IOT - CONNECTING ASSETS AND MUCH, MUCH MORE!

The Art of the Possible

Maj Gen (Ret) H. Brent Baker, Sr.
October 2016

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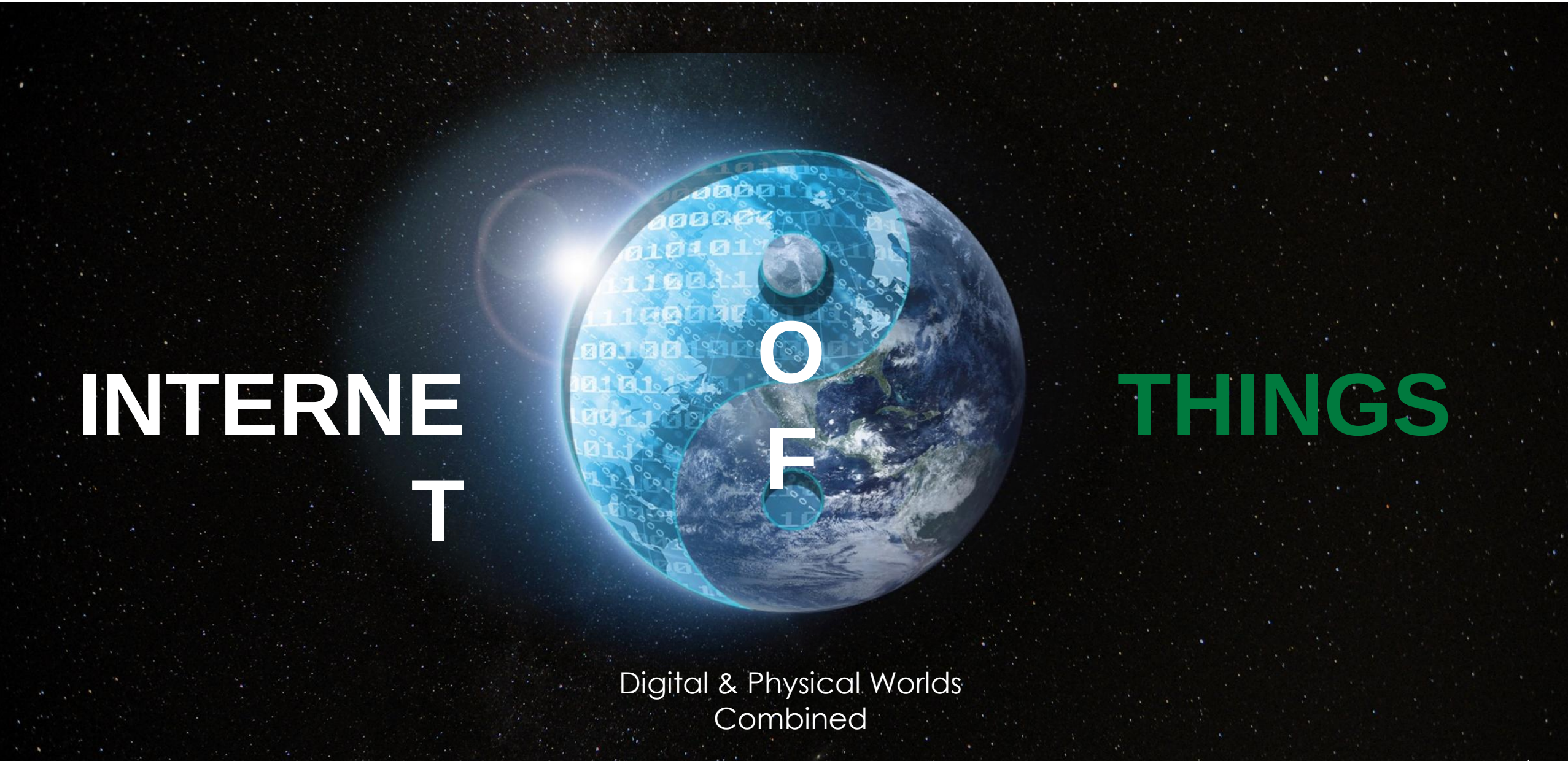
AGENDA

1. The evolving conversation
2. The 'Things' side of the IoT
3. Academic, industry, govt and think tank reaction
4. Recent trending in DoD
5. The 'end game' for IoT based maintenance
6. How SCOR, OODA and the Third Offset apply to IoT
7. IoT enabled service use case types and examples
8. Questions

THIS WAS THE CONVERSATION 5 YEARS AGO

Core Capabilities of an Integrated Service Information Solution

NEW REALITY: INTEGRATING DIGITAL AND PHYSICAL WORLDS



'THINGS' ARE CHANGING

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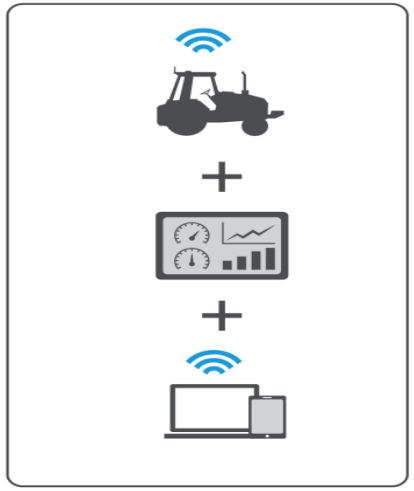
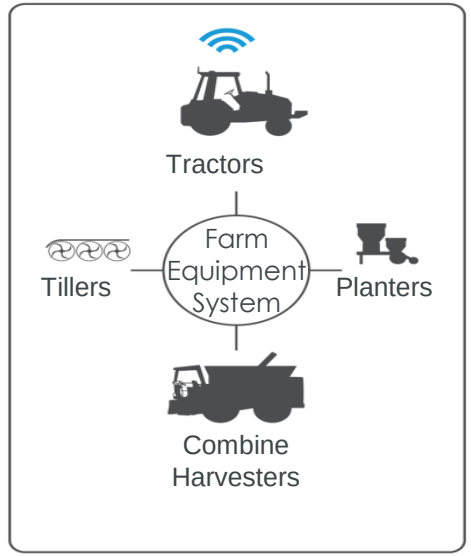
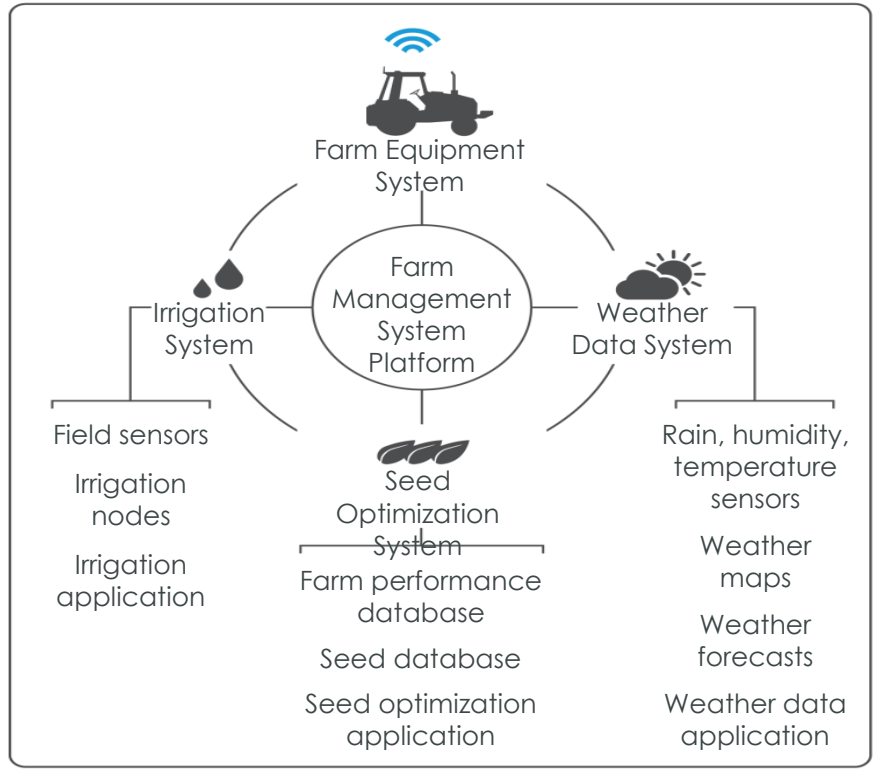
Product → Smart Product → Smart, Connected Product → Product System → System Of Systems







"The changing nature of products is disrupting value chains, forcing companies to rethink and retool nearly everything they do internally."

CHANGE IS EVERYWHERE

Smart, Connected Products

Remote Service, Ops & Analytics

Smart, Connected Operations

Brilliant Factory/Industry 4.0

Smart, Connected Systems

Smart Farms, Smart Cities, etc.

ACADEMICS AND INDUSTRY ARE TAKING NOTE

Smart, connected products are transforming how companies design, manufacture, operate and service products, and ultimately, how they organize to create and capture value.

– October 2015

Michael Porter
Harvard Business School

Jeff Immelt
GE Chairman & CEO

Technically, we're going to be one of the players that's both offering an operating system, in the case of Predix, and also applications, in an open setting. So you have a macroeconomic story: Here's what the Industrial Internet means, but then you have a technical story that says GE's going to be one of the players that's driving both horizontal platforms and vertical applications.

– September 2015

FEDERAL GOVERNMENT REACTION

Congress

- Depot Caucus
- IoT Caucus
- DIGIT Act
- Committees asking DoD

DoD

- Spending on SLM vs. PLM
- Augmented reality
- Additive manufacturing
- Third Offset Strategy

WHAT WE ARE HEARING

Think tank recommendations for DoD IoT adoption…

- **Condition-Based Maintenance**
- **Real-Time Fleet Management**
- **Inventory Management**
- **Base Management /Energy Efficiency**

CSIS Whitepaper
9/2015

"We live in a very dynamic time. Our Air Force is being asked to shift focus and do different things very quickly. And we need to respond and be very creative and innovative in how we do that."

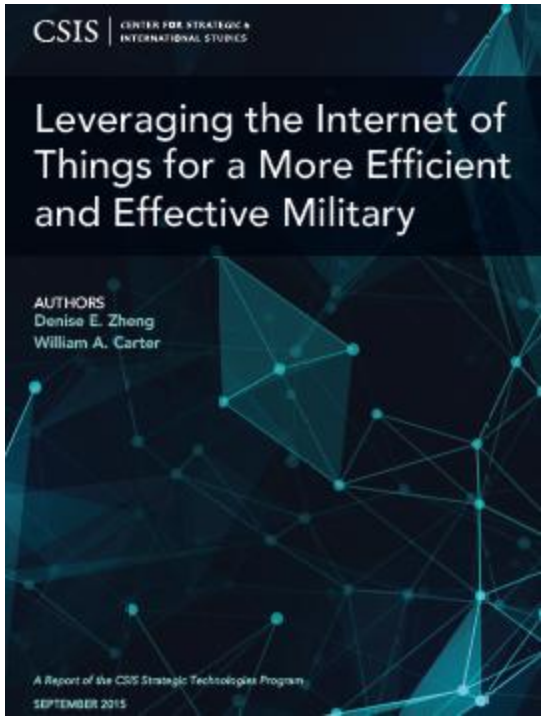
Lt Gen Ellen Palikowski, AFMC Commander 8/2015

Ideas for IoT Adoption in USAF…

- **Base Facilities Management - Traffic management, Energy conservation,**
- **Vehicle Management (truck, airplane) - Maintenance prediction, location tracking**
- **Base Facilities Maintenance - Trash pickup, food replenishment**

Frank Konieczny – USAF CTO
11/2014

THINK TANKS WEIGHING IN ALSO - CSIS WHITEPAPER - 9/2015



Recommendations for DoD's IoT adoption

- **Condition-Based Maintenance**
- **Real-Time Fleet Management**
- **Inventory Management**
- **Base Management /Energy Efficiency**

TRENDS IN DOD THAT WE ARE TRACKING WITH YOU

- Third Off-Set Strategy to save dollars and make leap in technology
- "Center for Strategic Studies" supports "Smart-Connected" products
- Readiness Rates are troubling to say the least, some at all time lows
- Modernization efforts are growing but directly competing with legacy systems
  - Every $$ saved in legacy support goes towards modernization
  - Expect additional pressures to drive down cost of legacy maintenance
- Cyber Security is biggest concern now although we have to keep discussion on target
- DoD very interested in Digital Twin/Thread, Cloud Services, Augmented Reality, Augmented Training, Machine Learning, Smart depots/buildings, etc., but struggle on defining requirements

THE "END GAME" SCENARIO FOR IOT BASED MAINTENANCE

Integrating Systems to Life Management Processes

Diagnostics

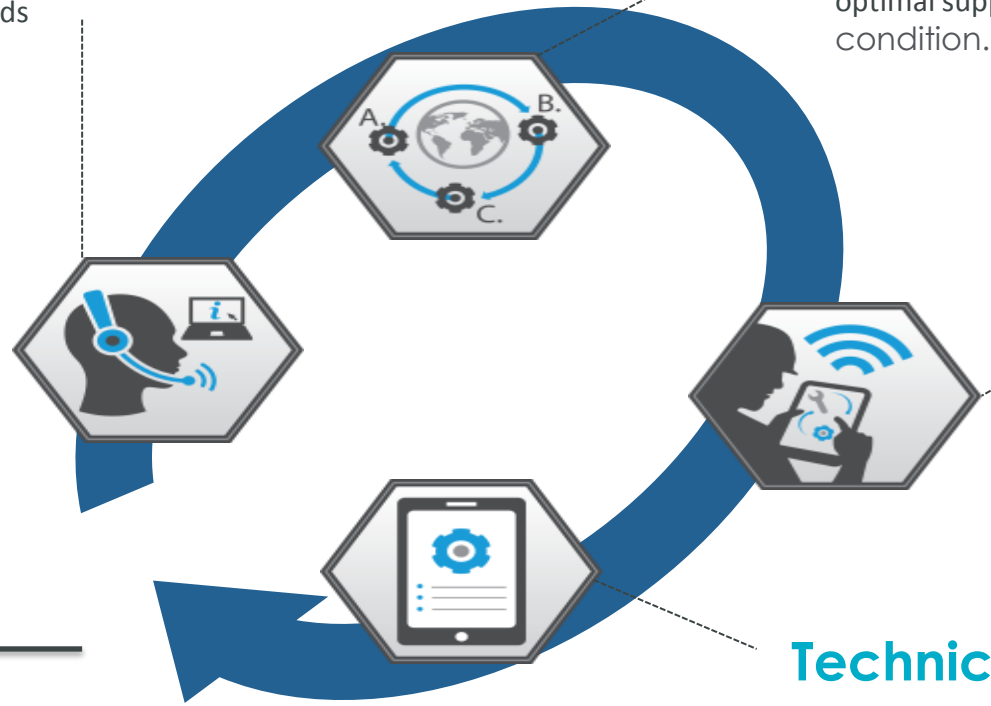
3) Diagnostics rules and maintenance schedules are used to identify or predict maintenance needs

Supply, Provisioning

4) Required parts are identified or ordered via optimal supply location, owner, utilization, condition.

Alerting

2) ThingWorx application monitors sensor data and confirms that problem or other conditions exist that trigger maintenance



Work-order Automation

5) Work Order generated in the maintenance systems with parts status for technician scheduling

Technical Data Integration

6) Required technical data and instructions are located and attached to work order

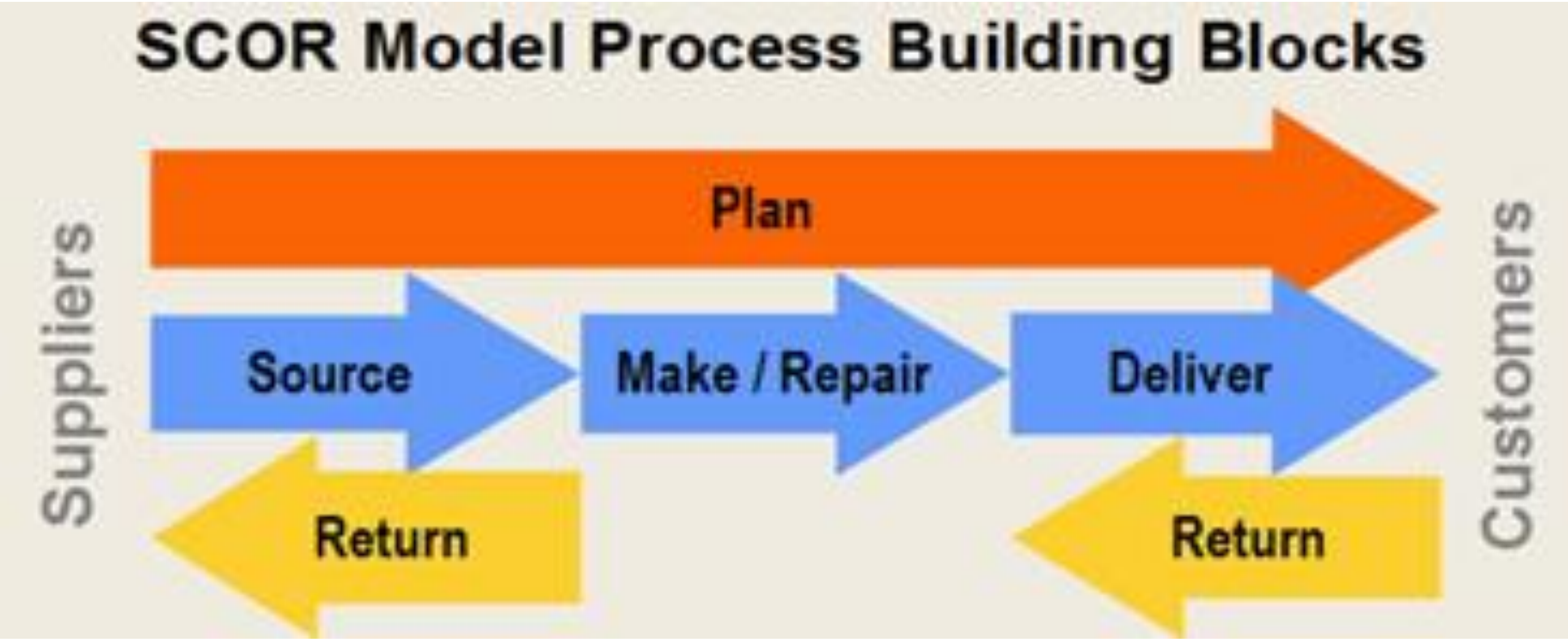
Data Capture

1) Sensor data gathered from connected asset inside depot

Asset Restored

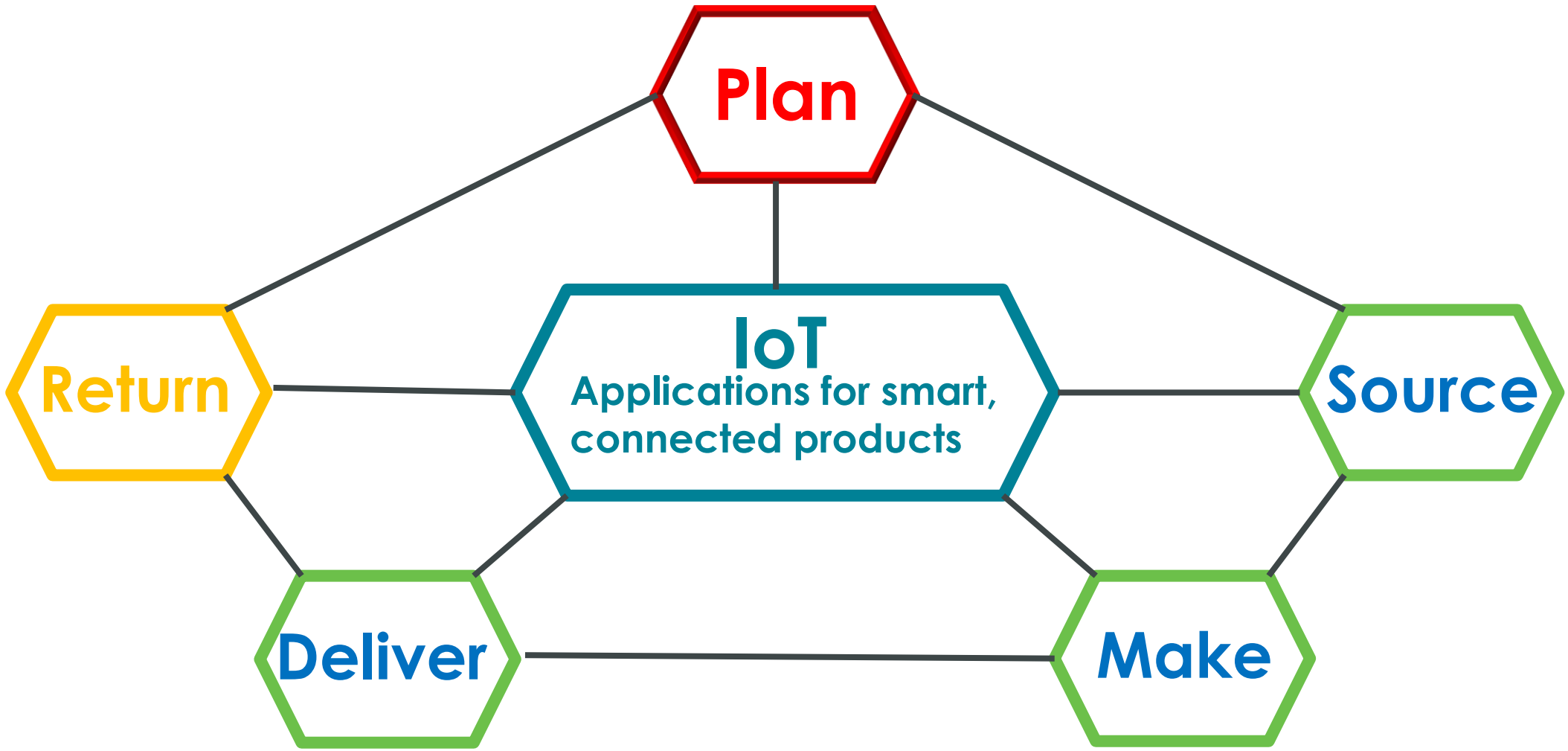
7) Service is performed, restoring asset to proper condition

SUPPLY CHAIN OPERATIONS REF MODEL (SCOR)



Dr. David Bertreau, OSD/LMR—"it took us a while to get here but SCOR is our model."

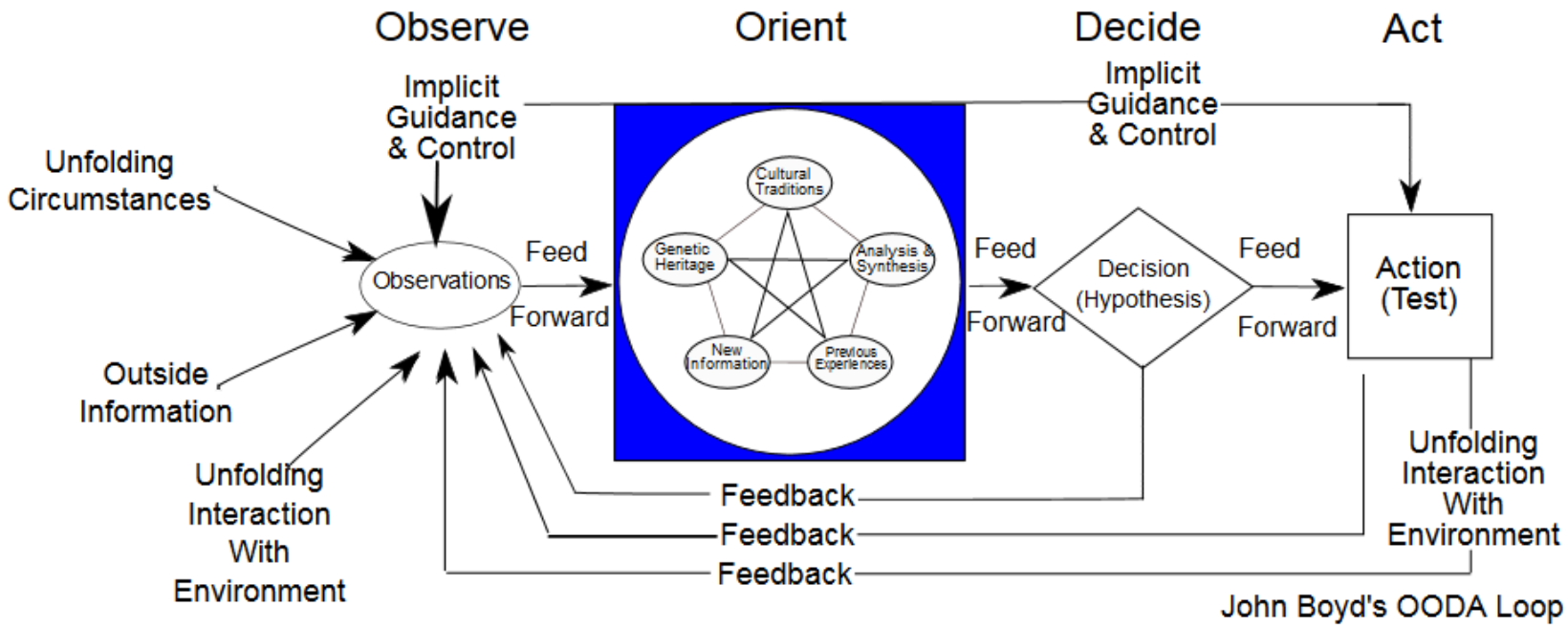
HOW SCOR RELATES TO IOT



IoT now links smart, connected products and all SCOR processes

HOW THE OODA LOOP CAN APPLY TO THE IOT

Col John Boyd, USAF



- **Collection of data by 'means of the senses'**
- **Time is the dominant parameter - must complete the OODA cycle quicker than enemy**
- **Decision-making changes on the fly based on introduction of new and quickly changing data**
- **Can apply tactically to battlespace or strategically (i.e. Third Offset Strategy)**

THIRD OFFSET - OPERATIONAL COMPONENTS RELATING TO IOT

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"Cyber hardened" semi autonomous

Weapons that survive cyber threats

Ex. - Small diameter bomb still operating without GPS

Autonomous "Deep Learning"

Automated analysis with no human

Ex. - NSA algorithm makes a threat profile based on ISIS posts to social media

At the middle of all of this is **data** coming from signals, sensors, machines, or other humans. So the **IoT** will play a central role.

Assisted Human Operations

Machines help human operate better

Ex. - Parking assist or the 'Iron Man' exoskeleton

Human-Machine Collaboration

Machines help humans w/ decisions

Ex. - F-35 Helmet using data from multiple systems into one layout for pilot

Human-Machine Combat Teaming

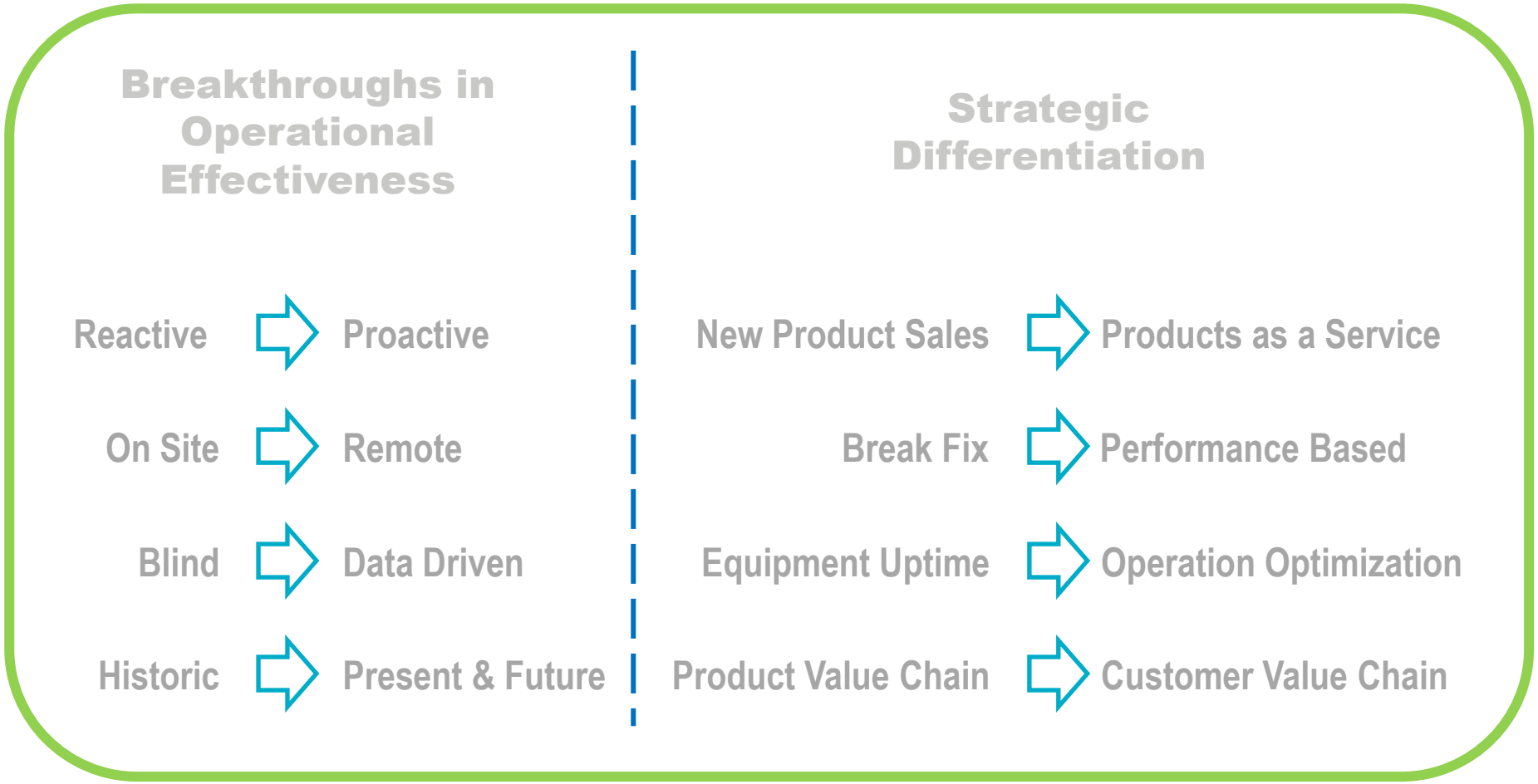
Humans and unmanned operating together

Ex. - P8 and Triton unmanned system or swarms of unmanned systems

Source: DoD (Dep SECDEF Bob Work, at Center for a New American Security12/14/2015

SERVICE IS THE LEADING USE CASE FOR IOT TECHNOLOGY

Smart, Connected Products Drive Two Levels of Accelerated Service Transformation



"Remote data, which can track performance, failure reasons, and potential fixes, provides service technicians with the answers to solve customer problems faster."

Aly Pinder Jr.
Senior Research Analyst, Service Management
Aberdeen Group
March 2015

NEW AUTOMATED SERVICE PROCESS

1 Service Insights

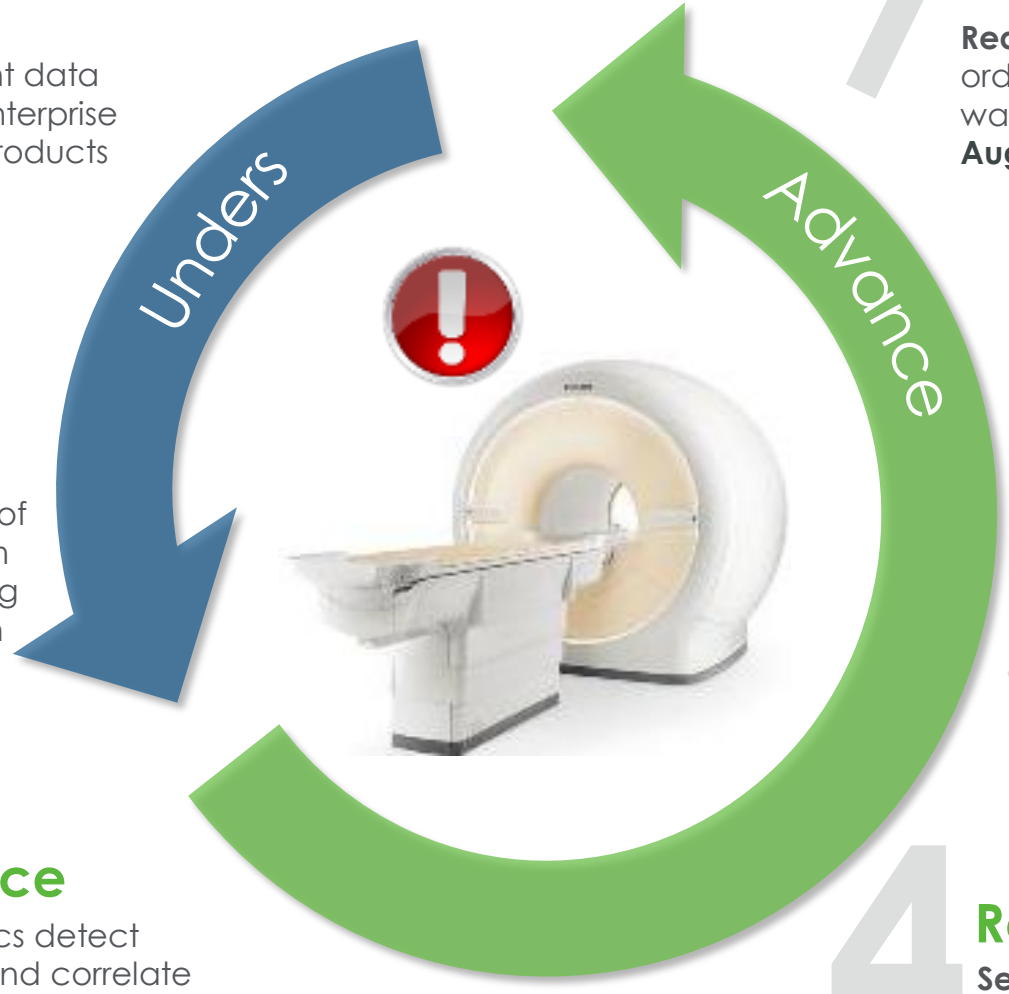
Aggregate view of relevant data for service from multiple enterprise systems and connected products

2 Remote Monitoring & Anomaly Detection

Real-time monitoring and analysis of sensor data that triggers Alerts from business rules and machine learning techniques to initiate further action

3 Predictive Service

Machine learning analytics detect changes in sensor data and correlate service history to **predict failures and enable condition based maintenance**



4 Remote Service

Service response conducted remotely with ability for **remote** access, calibration, diagnostics, software & file distribution, and customer self service

5 Connected Field Service

Field Service ticket is automatically opened and a technician with parts, skill set and knowledge to complete job is scheduled / dispatched

6 Connected Parts Mgmt

Parts forecasting optimization & planning informed in real-time by asset location, owner, utilization, condition

7 Interactive Equipment Service

Required service information is attached to service order for technician including sensor, alert details, warranty, procedure, and parts – all enabled with an **Augmented Reality** experience

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