Internet of Things and Facility Management: Five Trends to Keep an Eye On

Jake Smithwick, PhD, FMP, SFP

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Today's Agenda

- Explain the "Internet of Things"
- Safety & Privacy Concerns
- Adopting new Technology
- Q&A

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- **Research Consortium** and applied expertise
- Integrated with **all parties** (owners & vendors)
- Provide **tools** & **hands-on support**:
  - Organizational Transformation
  - Procurement & Sourcing
  - Risk-based Partnering & Contracting
  - Project & Risk Management
  - Performance Measurements

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Arizona State University

THE UNIVERSITY OF KANSAS

UNC CHARLOTTE

The UNIVERSITY of OKLAHOMA

WASHINGTON STATE UNIVERSITY

WESTERN ILLINOIS UNIVERSITY

BRIGHAM YOUNG UNIVERSITY

TEXAS A&M UNIVERSITY

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- Becoming a **Client of Choice**
- Becoming a **Performance-Based Contractor**
- Other things:
  - Industry Benchmarking
  - Human Dimensions
  - Talent Development
  - Workforce Studies
  - Exploratory research
  - Policy & Regulations
  - Standards & Templates

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Arizona State University

KU The University of Kansas

UNC Charlotte

The University of Oklahoma

Washington State University

Western Illinois University

BYU Brigham Young University

Texas A&M University

20+ Years | 150+ Owners

3,000+ Projects | $15+ Billion Procured

Information Technology

Networking
Data centers
Hardware
COTS software
ERP systems
Help desk services
eProcurement

Facility Management

maintenance
landscaping
security service
building systems
industrial moving
waste management
energy management
custodial
conveyance
pest control

Health Insurance/ Medical Services

Manufacturing

Business / Municipal / University Services

dining
multi-media rights
fitness equipment
online education
document management
property management
audiovisual
communications systems
emergency response systems
laundry
retirement fund
material recycling
bookstores
furniture

Construction / Design / Engineering

Infrastructure
Municipal
Laboratory
Education
Hospital
Corrections
Financial
Renovation
Repair
Maintenance
Roofing
Specialty
Demolition
Development
DBB
CMAR
DB
IDIQ
JOC
Low Bid
IPD

BEST VALUE

- Google
- GE
- GP Georgia-Pacific
- LA DWP
- U.S. General Services Administration (GSA)
- US Army Medical Command
- Arizona State University
- Canon
- State of Oklahoma
- City of Phoenix, AZ
- University of Minnesota
- State of Alaska
- Rijkswaterstaat (Dutch public works & water management)
- Aramark
- State of Oregon
- State of Idaho
- University of Alberta
- Boise State University
- United Airlines
- Neogard / Jones-Blair
- Tremco
- Bank of Botswana
- General Dynamics C4 Systems
- Salt River Project (SRP)
- US Air Force Logistics Command
- US Coast Guard
- US Embassy (Botswana)
- US Army Corps of Engineers
- Federal Aviation Administration
- IBM
- Brunsfield
- Qwest
- Honeywell
- City of Peoria, AZ
- University of Idaho
- University of Hawaii
- University of New Mexico
- Entergy
- Sodexo
- Chartwells
- Dallas Independent School Dist.
- Olmstead County, MN
- City of Roseville, MN
- Hennepin County, MN
- Scenter
- Abengoa Solar
- City of Sitka, Alaska
- US Solar
- Rochester Public Utilities
- Harvard University
- Denver Health & Hospital Authority
- State of Missouri
- State of Washington
- Idaho Transportation Department
- State of Georgia
- Arizona State Parks
- United Excel
- East Valley Institute of Technology
- Arizona Public Service (APS)
- Rochester School District
- Fann Environmental
- Idaho State University
- On Semiconductor
- Pearson
- State of Wyoming
- Idaho Department of Corrections
- City of Miami Beach, FL
- Lewis & Clark State College
- Hawaii Department of Transportation
- Baptist Health
- City of Columbia, SC
- PECO Energy
- Intermediate District 287

PROJECT PARTNERS AND PARTICIPANTS:

PARTNERS


Google


GP
Georgia-Pacific


TREMCO


IFMA
International Facility Management Association
Empowering Facility Professionals Worldwide


LA
DWP


aps


NECA
NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION


PROJECT
SUMMIT


CPE
Center for
Procurement Excellence


Hallmark


EPA
VICTORIA
Environment
Protection
Authority Victoria


SMACNA


CLN
CONSTRUCTION
LEADERSHIP NETWORK

uOttawa


WADDELL
&REED


evergy


Brooklyn
Park


Western
UNIVERSITY · CANADA


Seattle City Light


BRITISH
COLUMBIA


LEDUC
COUNTY


The City of
SPRUCE GROVE
www.sprucegrove.org


THE SEAL OF THE STATE
OF ALASKA


SFU


UCI


DALHOUSIE
UNIVERSITY
Inspiring Minds


Kansas City Kansas
Community College


THE
Water
Research
FOUNDATION


STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION


CITY OF LOS ANGELES
FOUNDED 1781


City of Lawrence
KANSAS


electrical training
IBEW - NECA
ALLIANCE


UNIVERSITY OF CALIFORNIA
UCRIVERSIDE


BEST VALUE
EUROPE


COMPASS
GROUP


GE

By way of example…

https://www.engineersrule.com/how-a-coke-machine-and-the-industrial-internet-of-things-can-give-birth-to-a-planetary-computer/

- Early 1980s, Carnegie Mellon University
- Students had to walk a long distance to the Coke machine
- So, they rigged it up to the internet

https://www.ibm.com/blogs/industries/little-known-story-first-iot-device/

What is “IoT”?

Gartner defines it as,

“network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.”

https://www.gartner.com/en/information-technology/glossary/internet-of-things

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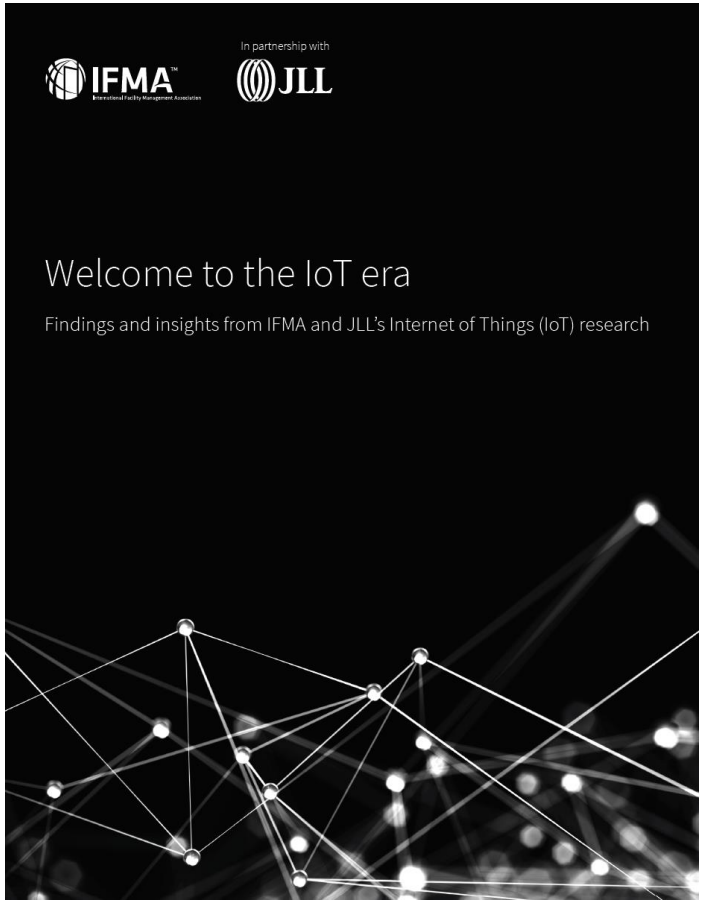
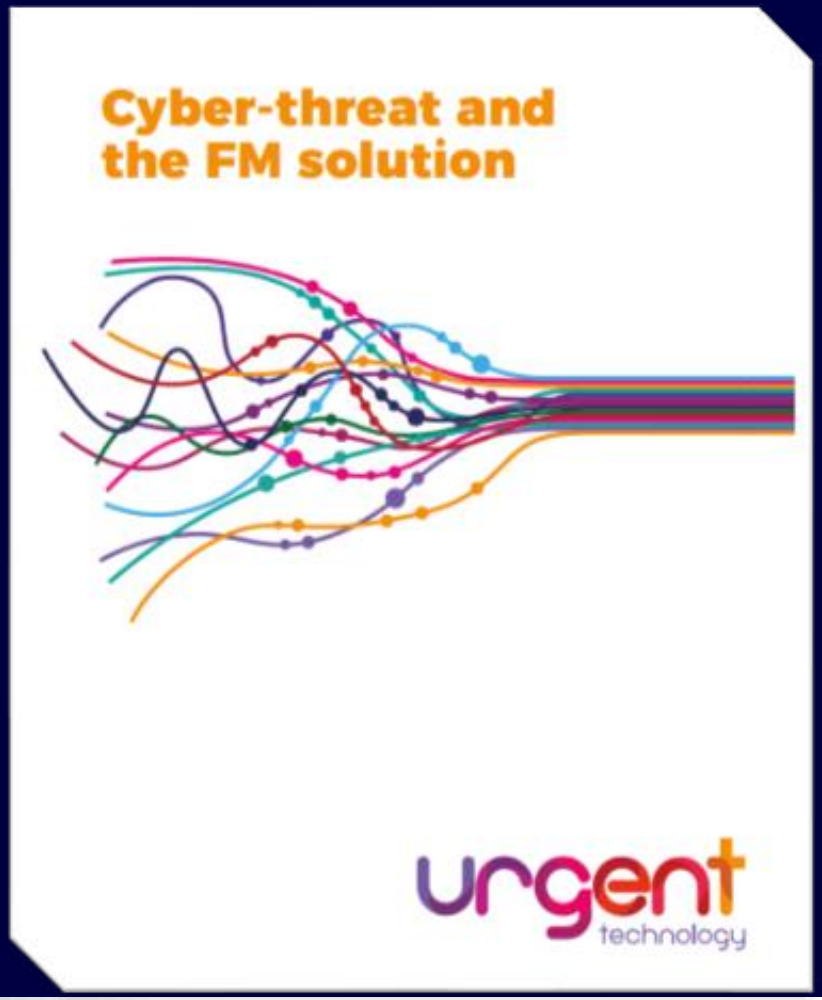
Resources

IFMA™ Engage
International Facility Management Association





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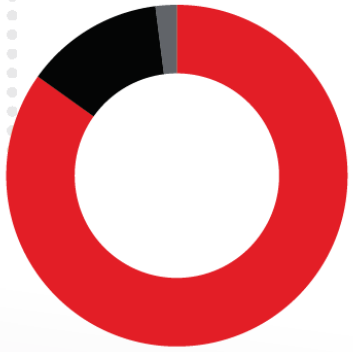
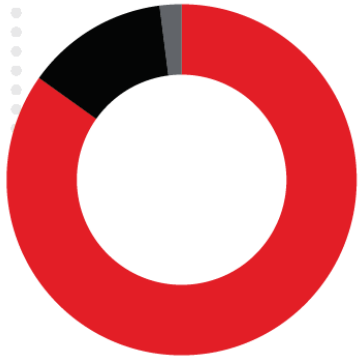
IoT Is Coming

I expect that the IoT will impact my job's activities within the next five (5) years.



- Agree/strongly agree **83.41%**
- Neutral **13.8%**
- Disagree/strongly disagree **2.79%**

I anticipate that the IoT will influence the skills required of CRE/FM professionals in the future.



- Agree/strongly agree **85.11%**
- Neutral **13.16%**
- Disagree/strongly disagree **2.02%**

"Welcome to the IoT Era", pp. 4-5

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FM Examples of IoT

- Sensors to monitor & control building & lighting systems
- Real-time data to adjust environments (e.g., dimming conference room lights)
- Predictive analytics… knowing when equipment could fail

"Welcome to the IoT Era", p. 3

Prevalence of IoT in Facility Services

The prevalence of IoT in the facility services industry

Claudia Höhenberger and **Alexander Redlein**

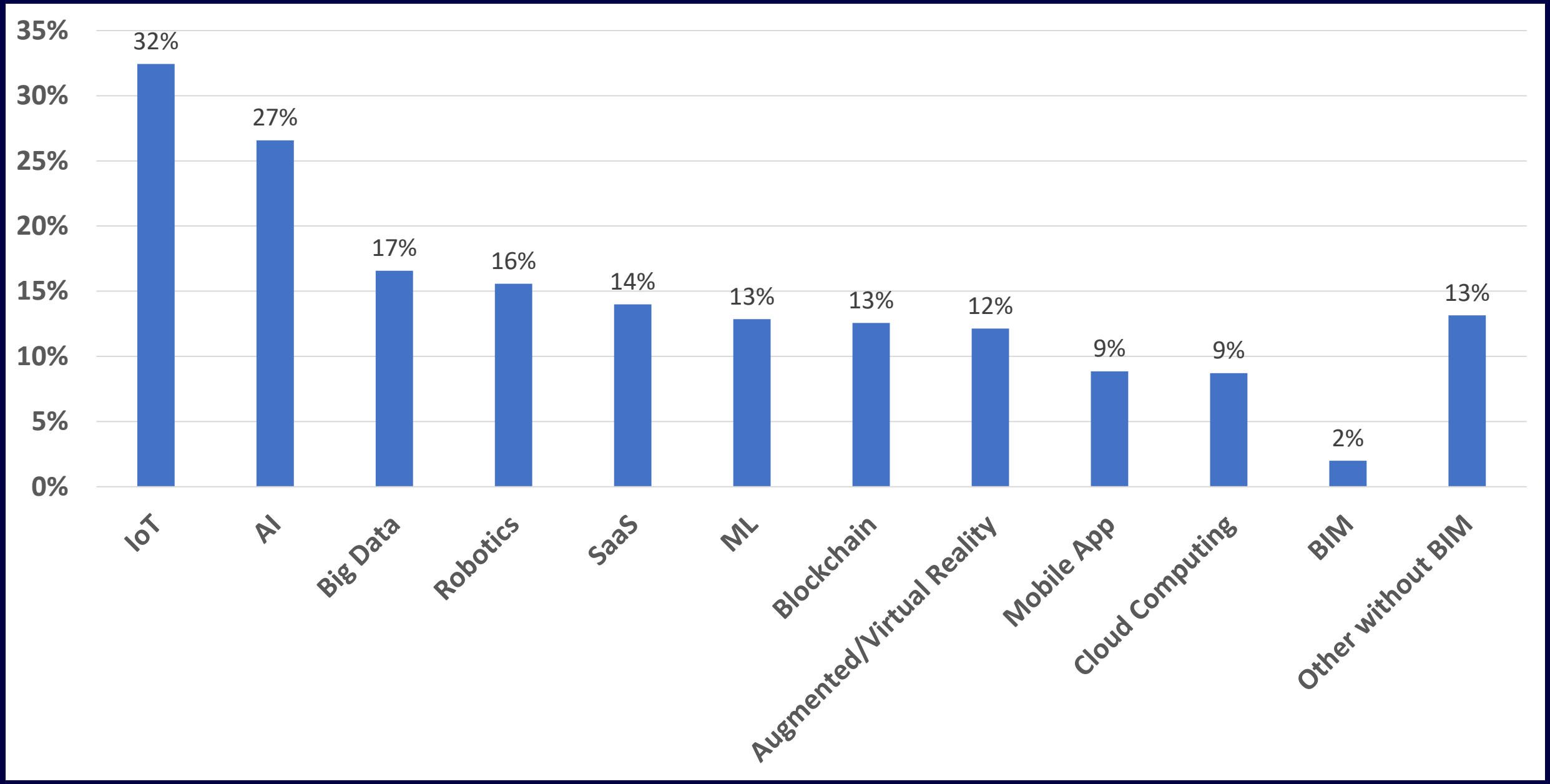
1 INTRODUCTION

There are many studies that analyze the impact of digitization on work processes. Most of these studies assume that routine tasks will be the most likely victim of this revolution. Drastic changes and shifts in skills will be required from workers, who are used to completing often repetitive tasks. (Nagl, Titelbach, & Valkova, 2017) (Stopajnik & Redlein, Current Labour Market Situation and upcoming Trends in the European Facility Service Industry, 2017) (Frey & Osborne, 2013).

Consulting firms like EY recently published reports on the progress of digitization in the real estate industry (Herrenkohl, Magrans, Buisman, & Banerjee, 2017). These reports often state that the industry is neither taking care of nor preparing for the changes (Nagl, Titelbach, & Valkova, 2017).

In Europe and the US around 10% of all employees work in the facility services industry, making the outsourced FS industry the 3th largest with regards to employment in the EU (Stopajnik & Redlein, 2017). Due to demographic changes and the lack of skilled people in

- Study of how new tools and technology affect provision of FM Services
- Three main questions:
  - What are the emerging technology?
  - What services are affected?


35%
30%
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27%
17%
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12%
9%
9%
2%
13%
IoT
AI
Big Data
Robotics
SaaS
ML
Blockchain
Augmented/Virtual Reality
Mobile App
Cloud Computing
BIM
Other without BIM

Maintenance and Operations

- IoT sensors produce accurate data of usage
- Helps improve energy consumption and delivering information for optimization (e.g., IBM Watson IoT sensors and cloud services
  - 1.1 million elevators and escalators worldwide.
- Sensor remotely observes machinery, and identify and predict failures before equipment breaks

Energy

- Electric load forecasting is used to predict spikes in electricity.
  - Research project used mobile phone data, census data, and electric load data to create model energy use in Trentino, Italy. The cell phones are used as presence sensors.
  - Data collected from these IoT devices was then analyzed and mapped to create a representation of the changes in population of Trentino

3D Sensing

- What is 3D sensing?
  - 3D sensing is the depth sensing technology that modern camera and equipment uses in a wide range of application ranging from augmented reality, gaming, autonomous driving etc.
- Where can 3D sensing be found?
  - Infrared gesture sensors as found in modern consoles such as the Xbox one.
  - Augmented reality as found in modern smartphones
  - 3D sensing can also be found in specialized scanner for sites/room (Some smartphones have this capability.)
  - Self driving cars.
- Importance:
  - Future of many industries involves 3D sensing.
  - In the construction industry, 3D sensing can be used to overlay the job to drawings.

https://www.tek.com/application/3d-sensing

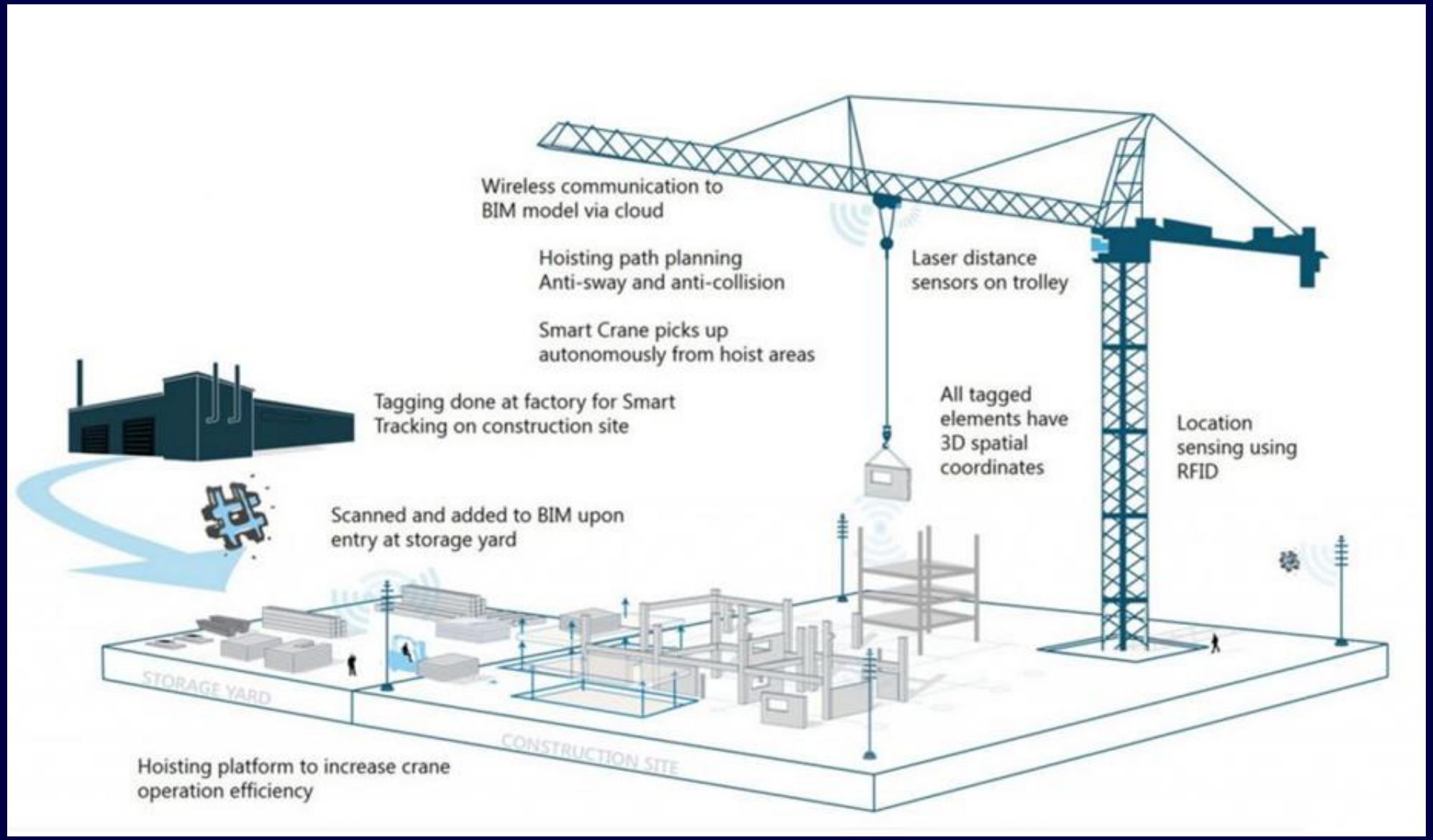
What are the problems?

- Collisions between bridges and oversized trucks
- Misalignments between prefabricated bridge components
  - Accelerated Bridge Construction

http://photoblog.nbcnews.com/_news/2011/06/28/6966971-two-hurt-in-atlanta-after-truck-hits-bridge?lite

http://www.utsandiego.com/news/2013/May/25/ntsb-bridge-collapse-in-wash-is-wake-up-call/

http://www.flickr.com/photos/iowadot/sets/72157628416564269/



https://www.todayonline.com/singapore/search-ways-make-flat-construction-speedier-more-productive

Condition-based Maintenance & IoT

Condition Based Maintenance: a UK pilot study

Ruhul, Amin[1] and Peter, McLennan[2] and Michael, Pitt[3]

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[2] Mr, University College London, Central House, 14 Upper Woburn Place, London WC1H 0NN; email: p.mclennan@ucl.ac.uk
[3] Professor, University College London, Central House, 14 Upper Woburn Place, London WC1H 0NN; email: michael.pitt@ucl.ac.uk

Abstract

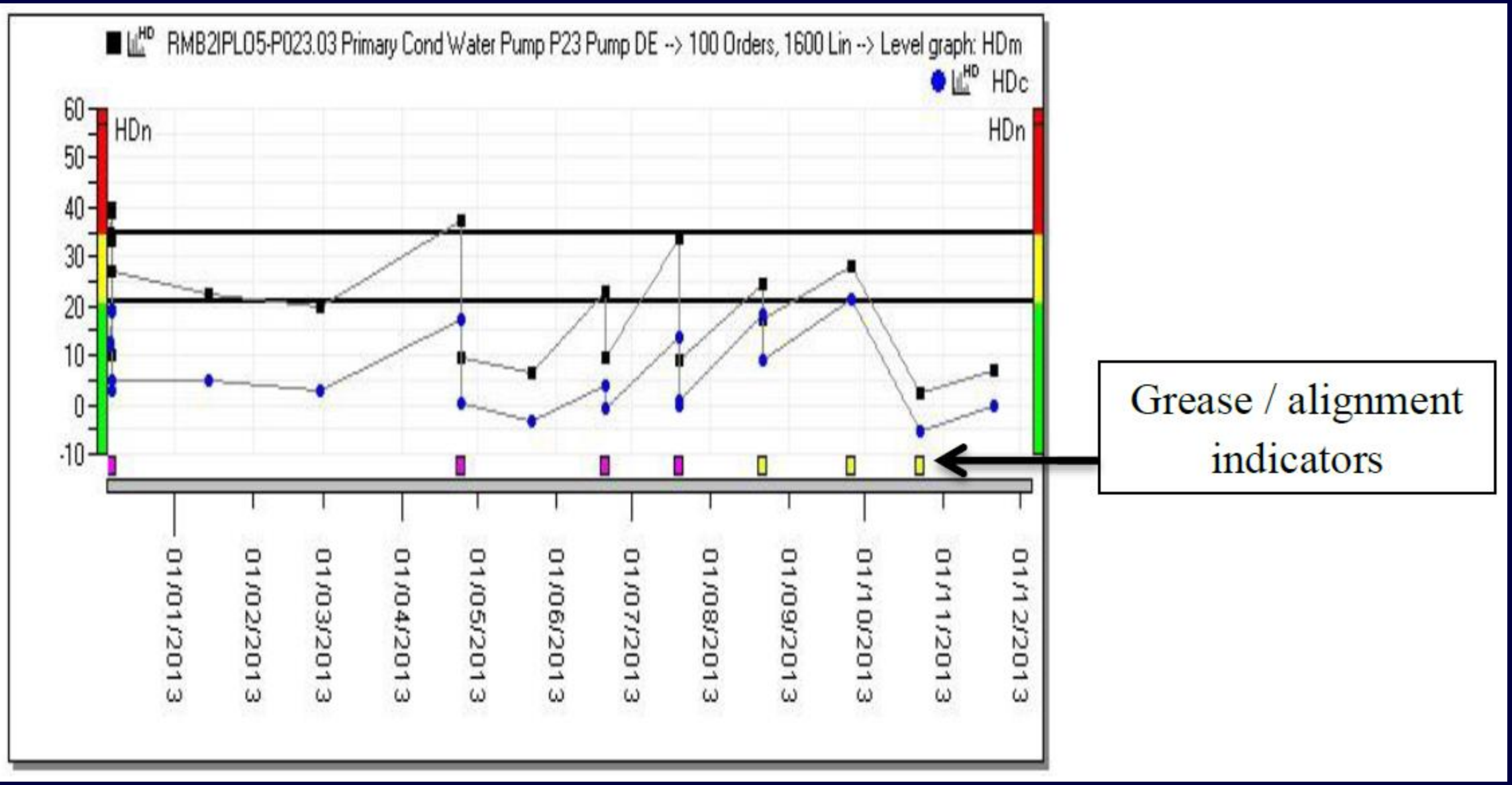
Condition based maintenance (CBM) is a technique that relies on data and analysis to identify and diagnose equipment faults through the use of sensors and other data collection devices. CBM is used normally for high asset value equipment in sectors such as aviation and automobile racing (Formula One). As a proactive maintenance technique, CBM is rarely used in the general maintenance areas of the built environment. It is believed generally that CBM is too expensive given the normal equipment asset values within the built environment. Therefore, a fifteen-month monitoring study was undertaken manually to determine the feasibility and impact of CBM on eighty-three rotary assets (valued at £1.5 mil. and about 5% of the existing centrifugal pumps and air handling unit fans and motors) in a large public sector building in the UK (over 1 mil. square meters of space) with a maintenance budget of circa £4 mil per annum. The benefits of moving to a CBM approach are expected to have positive impacts on the reliability, downtime, replacement and operational costs, and life of an as

- 15 month pilot study
  - 67 Centrifugal pumps / motors
  - 16 AHU supply / extract fans
  - About £1.5 million
- Same make, same age, same maintenance schedules

The need for this study

- 48% of the asset had faults from the vibration analysis [even though that had been maintained according to the schedule]

- Before this study, owner reported a “reactive” replacement of fan motor bearing… several weeks of downtime & twice the cost [compared to appropriate maintenance costs]


RMB2IPL05-P023.03 Primary Cond Water Pump P23 Pump DE --> 100 Orders, 1600 Lin --> Level graph: HDm
HDc
HDn
HDn
60
50
40
30
20
10
0
-10
01/01/2013
01/02/2013
01/03/2013
01/04/2013
01/05/2013
01/06/2013
01/07/2013
01/08/2013
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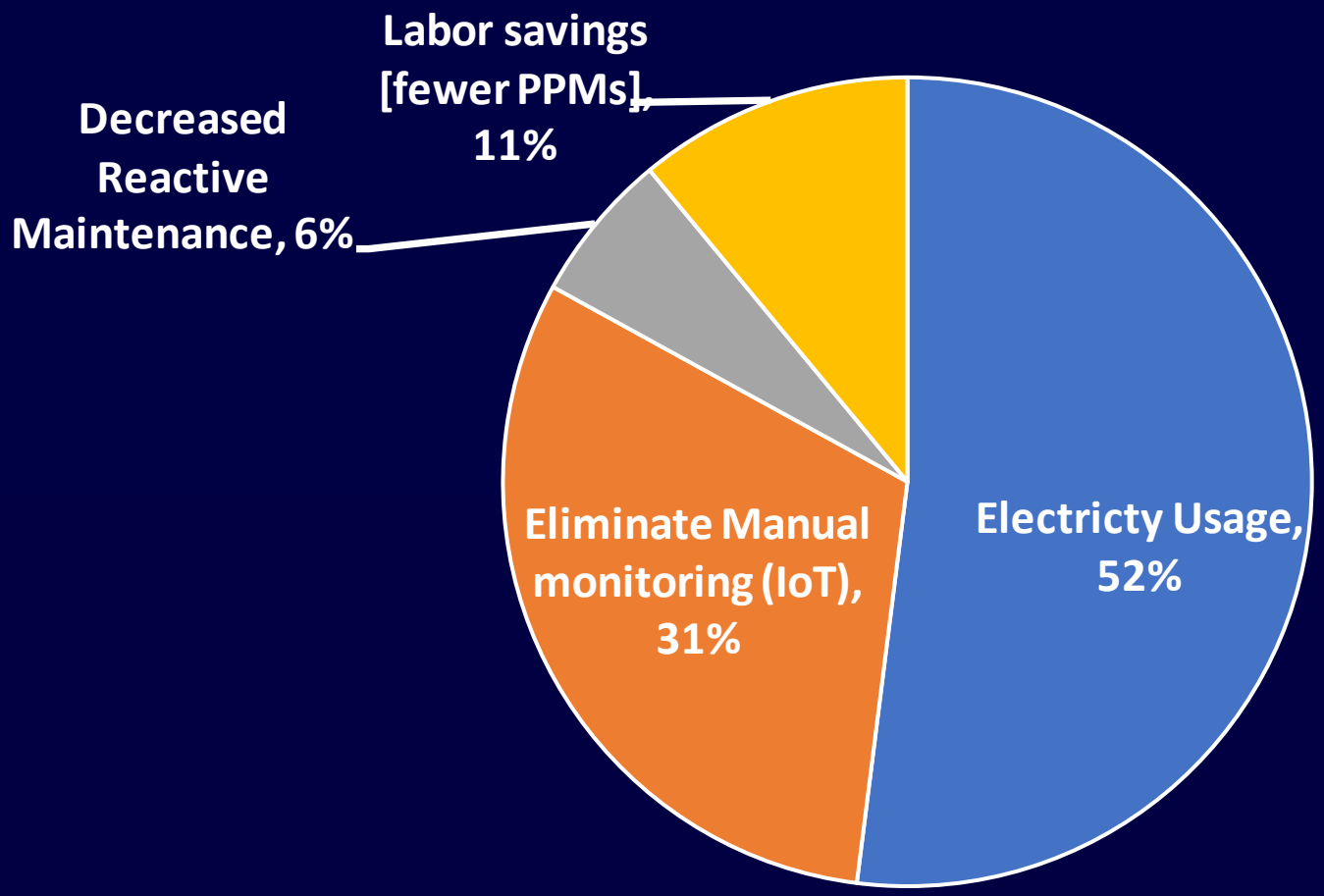
01/10/2013
01/11/2013
01/12/2013
Grease / alignment indicators

Cost / Benefit Analysis: 239% Savings



What Does Resistance Look Like?

- “But we’ve always done it that way…”
- “We already do that…”

- “We don’t have the time…
- “Let’s skip this part, we need to get moving ASAP…”
- “Why don’t we hybrid-ize this portion…”

- “In all my years of experience…”
- “I don’t think these changes will have much of an impact…”

OCM Case Study in FM
Semiconductor Manufacturing Facility

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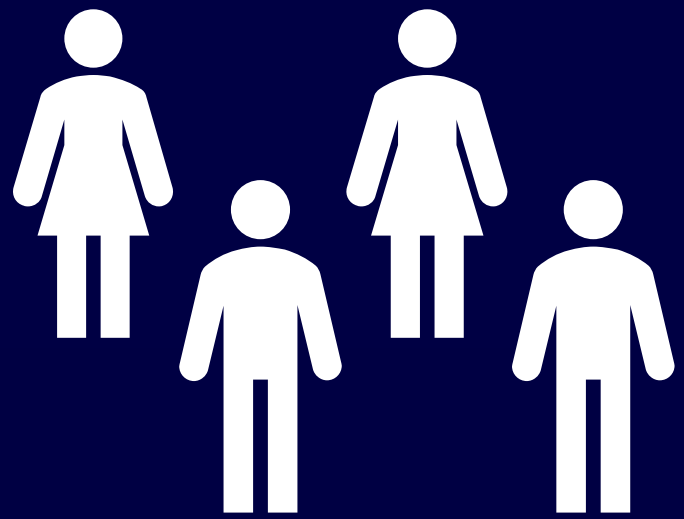
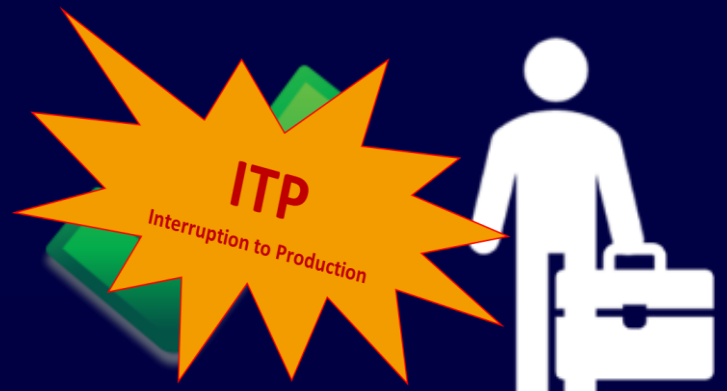
OCM Case Study in FM





Change Agent Leaves on Sabbatical

Worst ITP Rates in History!!!

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OCM Case Study in FM

"Well boss, it was going so well, **we stopped collecting the data**"

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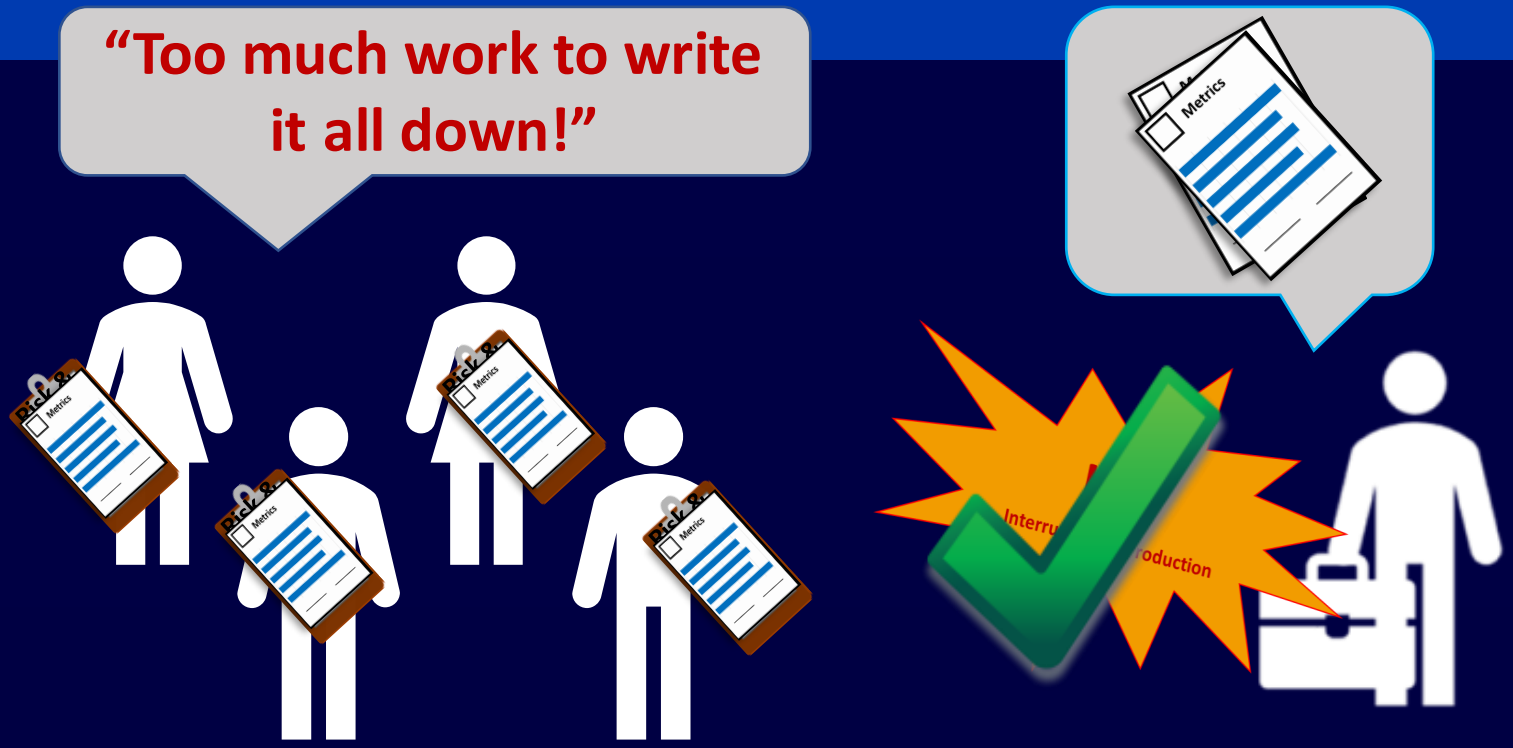
OCM Case Study in FM



OCM Case Study in FM

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OCM Case Study in FM

SIMPLAR

OCM Case Study in FM

By shift?
By crew?
By equipment/technology?

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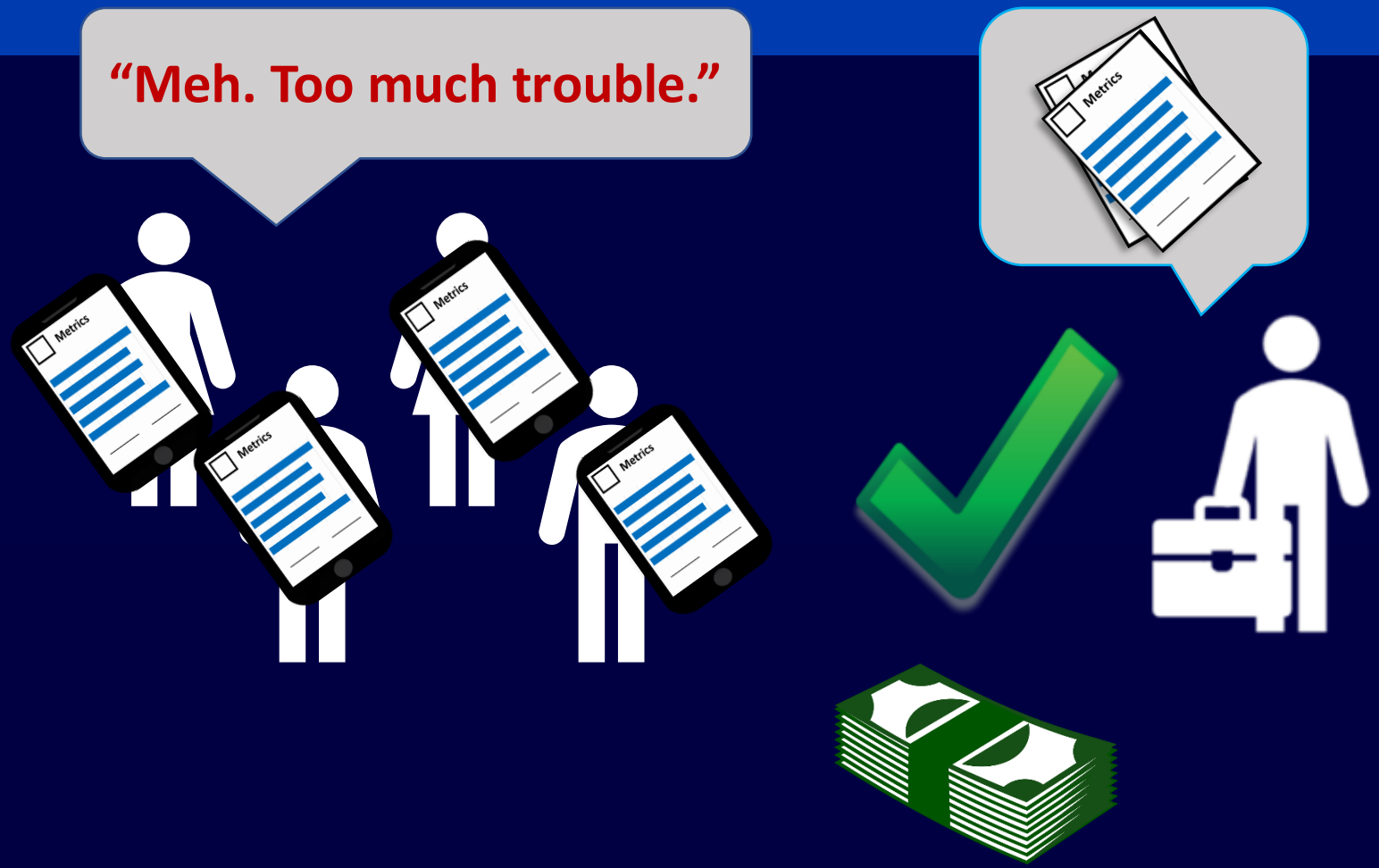
OCM Case Study in FM



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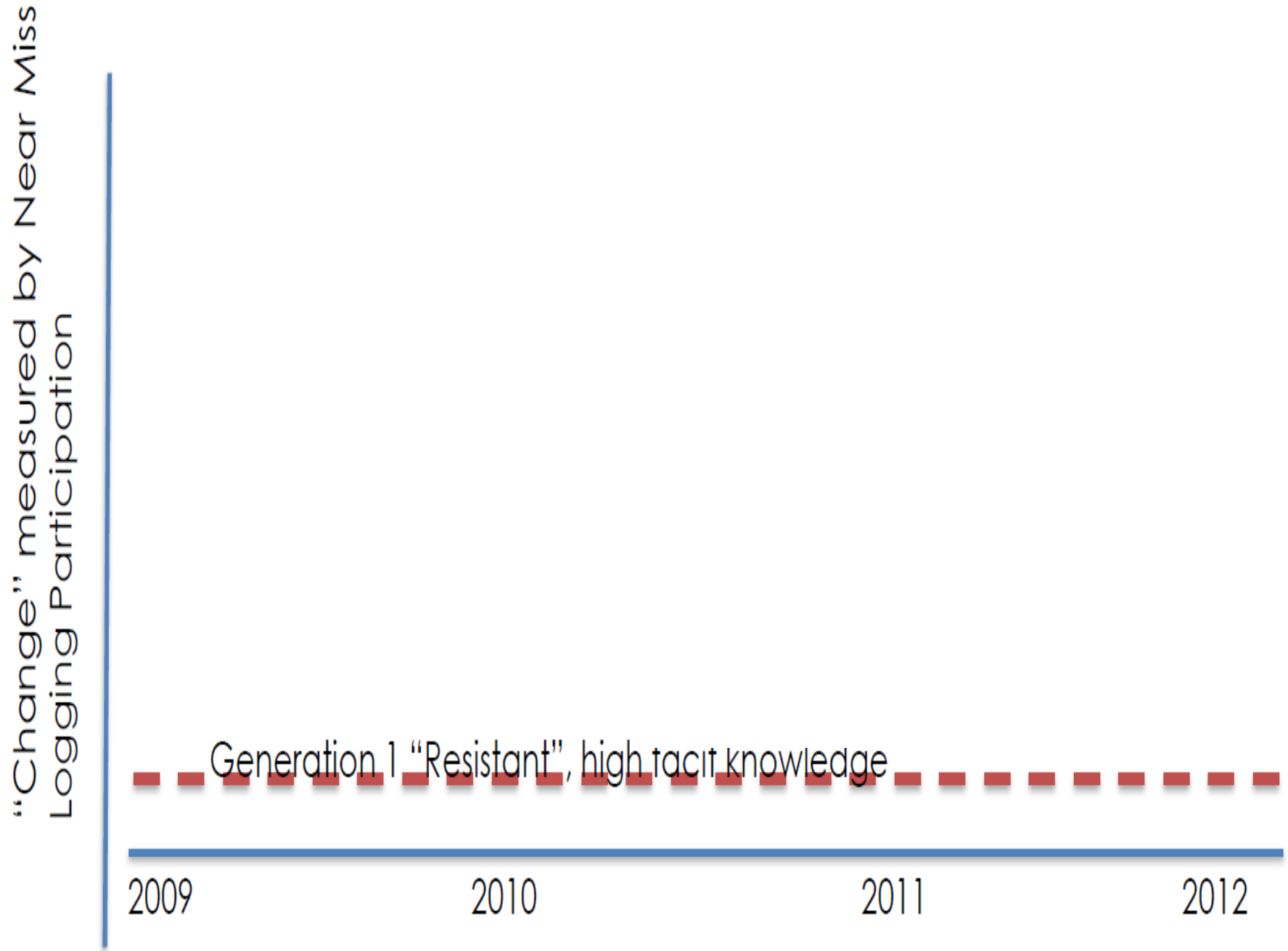

"Change" measured by Near Miss Logging Participation
Generation 1 "Resistant", high tacit knowledge
2009
2010
2011
2012

What about leadership issues?

- Andrew Rennert M.S. Thesis, “CMMS: Misconceptions Between Management & Employees”

Computerized maintenance management systems (CMMS) are largely underutilized, often leading to the loss of efficiencies in an organization’s maintenance program

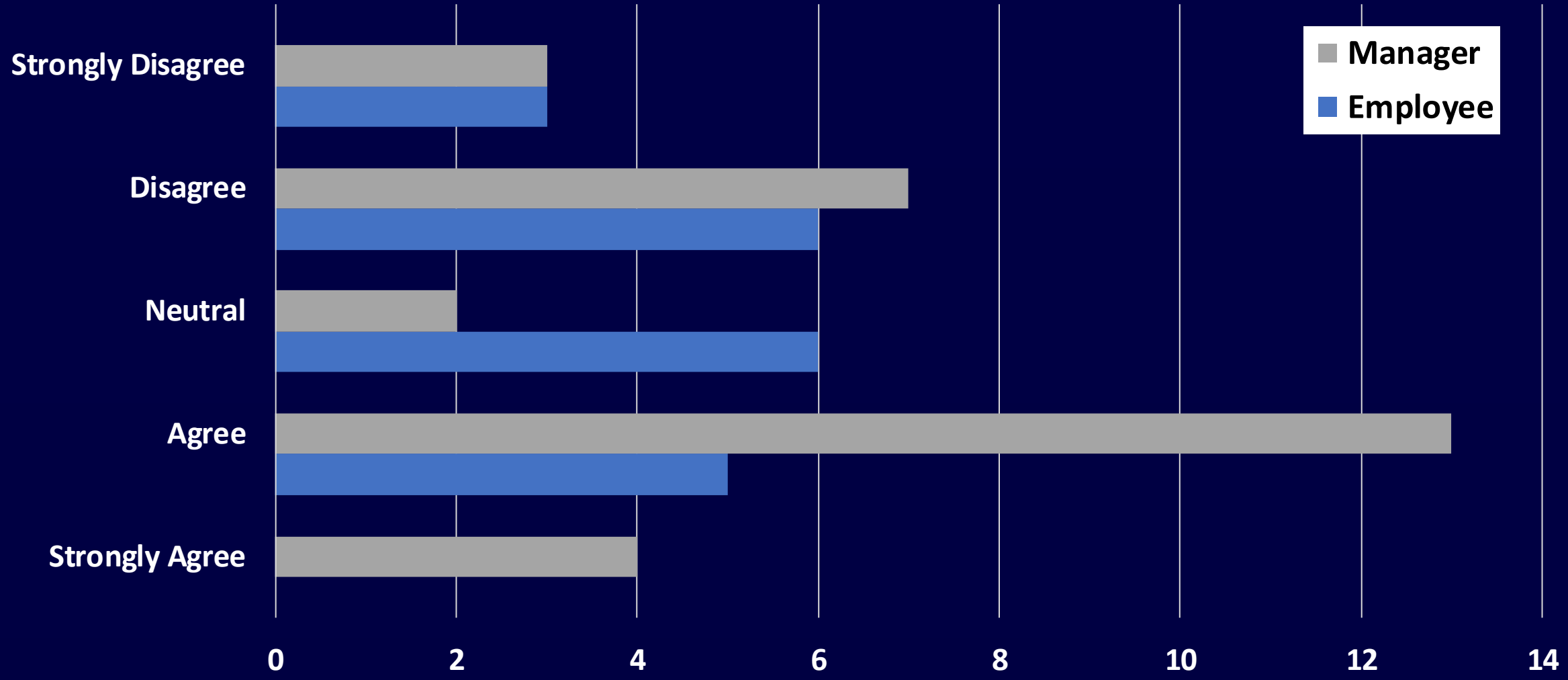
Research Objectives

- Better understand how management and employees feel about their CMMS programs
- Discover perceptions management may have about employees and vice versa
- Understand how each group (employees or management) may be invested, or lacking investment, in the program's integrity.

Challenges with Implementation

- Many employees may struggle with change
- Confidence in a CMMS program can drop even more if employees are not included within the implementation process
- In order for a CMMS to be effective, considerable data and training that aligns with implementation timeframe must be executed
- Fundamental management or philosophical issues can impede reports delivered by a CMMS

Management has shown continued involvement in improving the CMMS beyond the implementation stage.



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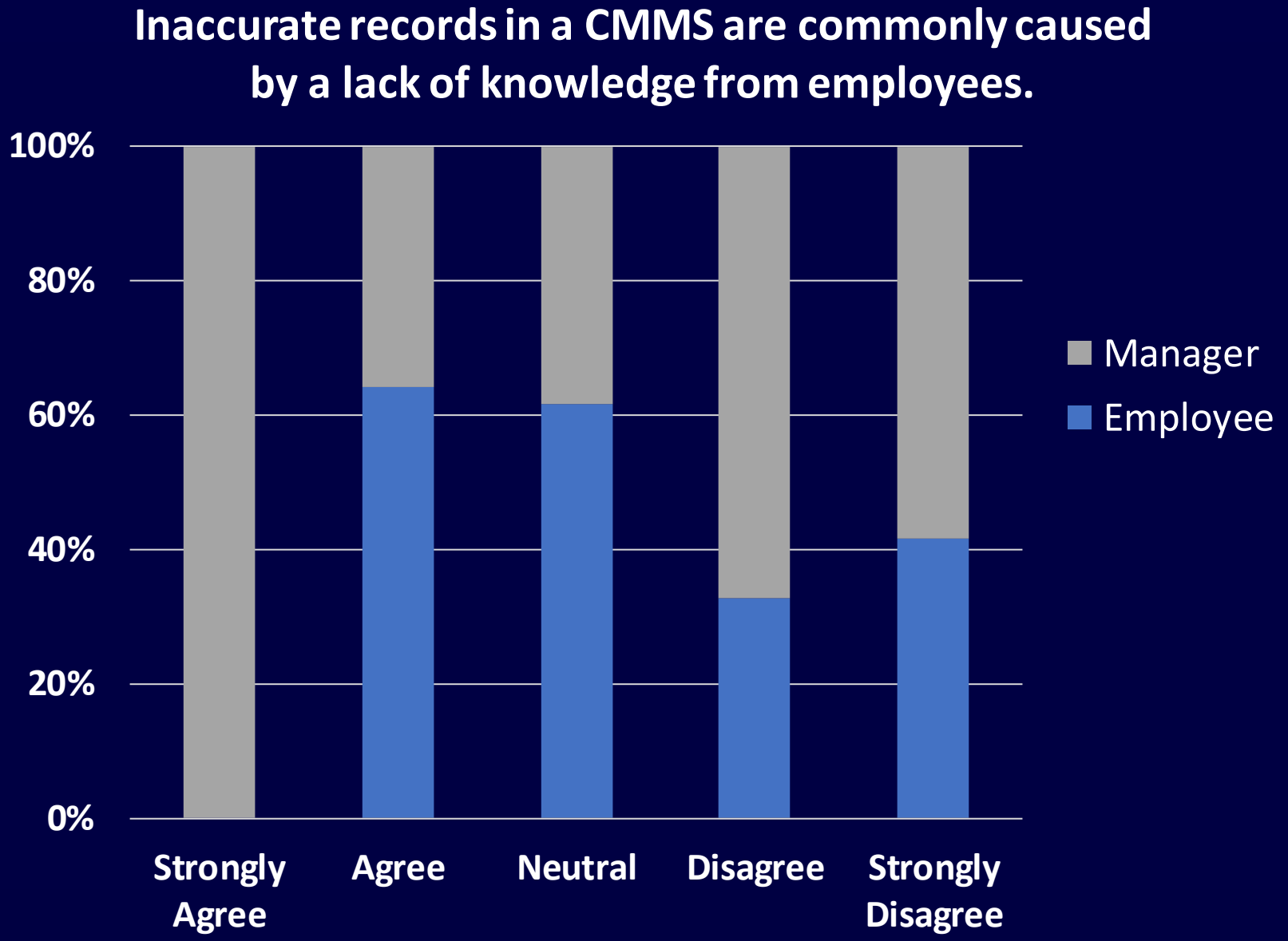
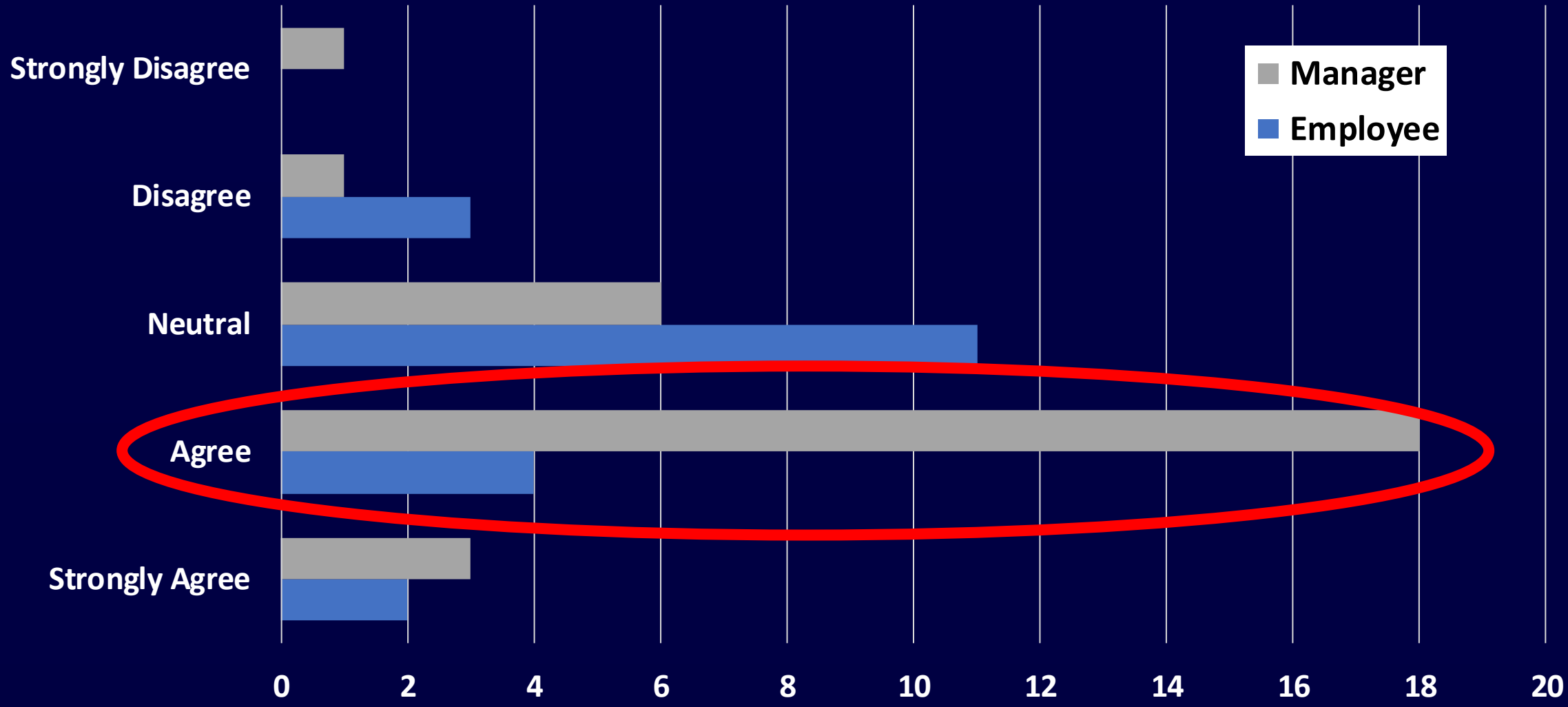


- Inaccurate records based on employee knowledge
- 50% of employees agree that inaccurate records in a CMMS are commonly caused by a lack of knowledge

Inaccurate records in a CMMS are commonly caused by a lack of motivation from employees.



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Security Concerns

- One common risk area: integration with legacy systems
- Data governance and use of standards
- FM's have an important role in IT security

Summary

1. IoT is becoming more embedded in our facilities

2. Change management is a huge part of this being a successful outcome

3. We can leverage the technology to enhance the value to our customers