



## IoT and Compressed Air Management Systems

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Tim Dugan P.E., *Compression Engineering Corporation*  
*Keynote Speaker*

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## Handouts

**COMPRESSION ENGINEERING CORPORATION**

**Engineering Services**  
2017

- **Energy analysis services:**  
For industrial compressed air, process vacuum, pneumatic conveying, process pumping, industrial process cooling and other similar electric motor-driven rotating machinery systems:
  - Walk-through and development of potential opportunities and solutions
  - Energy efficiency measure selection
  - Data-logging
  - Data-reduction
  - Analysis and simulation
  - Project budgeting
  - Report writing
  - Peer review
  - Commissioning
  - Inspection
  - Re-tuning/re-commissioning
  - Energy management
- **Project technical services:**
  - Control system specification
  - P&ID development
  - Equipment layout and piping design
  - Ventilation design
  - Submittal review
  - Commissioning
- **Miscellaneous services:**
  - Performance testing
  - Tuning and re-tuning
  - Leak assessments
  - Remote monitoring of key performance indicators
  - Project management
  - System start-up assistance and trouble-shooting
  - Standards and procedures development
  - Training

The Magazine for ENERGY EFFICIENCY in Compressed Air Systems

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December 2017



**System Control**

- 14 Air Compressor Control at Remote Mining Complex
- 24 Zinc Producer Reduces Compressed Air Use by 1,090 scfm
- 30 Compressed Air Dryer Fundamentals – the Last 25 Years

390 2017 WEEA  
Green & Color Magazine for Control

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**All materials presented are educational. Each system is unique and must be evaluated on its own merits.**

# BEST PRACTICES

2018 EXPO SEPTEMBER 17-19 CHICAGO O'HARE, IL

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– the **2018 Best Practices EXPO & Conference!**

Leading Manufacturing Managers and Compressed Air Industry Experts will share their system knowledge in a full 3-Day **Technical Exhibition and Conference** dedicated to making plants more profitable by optimizing Compressed Air, Blower, Vacuum, Chiller and Cooling systems.

## ***Date***

September 17-19, 2018

## ***Location***

Chicago O'Hare Crowne Plaza Hotel



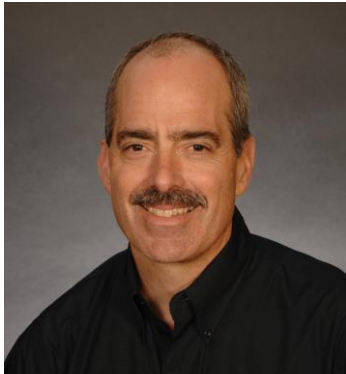
## IoT and Compressed Air Management Systems

Introduction by *Rod Smith*, Publisher  
Compressed Air Best Practices® Magazine

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## About the Speaker



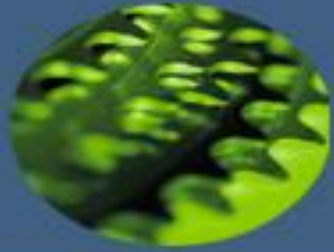
**Tim Dugan P.E.**  
Compression Engineering Corp.

- President and Principal Engineer of Compression Engineering Corporation
- Over 25 years of experience in the industry

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# IoT for Compressed Air

**Tim Dugan**  
**Compression Engineering Corp.**

For Compressed Air Best Practices®  
Magazine  
12-14-17

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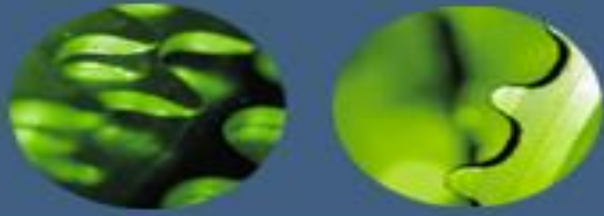


## Outline

- **Compressed Air Information You Need**
- **Existing Tools for Monitoring**
- **New Comp Room Tools for Monitoring**
- **New System Tools for Monitoring**
- **Emerging Tools**
- **Challenges**
- **Making It Happen**







# Information You Need

- Reliability Data
- Cost Data
- Quickly Accessible
- Using Tools You Are Familiar With
- Wherever You Are





# Existing Tools

- Gauges, Transmitters and Displays



- Some Are For Inspection
- Some For Trending
- Separate Systems



# Existing Tools

- PLCs, Master Controllers, SCADA Systems, & EMCS Systems





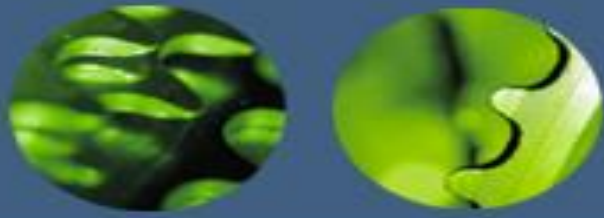
## Existing Tools

- *For Compressed Air*
- Which Ones Gets Used?
- By Whom, Why, and What For?
- Is There a Disconnect?



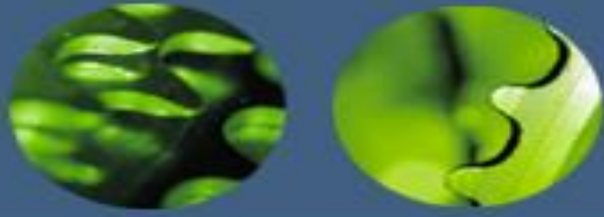
## **New Tools, Compressor Room**

- Equipment Control & Monitoring
- “HMI” Similar to PC or Smartphone
- Graphics - Multiple Screens
- Trending
- Local and Remote Similar – Browser Interface
- Usually Has Controller Set up As Fixed IP



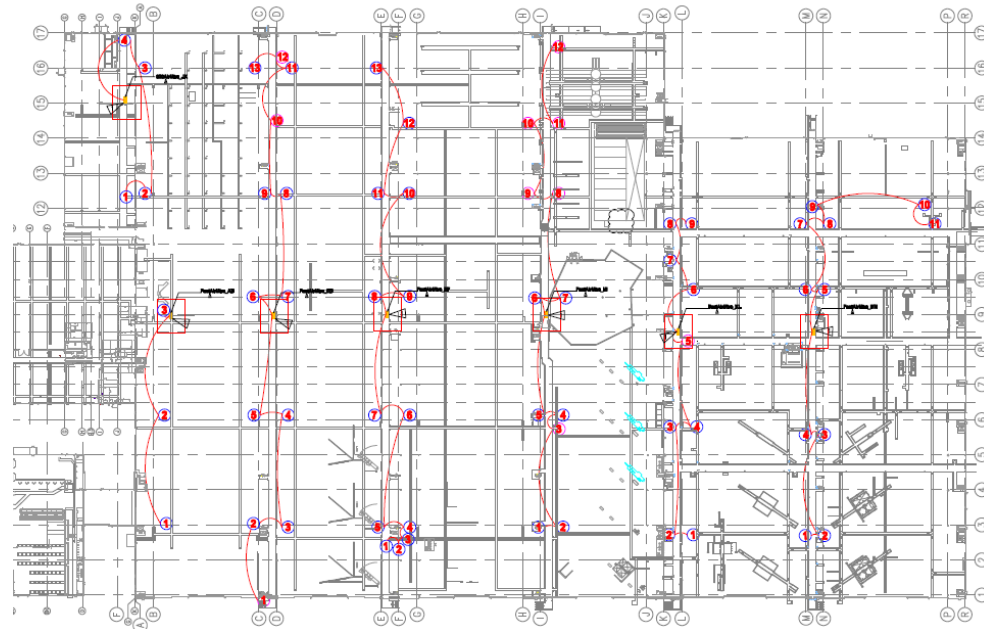
## New Tools, Compressor Room

- Smart Master Control w/ Integrated Monitoring, Remotely Accessible on a PC
- Compressor Power and Flow
- System Flow
- Real-time Calculation of “Key Performance Indicators”
- Specific Power, kW / 100 scfm or scfm / kW
- Min Flow on Weekend
- Max Production Flow



# New Tools Demand Side

- Wireless-enabled Sensors
- Ethernet-capable Sensors
- Metering Systems





# New Connectivity Tools

- Adding Digital to Analog, (HART for instance)
- Modbus Over Wireless
- Data Concentrators & Data Diodes
- Fast Cellular Data Modems
- Goal: Add New Remote Monitoring System Quickly, Cheaply, and Securely

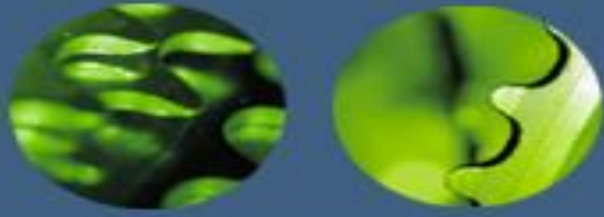




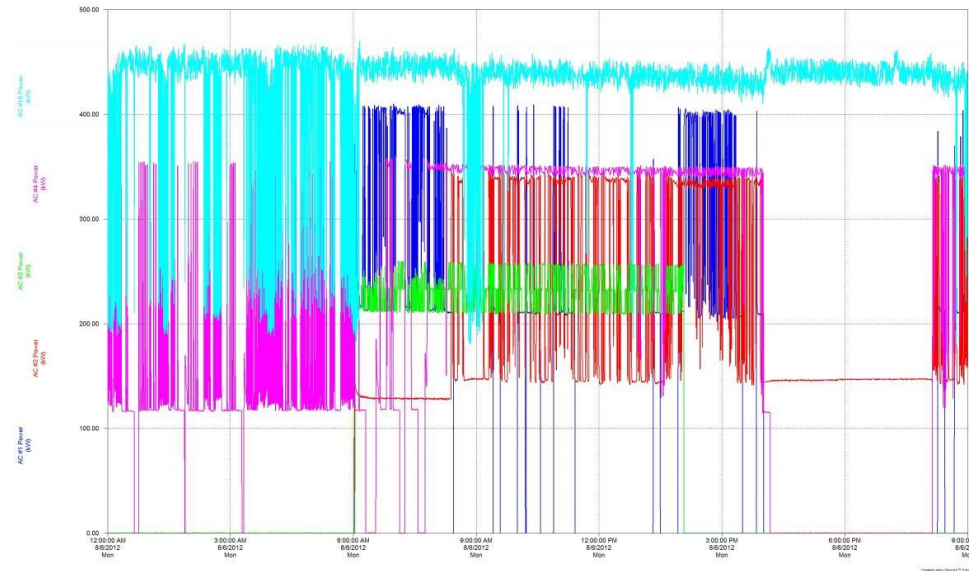


## Using the Internet

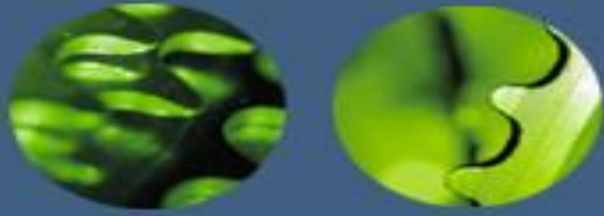
- In 1998, I was Chief Engineer for a Compressed Air Internet-Based Remote Monitoring Start-up.
- Technology Was Not Cheaply Available. Custom Server & PC Code Developed. \$\$.
- Slow Bandwidth.
- Typical Industrial Maintenance Staff Were Not Using the Internet Much.
- The Market Was for Controls, not Monitoring – no “Economic Value”.
- Boy, Have Things Changed ...



# Emerging Tools, Compressor Room

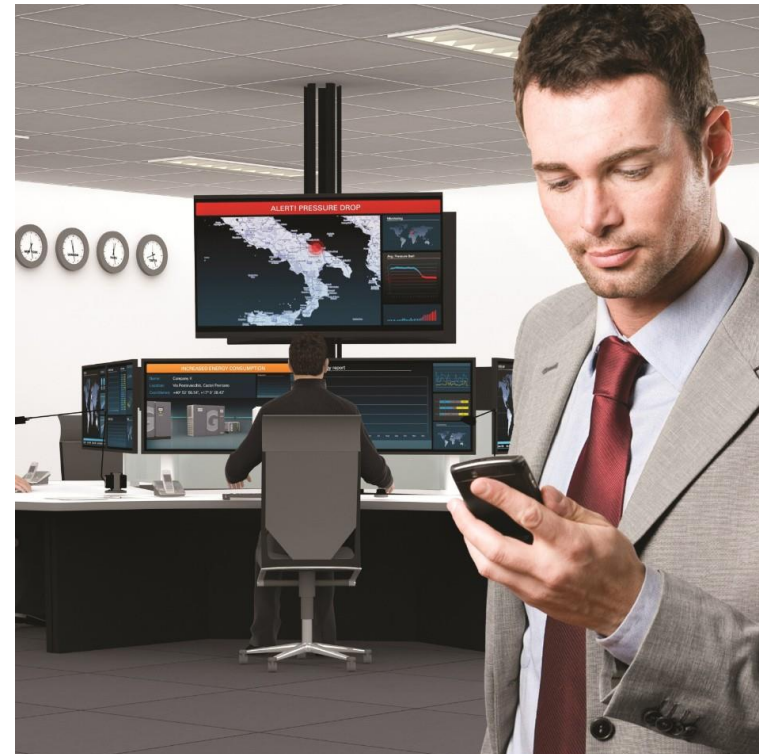


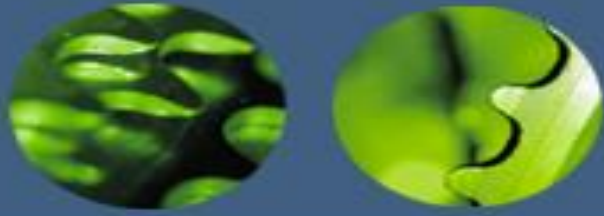
- Cloud-based, Secure Platforms for Manufacturing
- Cloud-based *Internal Utility* Monitoring, Including Compressors, Dryers, Filters
- IoT-enabled Field Devices Included (flow, power, etc)
- Automatic Performance Calculations (“Analytics”)



# Emerging Service Models, Equipment

- Leverage Best Resources, Wherever They Are, Empowered by Analytics:
- Plant Technicians & Engineers
- Corporate Reliability & Equipment Engineers
- Compressor & Dryer OEM Experts
- Controls Engineer
- Energy Analysis Engineer





## Challenges for New Tools

- Widely Varying Vintages of Equipment
- Different Equipment OEMs & Controllers
- Adoption of New Tech in Comp Air Lags
- Minimal / no Plant IT Support
- Lack of Training
- Minimal Local Support
- Incompatible Technologies
- Contradictory Needs From Different Staff



# Making It Happen

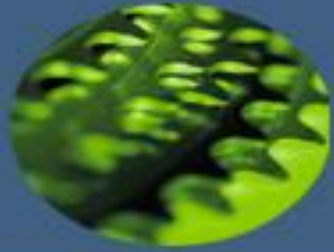
- Start with KPIs That You Need to See on Your PC.
- Pick Architecture
- Build a Spec for Monitoring Compressor Room & System That:
  - Empowers People
  - Leverages Resources
  - Uses the Internet
  - Simplifies Internal IT.
  - Simplifies wiring
- Sell Project to Upper Management
- Implement it Gradually





## Key Players

- You and Others Who Care About System Performance
- System Champion
- IoT Partner & Architecture
- Vendors Who Can be Integrated Into Architecture
- Key Integration Staff or Contractor
- Process Brains - Consultant & Corp Engineer
  - Empowered with Analytics Tools



**Thank you**

**Tim Dugan**

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## About the Speaker



**Jarno Manzke**  
Kaeser Compressors

- Technical Director for Kaeser Compressors and has been with the company since 2008



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Jarno Manzke  
Technical Director  
Kaeser Compressors, Inc.

## How the IIoT Will Change the Face of Compressed Air in Industrial Environments

## Industrial Internet of Things (IIoT)



## Industrial Internet of Things (IIoT)

“...automation technology is improved by the introduction of methods of self-optimization, self-configuration, self-diagnosis, cognition and intelligent support of increasingly complex work...”

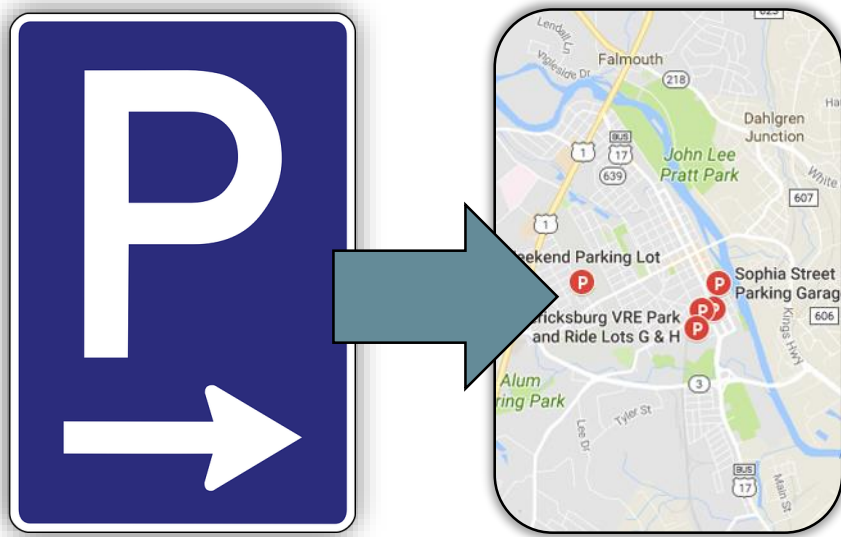
*Juergen Jasperneite,  
Automatisierungstechnische  
Praxis, Oldenbourg Verlag,  
Muenchen, September 2012*



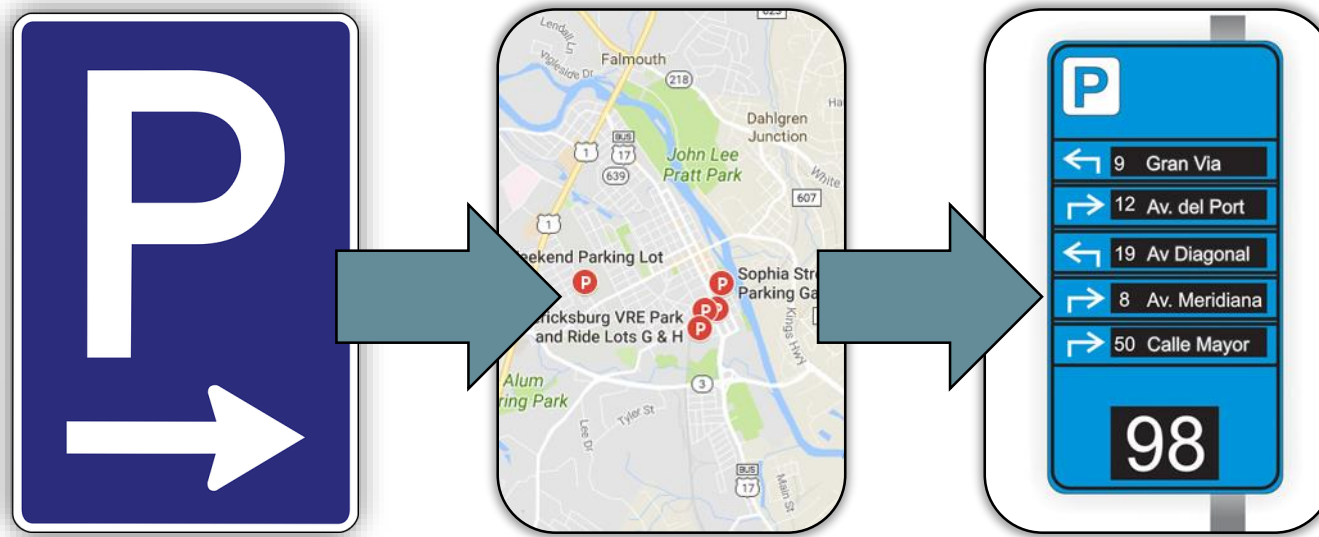
## Industrial Internet of Things (IIoT)



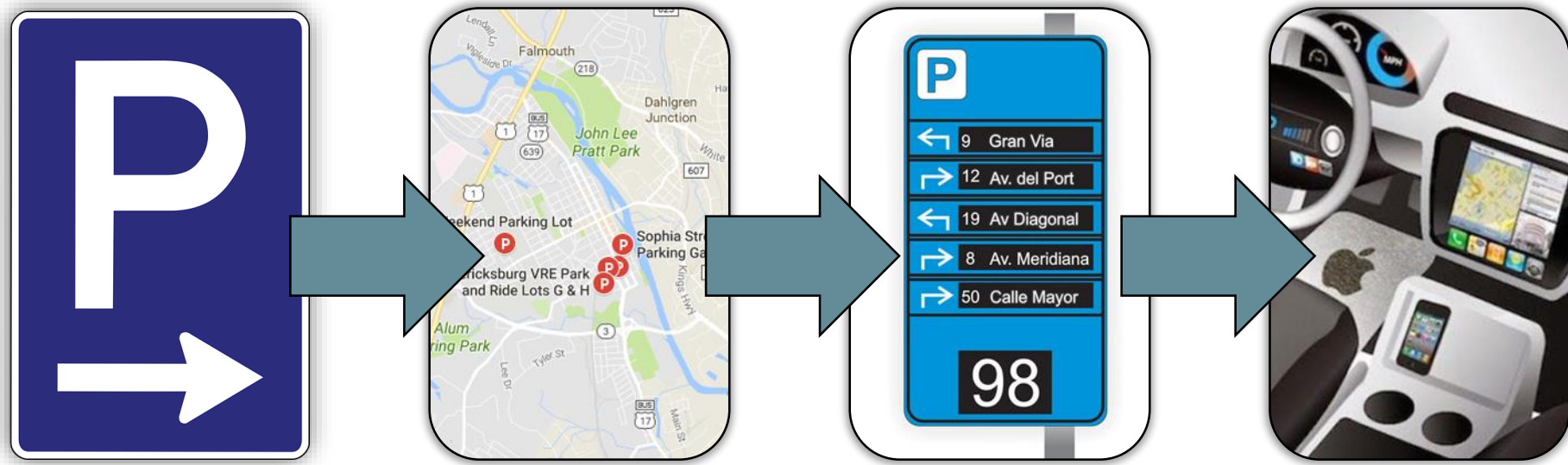
## Industrial Internet of Things (IIoT)



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## Industrial Internet of Things (IIoT)



## Key Features of Smart Factories and Smart Machines

**Improved Performance**

**Improved Safety and Security**

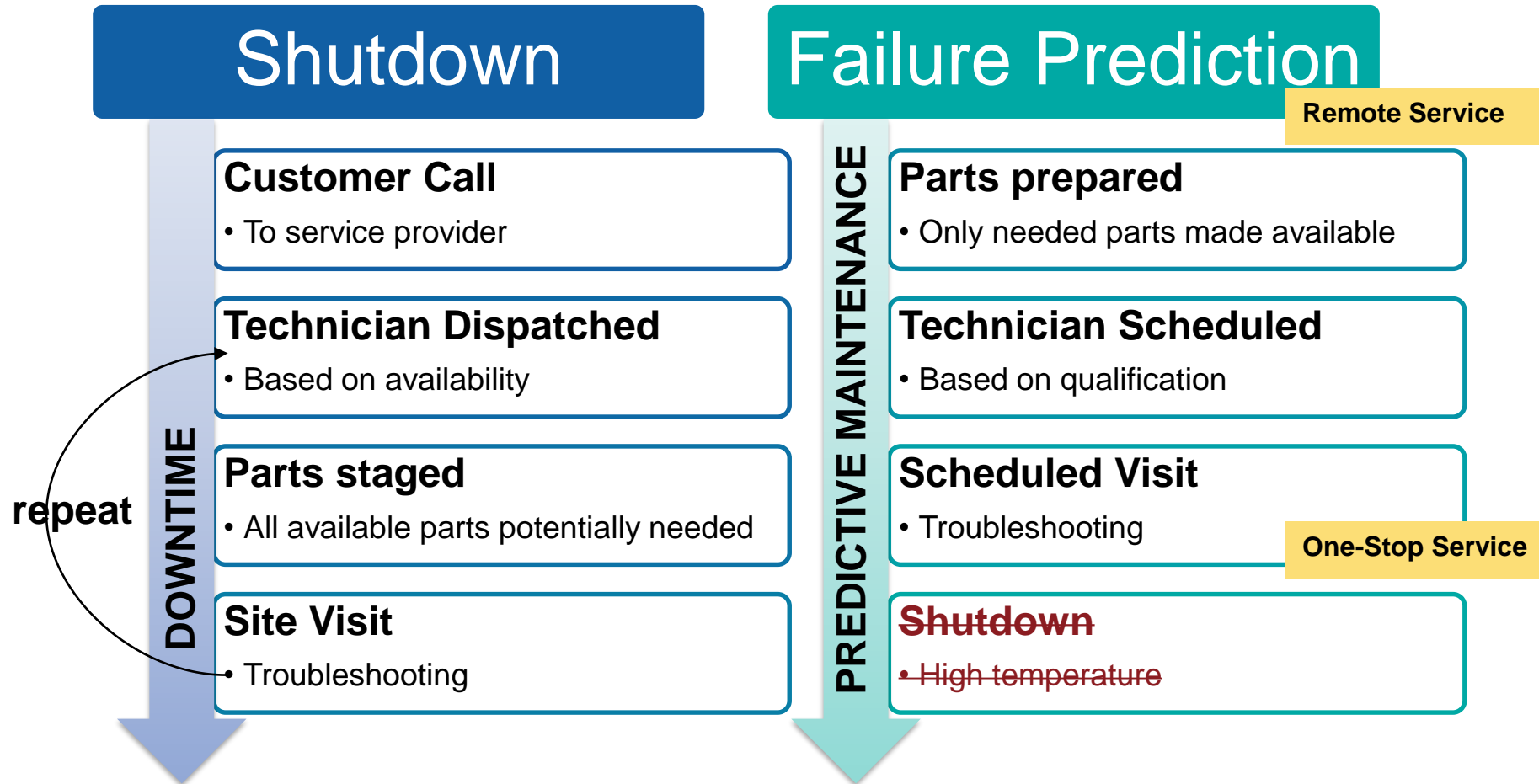
**Technology**



## Maintenance



# Typical Maintenance Scenario



## How can this be achieved?

### Failure Prediction

- Collect operational, user, and system data points
- Analyze data points to identify trends leading to certain events

### Preparing Parts

- Maintain complete bill of material including parts relationships
- Consider service history

### Scheduling Technician Visit

- Digitize list of each technician's skills

## IloT Benefits for the Compressed Air Industry

- Reduced
  - Asset life cycle cost
  - Energy costs
- Extended asset life
- Increased uptime
- Improved
  - Performance
  - Safety

Customer

- Improved
  - Just-in-time inventory
  - Diagnostics and troubleshooting
  - Safety

Service  
Provider

- Use collected data for product re-designs
- Improved just-in-time inventory

Supplier

## IloT Challenges for the Compressed Air Industry

- Invest in smart machines
- Allow remote system monitoring
- Designate operators to monitor performance and machines

Customer

- Hire / train skilled staff to interpret data

Service  
Provider

- Monitoring equipment
- Interdisciplinary system engineering during R&D
- New hard- / software for connectivity and data
- Focus on system engineering, analytics, security

Supplier



Thank you.  
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## IoT and Compressed Air Management Systems

### Q&A

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**Tim Dugan P.E.,**  
**Compression Engineering Corporation**  
*Keynote Speaker*

**Thursday, January 25, 2017 – 2:00 PM EST**

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