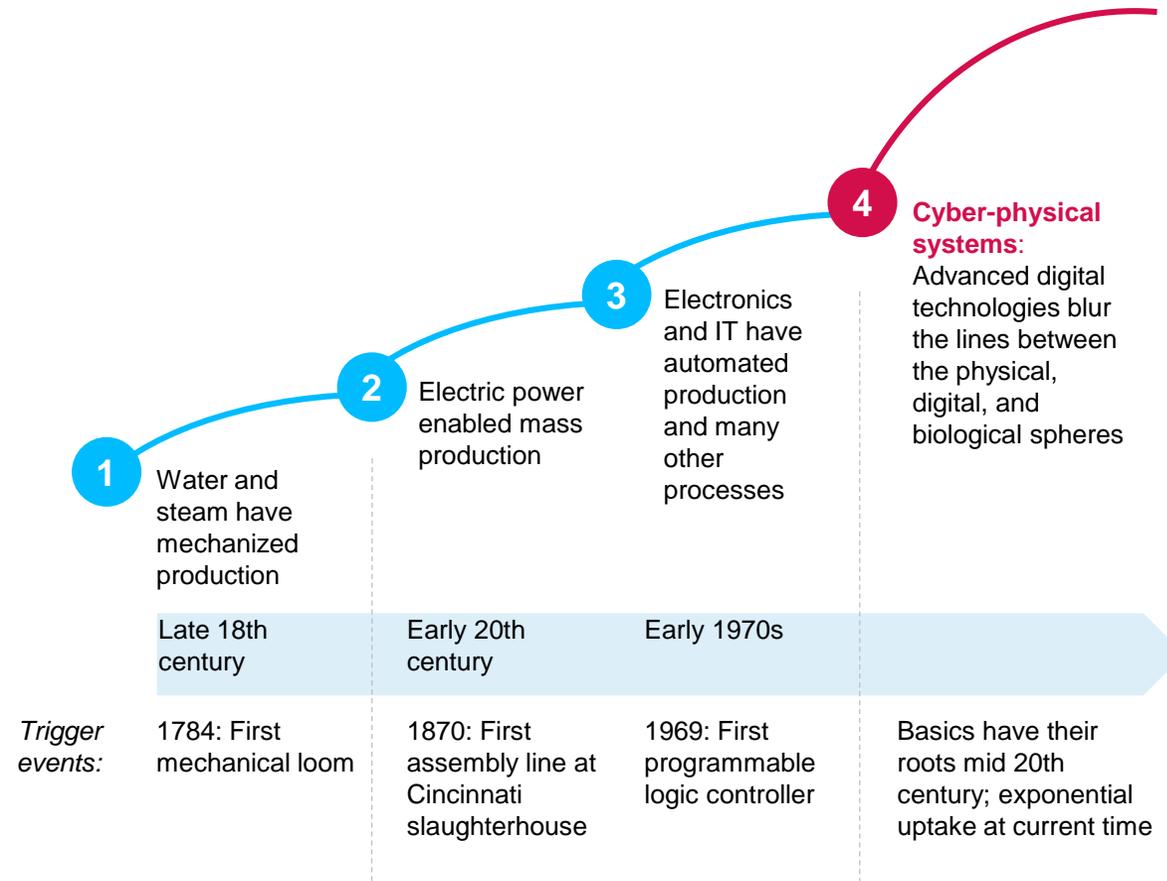
Actions



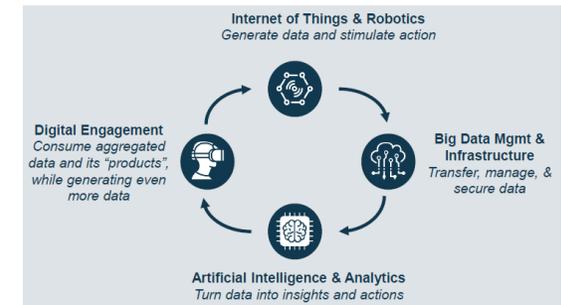
The fourth industrial revolution will profoundly change the way we work, live and relate to one another

4 waves of industrial revolution

- // The fourth industrial revolution is under way, driven by **major advances in digital technologies**
- // The transformation is exponential and **is impacting and disrupting almost every industry** around the world. Unlike former industrial revolutions, it will impact all walks of life
- // The speed of diffusion of new technology will not only depend on technological possibilities but also on societal acceptance and business adoption



- // The 4th industrial revolution builds upon the 3rd: Internet access, smartphones and on-demand accessibility to unprecedented cloud-based processing power and storage capacity build the foundation for growth
- // Technologies that currently drive the 4th industrial revolution include e.g., faster mobile communication (5G), the Internet of Things, artificial intelligence, robotics, blockchain, and virtual and augmented reality
- // Technologies are interconnected:



Picture: Bayer Digital Trend-Radar

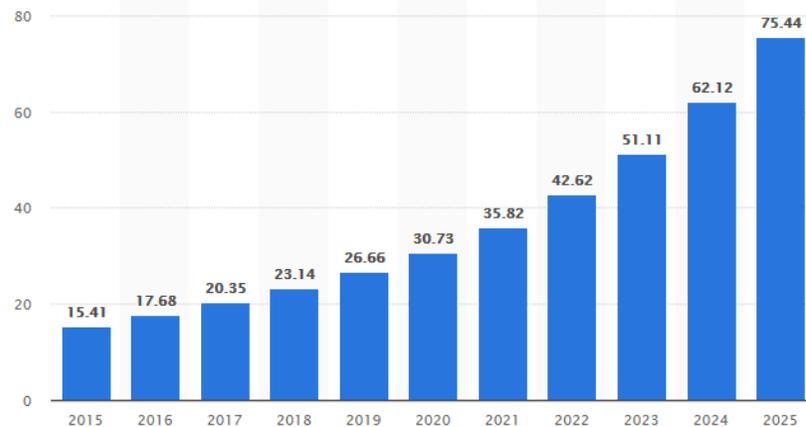
Sources: WEF, Siemens, Bosch, STR analysis



The Internet of Things (IoT) represents another hallmark of connectivity and data abundance

- // Machines and devices are **communicating, continuously in real-time**, and in ever greater numbers. Virtually every activity creates a **digital trace**
- // As a result, **data have become abundant, ubiquitous and far more valuable**: Advanced data analytics extract more **value from data and predict** e.g., when a customer is ready to buy, a jet-engine needs servicing or whether a plant or a person is at risk of a disease
- // A connected world is more prone to hacking. Cybersecurity and data protection will become ever more important

Connected devices¹, in billions



Source: Statista

Related data flows are enormous – some estimate that a self-driving car will generate 100 gigabytes per second

Quantum computers² – still in development – are expected to better handle these data loads. They will be exponentially faster at running artificial-intelligence programs and handling complex simulations and scheduling problems

Rise of the data era



Tech and data-driven companies have seen an unprecedented rise in value. Status mid January 2019, 7 of the 10 most valuable companies of the world are tech companies

Source: The Economist

¹ Incl. smartphones and alike

² At the heart of quantum computing is the quantum bit, or qubit, a basic unit of information analogous to the 0s and 1s represented by transistors in your computer. Qubits have much more power than classical bits because of two unique properties: they can represent both 1 and 0 at the same time, and they can affect other qubits via a phenomenon known as quantum entanglement. That lets quantum computers take shortcuts to the right answers in certain types of calculations

Sources: WEF, The Economist, MIT Technology Review, Bloomberg, Statista





AI will support humans in everyday life and work. Digital twins will gain further relevance

- // As technology and esp. voice and language recognition and articulation improve, smart virtual personal assistants will become an integral element that will serve and support us in everyday life and work
- // 'Digital twins' will gain relevance to predict events in many areas from machines to consumers
- // Companies benefit from AI in 3 ways:
 - // **Automation of tasks:** AI will not just automate simple, repetitive tasks but also those that require cognitive capabilities. Tasks that can be outsourced today can probably be automated tomorrow
 - // **Gain insights & improve decision making:** AI can advance data analytics, detect patterns interpret their meaning and make predictions. It can extract more value from data and improve rational decision making
 - // **Engage with customers and employees in conversations with humans, e.g., via chatbots**

Sources: NVIDIA, Harvard Business Review Jan-Feb 2018

Virtual personal assistants



Language recognition will allow real two-way conversations between humans and AI – a paradigm shift in user interface

The first virtual assistants for everyday life are already in use – e.g., Siri (Apple), Google Assistant (Google), Echo/Alexa (Amazon). Their use will spread further once technology matures (today's conversations are often quirky) and data-privacy can be ensured



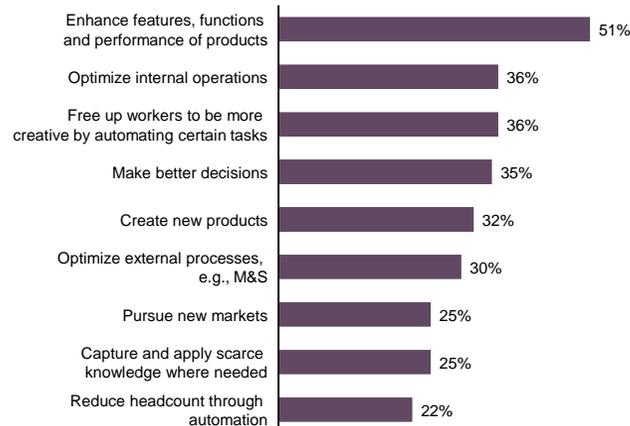
Picture: futureoflife.org

“Human + Machine = Superpower”

Pauly Daugherty, Chief Technology and Innovation Officer at Accenture

Today's businesses benefit from AI mainly in product improvement

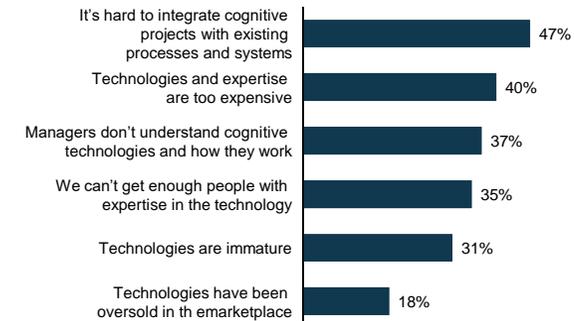
Share of executives who cite the following benefits of AI



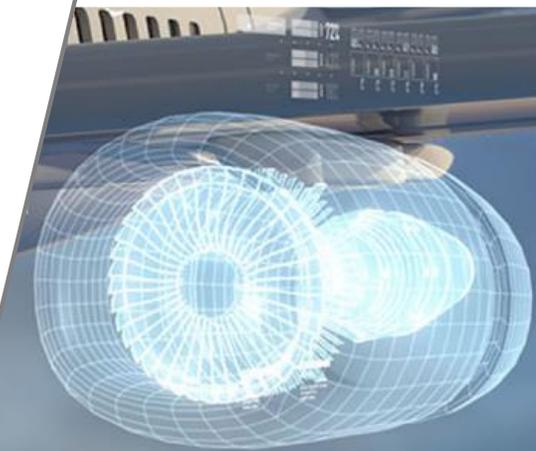
Source: Deloitte 2017. Survey on 250 executives

In today's 'traditional' business environment, AI still faces some challenges

Share of executives who cite the following as obstacles



Source: Deloitte 2017. Survey on 250 executives



Companies like GE use AI to evaluate data gathered from sensor networks in their aviation turbines to run “digital twins” that forecast maintenance needs and thus reduce downtimes

Picture: GE. Digital twin of a jet engine



Smart sensors and cameras provide sensing input for AI

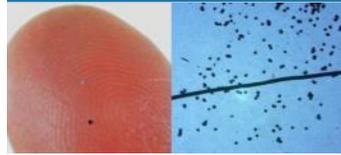
// **Already today, sensors are widely used and can literally monitor everything.** A single smartphone is loaded with numerous sensors including a proximity sensor, fingerprint sensor, GPS, gyroscope, accelerometer, and barometer, integrated heart-rate sensor and optical sensor

// The next generation of sensors and cameras are smarter and smaller. They will be able to **continuously collect information in a seemingly invisible way.** As such, they provide cognitive input for AI and provide an important basis to better monitor human and plant health, diagnose disease, and **induce actions**

// With synthetic biology, plants could eventually be turned into smart sensors themselves, **displaying their needs early on, or even detecting chemicals, pests, and pathogens**

Sources: Sensors Online, U.S. DARPA

Advanced sensors are smart and small. Selected case examples



Smart dust:
3D printed microelectromechanical systems outfitted with miniature sensors could collect data including acceleration, stress, pressure, humidity, sound and more

Sources: Forbes, Picture: The Future of things



Tiny tooth sensor:
The wireless sensor monitors your nutrition, e.g. sugar, salt and alcohol intake

Sources: Science (Picture, credits SilkLab/Tufts University), Adv. Mater. 2018, 30, 1703257



Sensing plant health:
Sensors that can be printed onto plant leaves reveal when the plants are experiencing a water shortage, for example

Source: MIT News 2017, Nature Materials DOI: 10.1038/NMAT4771. Picture: Betsy Skrip



Smart tattoo:
The tattoo ink changes color according to the chemistry of the body's interstitial fluid. Different inks change color upon change in glucose or sodium concentration

Source: The Harvard Gazette



Picture: Sciencemag.org

The networked farm

Intelligent silos
Sensors monitor the amounts of harvested produce in storage. The information flows into the farmer's database so that he always has an accurate idea of his current stocks.

Drones and soil sensors
Drones generate field maps and deliver aerial infrared photos providing information on the condition of the crops. Soil sensors report the water and nutrient content of the soil.

Satellites and mobile radio antennas
Data collection hub. The information collected in the field is passed on to servers, then commands are sent from the analysis platform or the farmer to machinery, weather data from radar satellites to warning systems, etc.

User-friendly
The farmer receives yield predictions and recommendations on crop protection and irrigation, etc., on his smartphone, tablet or laptop. He knows what is happening in his fields at all times.

Farm robots
Highly specialized, automated machines are responsible for sowing and harvesting crops. They can irrigate and apply crop protection measures with millimeter precision according to the information on the field charts.

Analysis platform
Farms generate large quantities of useful data. Providers like Bayer can use these data to provide farmers with growth and yield predictions generated by their IT centers. The farm machinery can be given targeted pesticide application and irrigation orders. For this purpose, they also collect environmental data and comprehensive plant pathogen information that can be called up at any time to improve the crop management.



AI will enrich jobs and create entirely new roles. Only certain jobs will be completely replaced by AI

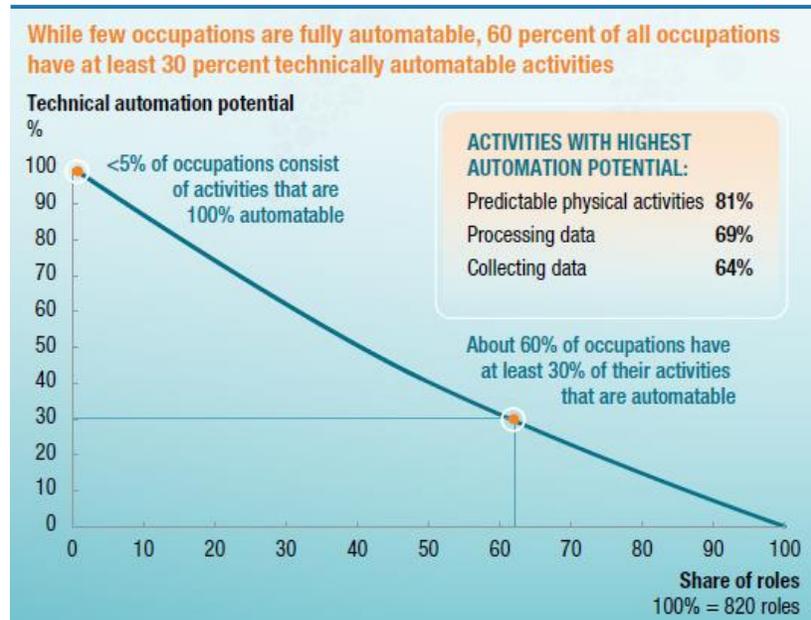
// **Automation will eliminate certain jobs and also create new ones.** Although estimations related to net job impact vary, experts agree that more **occupations will change** than will be automated away

// Many people fear that AI could threaten their jobs. **Most jobs, however, will be enriched with AI solutions at the individual task level. Saving time on routine tasks, humans can focus using their human skills that cannot be easily automated**, e.g., creativity, thinking abilities and complex problem solving, social skills incl. communication, service orientation and negotiation. **Companies and people need to learn to work with AI instead of competing with it**

// It will likely take years until some AI technologies **will become the norm. Companies need to prepare and re-skill their employees in the meantime**

Sources: MGI: The future of jobs. 2017, WEF: Future of Jobs survey, Wired, Brynjolfsson et al 2018: AEA Papers and Proceedings, 108: 43–47

More occupations will change than will be automated away



Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

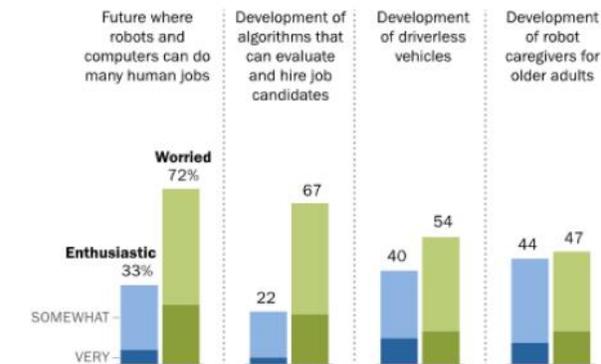
A future scenario:

Three jobs that could exist in a future when we work alongside artificial co-workers

- 1) Robot Psychologist:** Human co-workers who foster cooperation between the human and the artificial workforce
- 2) Agent Watch & Security:** Human co-workers that make sure the AI systems are not compromised/hacked
- 3) Agent Trainer:** A human co-worker that trains artificial co-workers so they can reach their full potential

Source: TRENDONE Futuregram

Still more worry than optimism about potential developments in automation
% of U.S. adults who say they are enthusiastic or worried about...



Note: Respondents who did not give an answer are not shown.
Source: Survey conducted May 1-15, 2017.
"Automation in Everyday Life"

Source: Pew Research Center

Improved Outcomes

Automated
24/7
monitoring

&

Real-time
program
verification



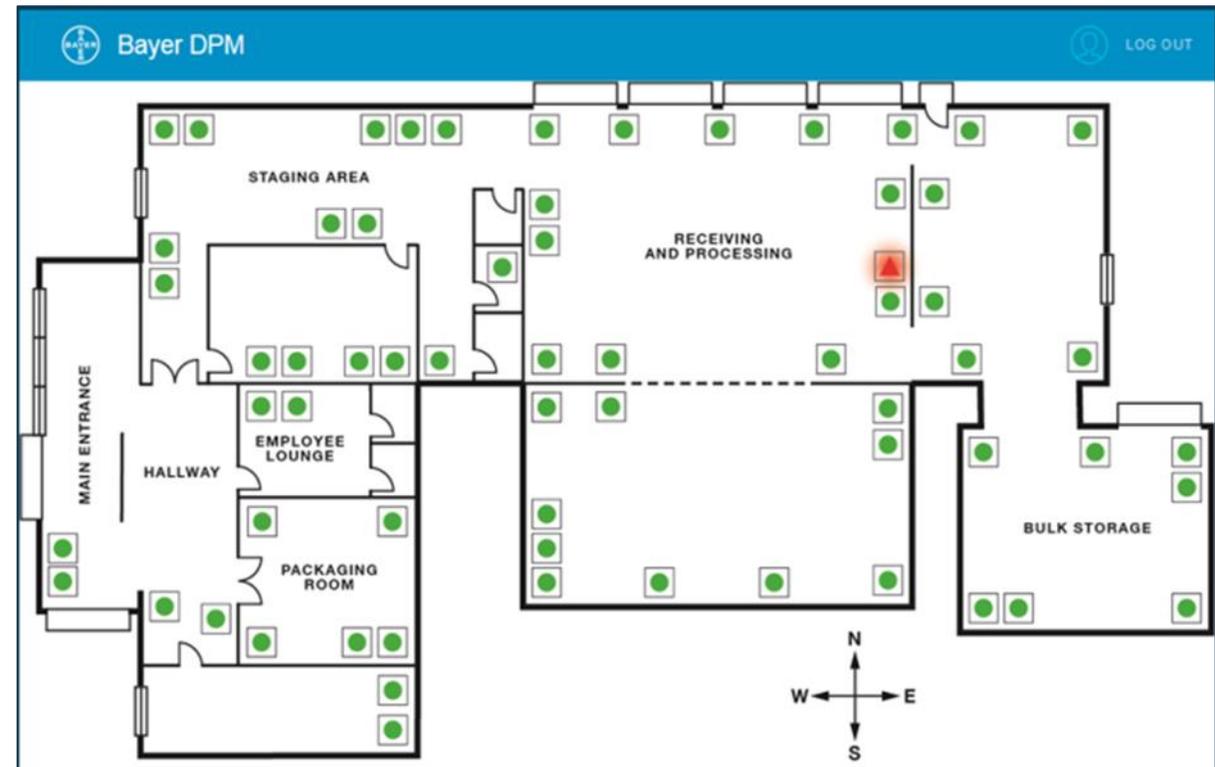
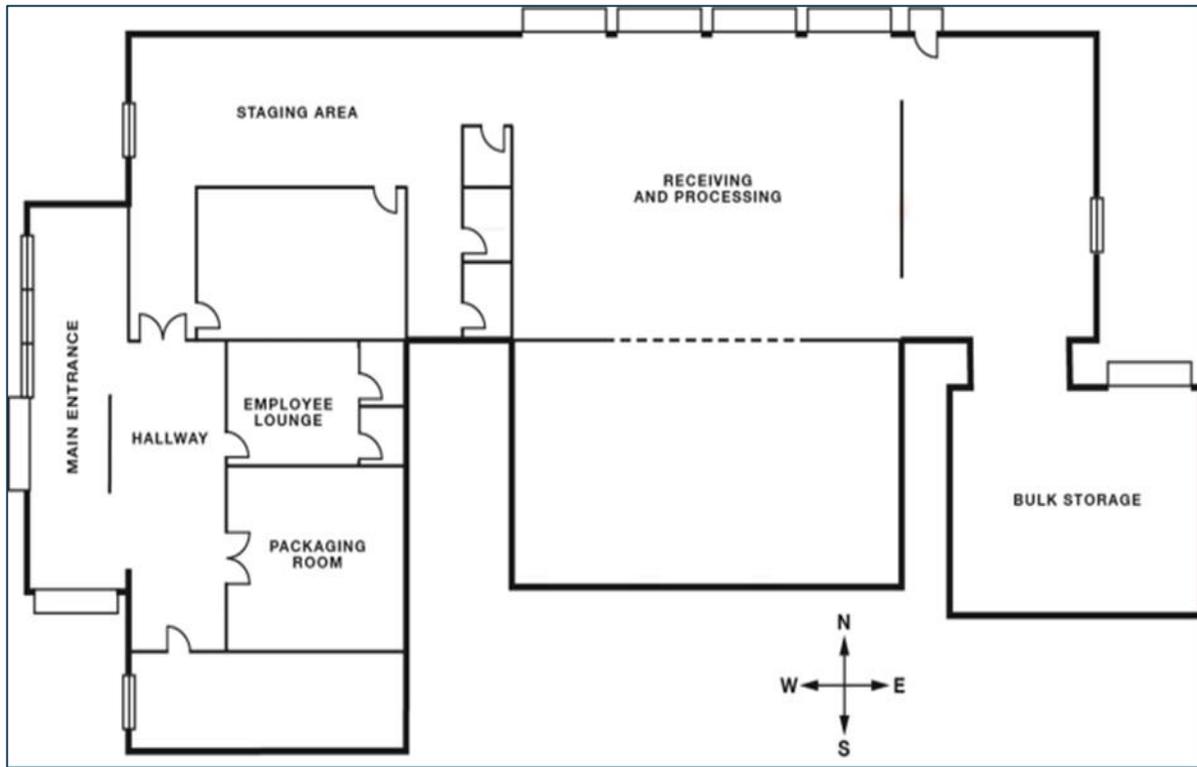
- Rapid response & corrective action
- Improved root cause analysis
- Continuous program improvement
- Predictive analytics & preventive action
- Automated trend lines & reporting





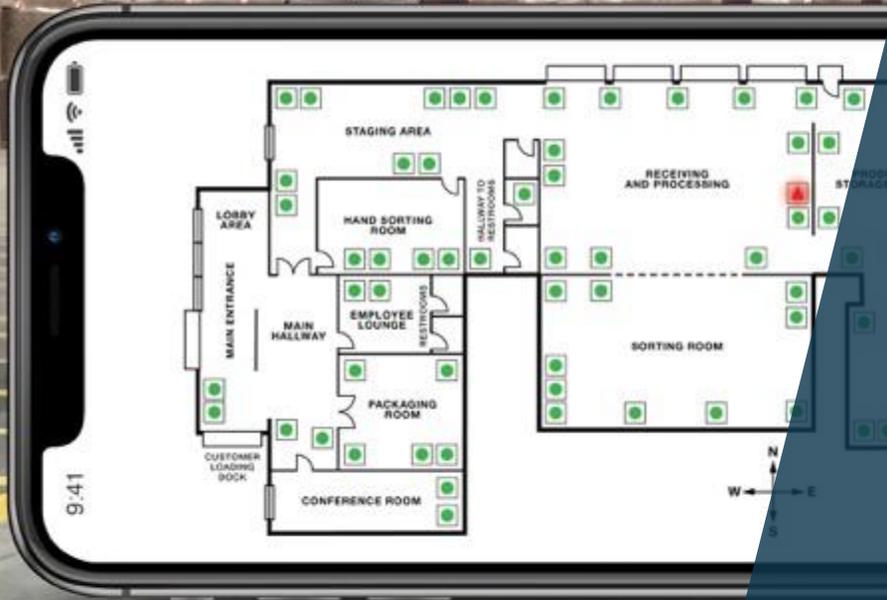
Current State vs. Desired State

Improved visualization & transparency by integrating digital!





////// *Designed for Your Business*



Intuitive Setup



Low Maintenance



Reliability in Sensitive Environments



Audit Compliance



Scalability



Rodent Monitoring System

Thank You



A game-changing strategy

in rodent control

- // Leverage automation to enhance the quality of your entire service.
- // Monitor 24/7, get real-time capture alerts.
- // Shift your time from checking empty traps to proactive IPM inspections, corrective actions and preventive measures.

STED