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**Technology Infusion
with E&C**

2017 Engineering and Construction Conference

Agenda

Module/Topic

Growing the business using technology

Latest in technology

Cushman & Wakefield Services – Virtual Reality and AI

Suffolk Construction – Virtual Design Construction

Geisler – Impact of Driverless Cars on Real Estate

Q&A

Growing the business

Industry investment in technology

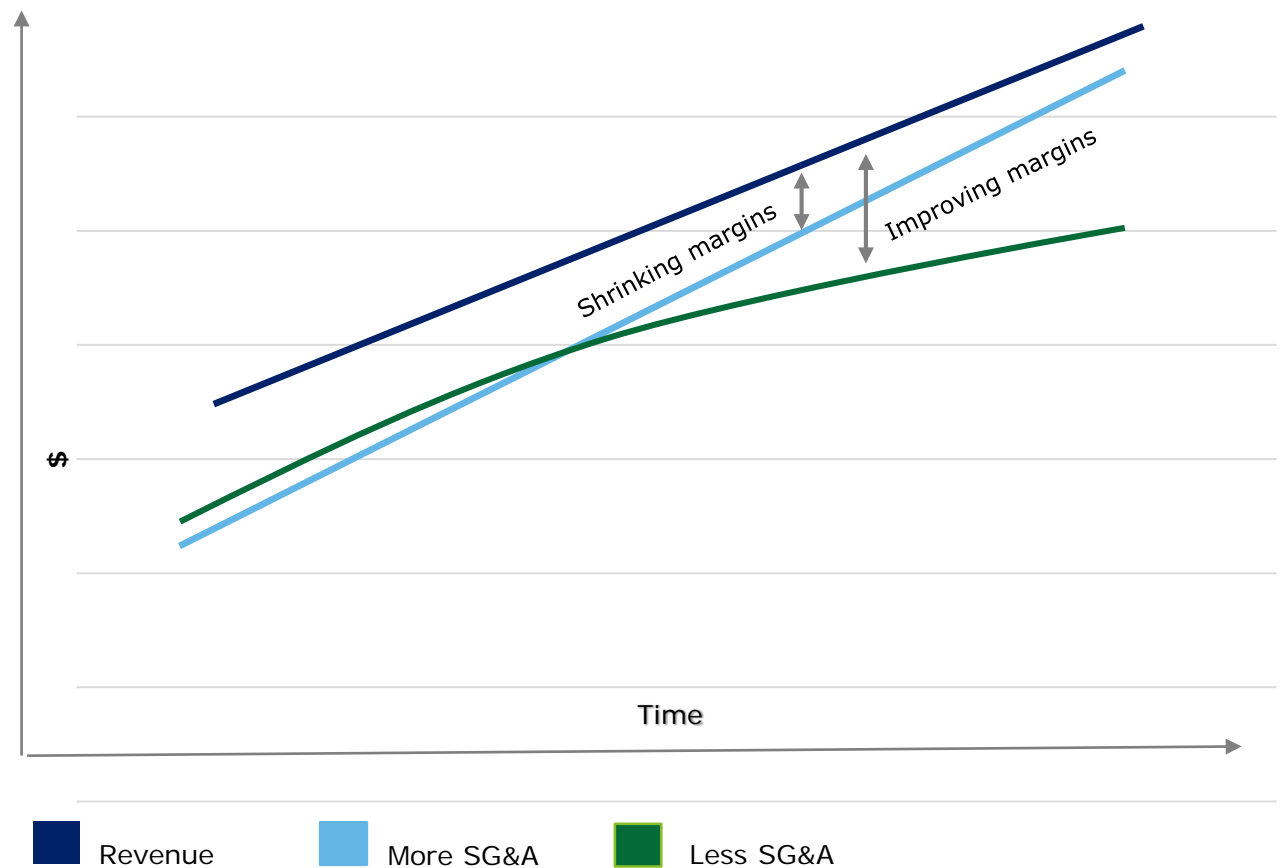
Argument for growing your technology spend

Investment in technology is likely to have positive effects on profit margins by reducing SG&A. Technology allows companies to deliver larger revenue projects with the same or reduced support team. Use of technology and integration may result in higher initial costs but bigger margins in the long run.

Industry Trends

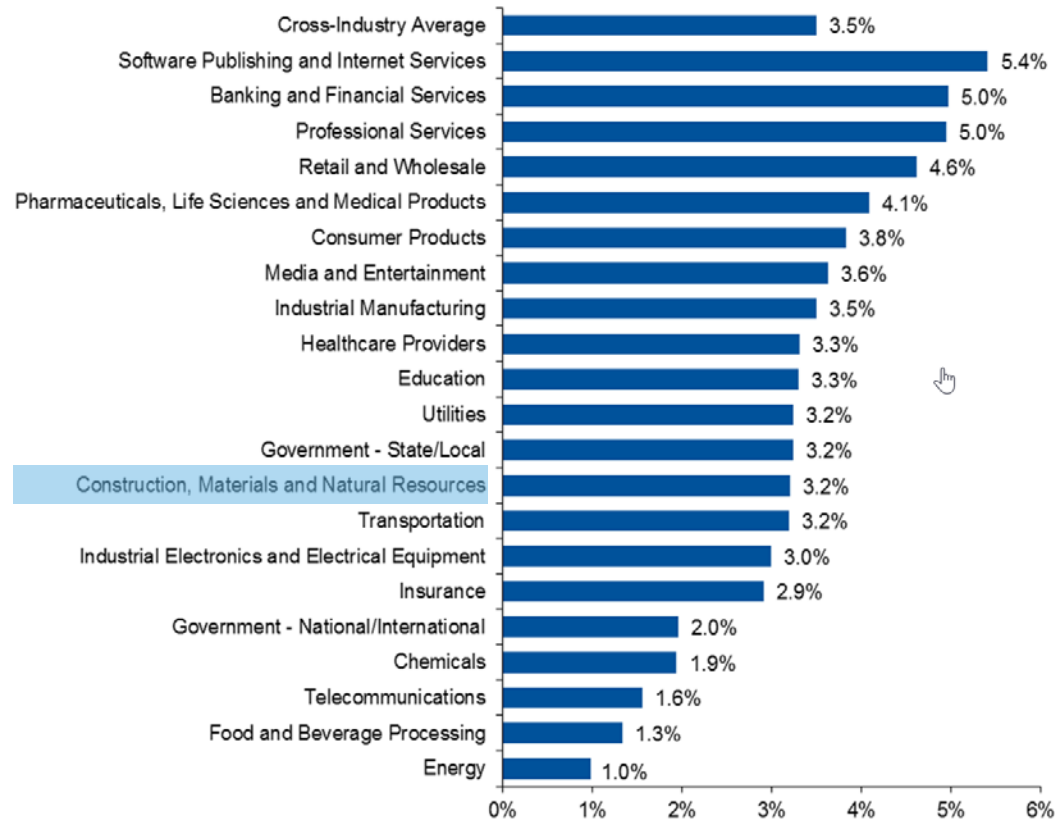
- Digital transformation
- The shifting role of ERP to Cloud and Digital
- BIM, Augmented Reality, Cognitive and Robotics
- The “field tech”, the end of the back-office investment
- Tech savvy and millennial focused workforce
- Labor shortage
- IoT coming on line everywhere

Profit Margin Affected by the Use of Technology and Integration



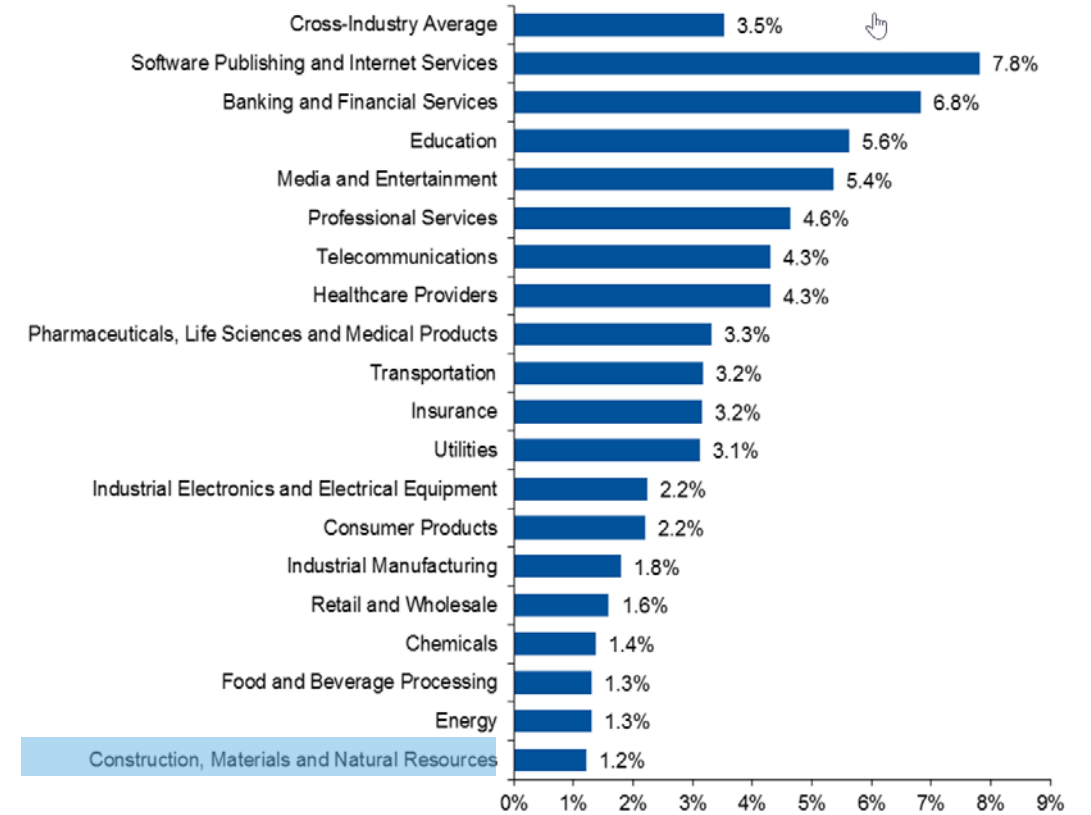
The state of technology spend in E&C

IT Spending Percent Change, by Industry, 2016. Up 0.6% from 2015, expected 2.5% jump in 2017.



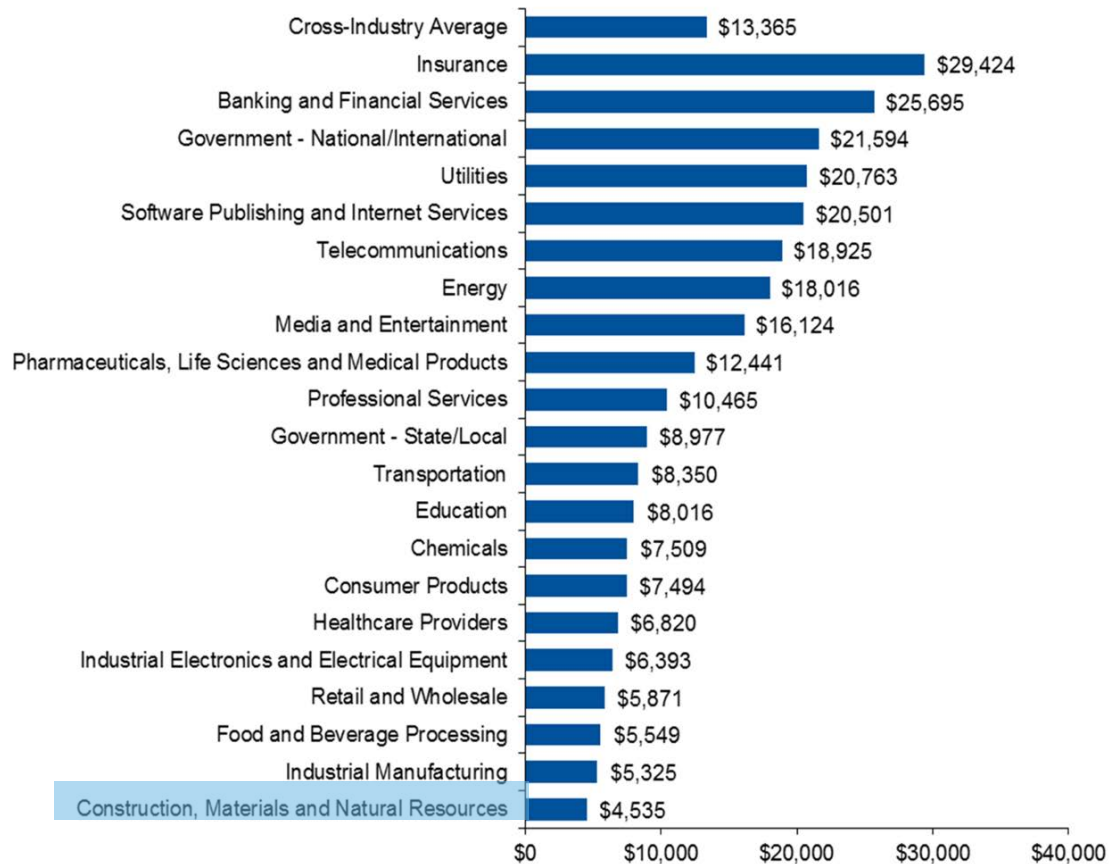
*SOURCE: GARTNER IT KEY METRICS DATABASE, March 2017

IT Spending Percent of Revenue, by Industry, 2016. Same as 2015.

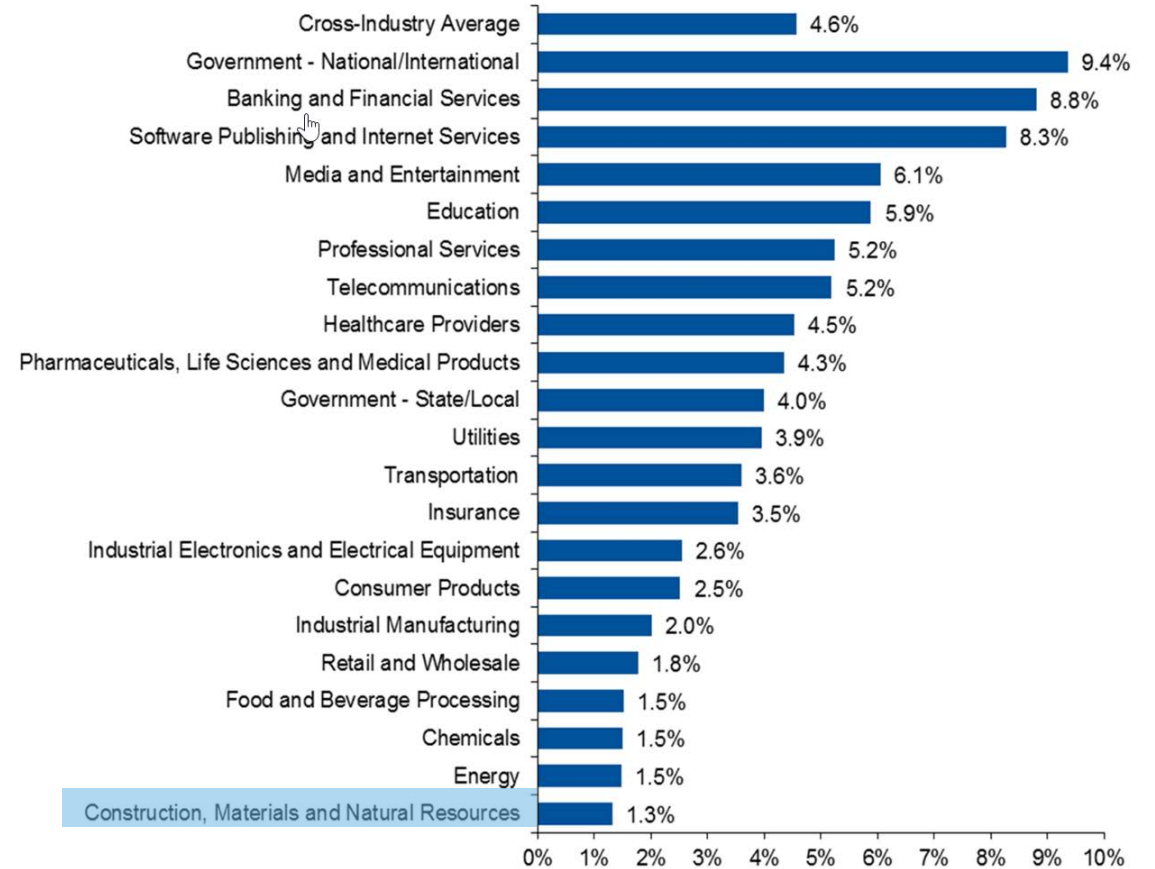


The state of technology spend in E&C (cont.)

IT Spending per Employee, by Industry, 2016. Up \$54 from 2015.



IT Spending Percent of Operating Expense, by Industry, 2016. Same as 2015



*SOURCE: GARTNER IT KEY METRICS DATABASE, March 2017

The state of technology spend in E&C (cont.)

Are you positioning your company into a competitive disadvantage? The tide is changing and more companies are understanding the power of digital transformation.

- Construction industry is last or near last in IT spending compared to 21 other industries
- The smaller revenue companies in E&C actually spend more on technology by Revenue, by Operating Cost, and by Employee than the larger companies
- Underspending on IT may be a short sighted strategy
- 70% of US productivity growth comes from technology
- Technology investment is one of the key drivers in attracting and retaining young talent, >70,000 construction jobs will be filled with millennials this year



Latest in Technology

Cushman & Wakefield Services

Terry Vergon

The coming crisis ... data flood

It started with vibration analysis...

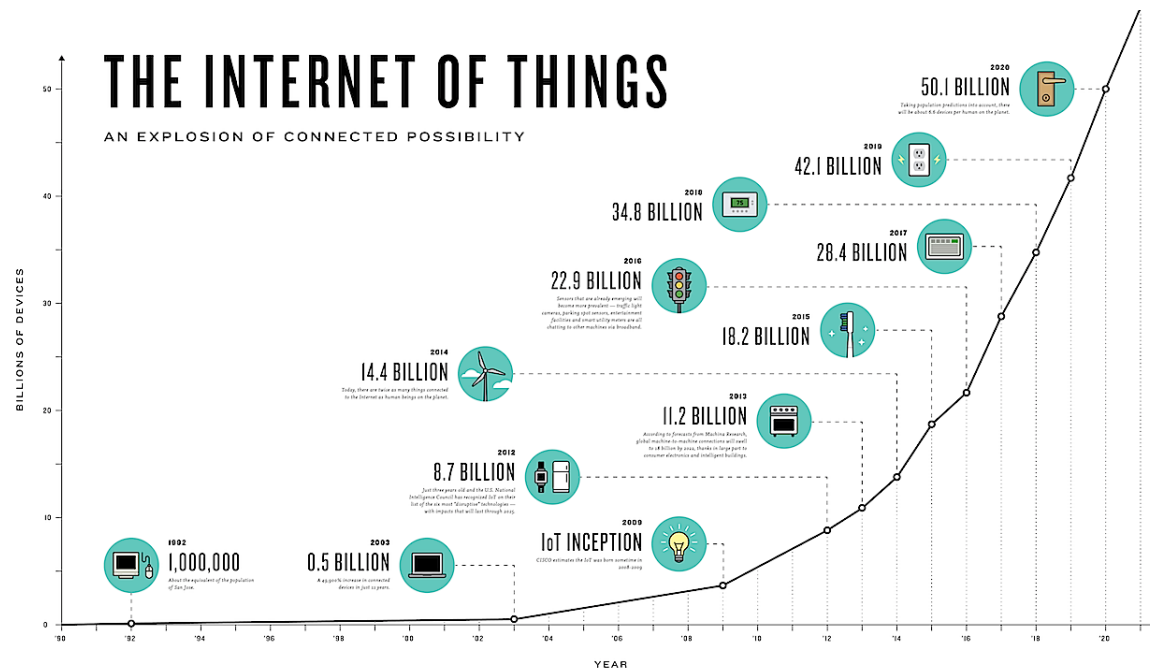


Evolution:

- Taking readings (monthly or ??)
- Wired monitoring (using alarm set pts, manual review)
- Wireless monitoring (using alarm set pts, manual review)
- Wireless monitoring (profile comparison, manual review)
- Wireless monitoring (AI and ML, multi-variable, EIB)



The coming crisis ... data flood



[The Internet of Things – infographic The Connectivist based on Cisco data](#)

IOT and ... (what's next)

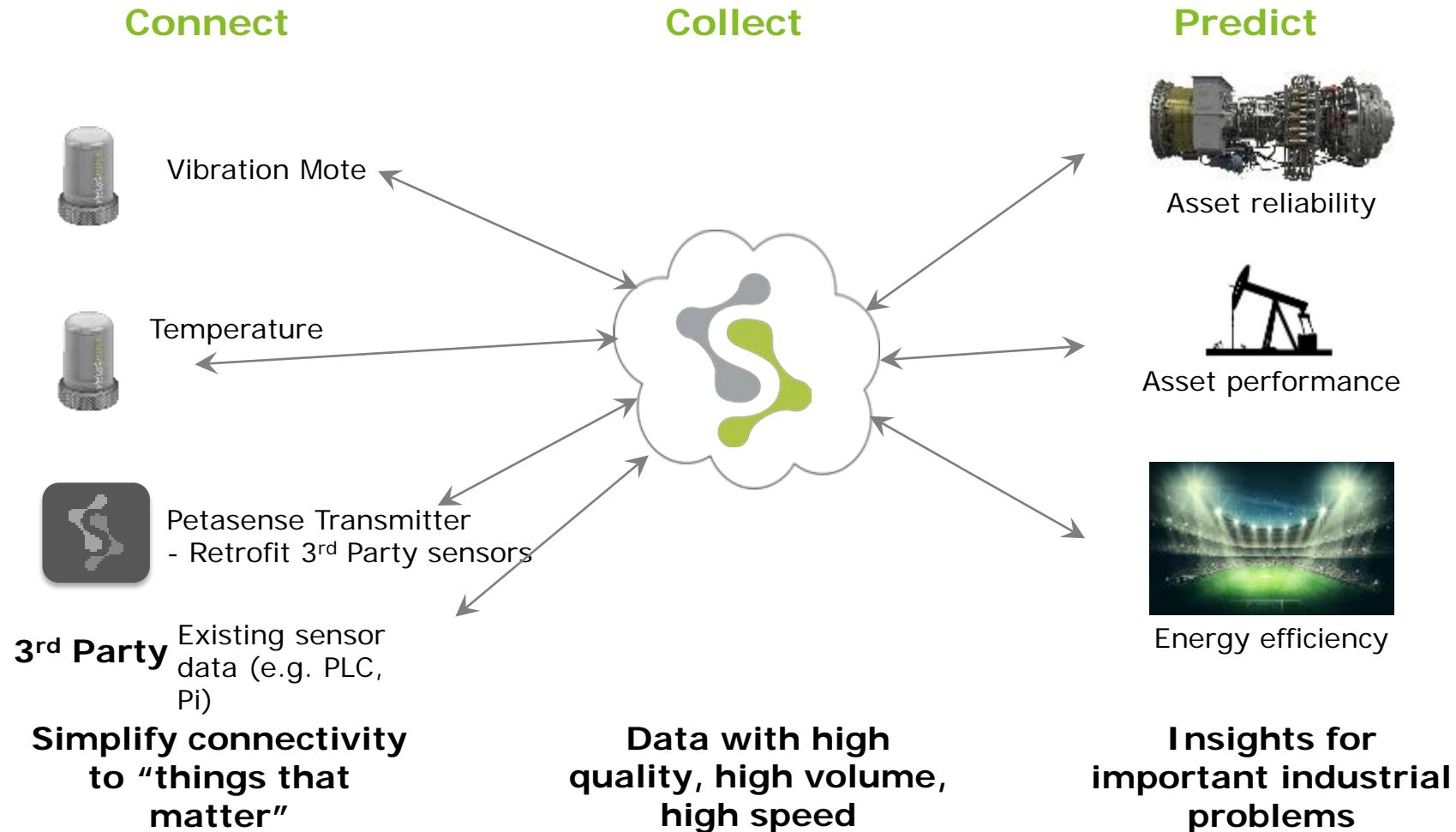
With IOT – gigabits per minute

Different inputs and perspectives

Not enough qualified engineers

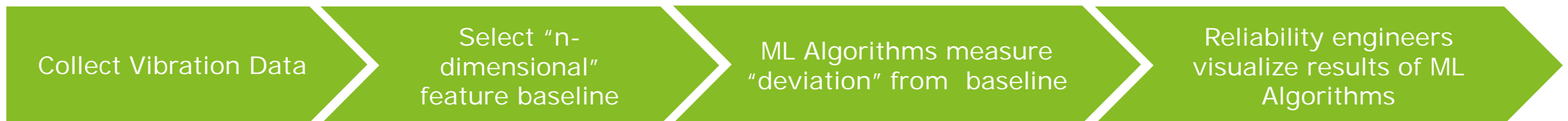
Must find a way to handle the analysis (smart decisions with course of action, manual or auto)

A simple end-to-end IoT based Predictive Maintenance system



Health Score

1. Class of Algorithms: Anomaly Detection
2. Types of machines: Rotating Machines (Motors, Pumps, etc.)
3. Data Sources
 1. Field Data (18 Billion Readings available)
 2. Simulated Data & Test Lab Data (have a test lab)
4. Phased Approach for Health Score Analysis Process
 1. Phase 1 – Target Simple Machines – Fixed Speed or Little variations in Load
 2. Phase 2 – Target Variable Speed machines - Get Current/Load Input alongside vibration
5. Overall Process



Latest in Technology

Deloitte Consulting

Allan Cook

Digital Reality

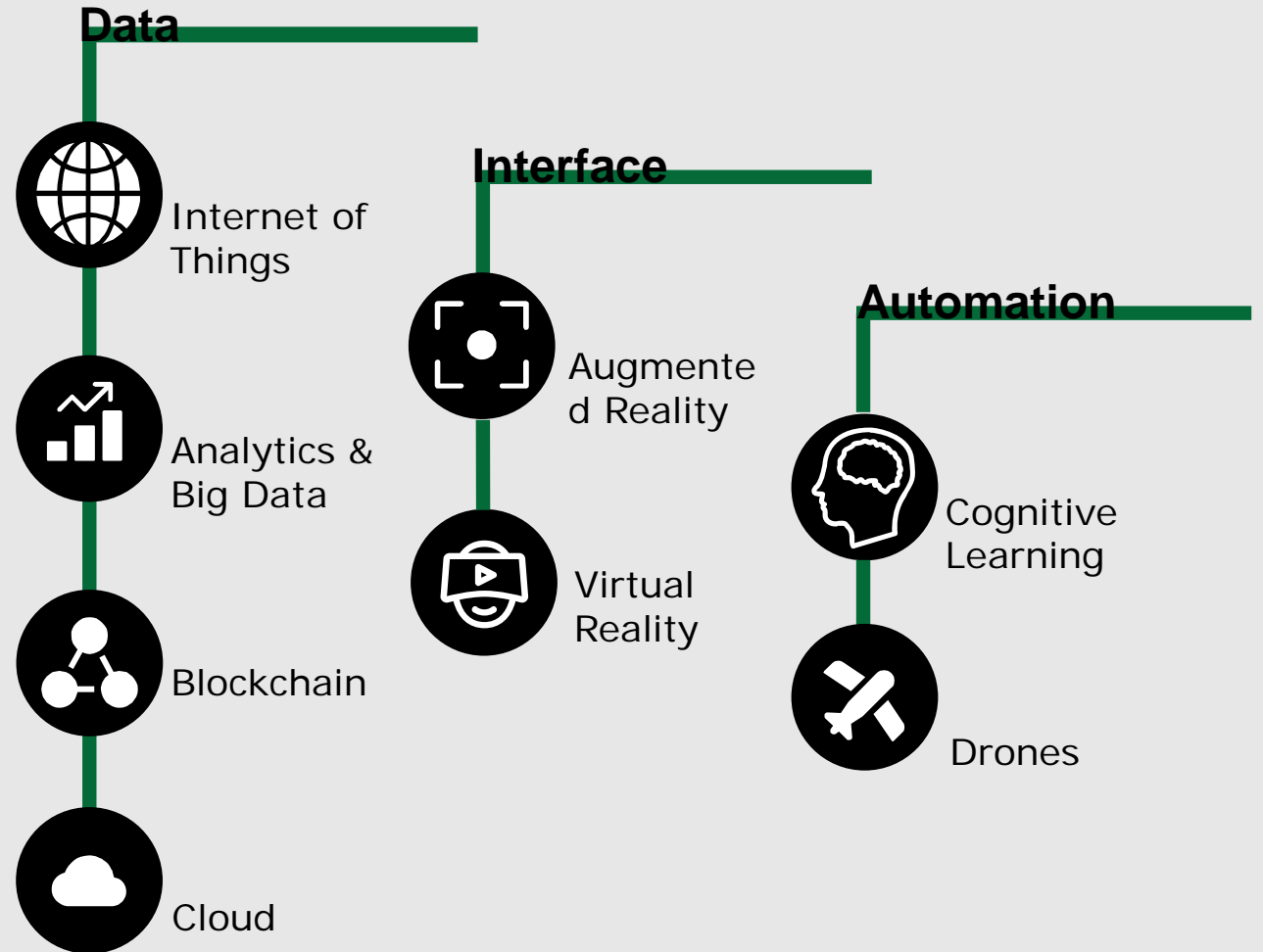
Engineering+
Construction

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Digital
D&C

DELOITTE
AUGMENTED
MIXED
VIRTUAL
REALITY

It's a digital world out there

Organizations are always looking for the next competitive advantage. By innovating technological capabilities through Next Generation (Next-Gen) Offerings, companies are able to compete and win against competitors in



Need to focus on Reality Disruption

"AR" is the real world with interactive digital elements locked contextually in the environment around the user

- Partially rendered, transparent environment
 - Nascent solution ecosystem
 - Aware of surroundings and self

Augmented Reality

OVERLAYING THE REAL WORLD

Virtual Reality

AN IMMERSIVE EXPERIENCE

"VR" is an entirely digital world that immerses the user, who is unaware of the environment around them

- Fully rendered, enclosed environment
- Consumer & enterprise maturity
- Robust behavioral analytics

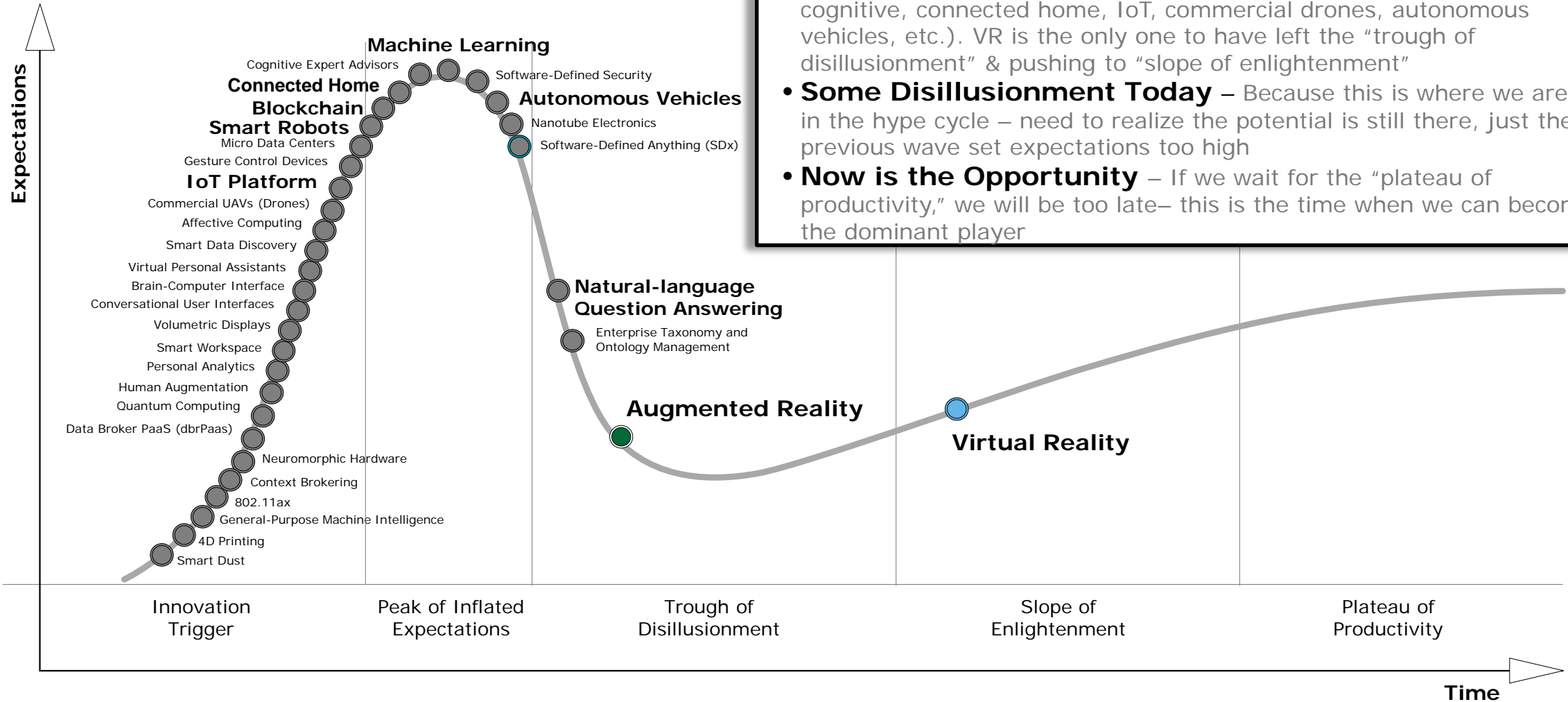
Mixed Reality

PUTTING OBJECTS INTO THE REAL WORLD

"MR" is merging real & virtual worlds to produce new environments & visualizations where physical & digital objects co-exist & interact in real time

- Partially rendered, transparent environment
- Fully rendered VR objects

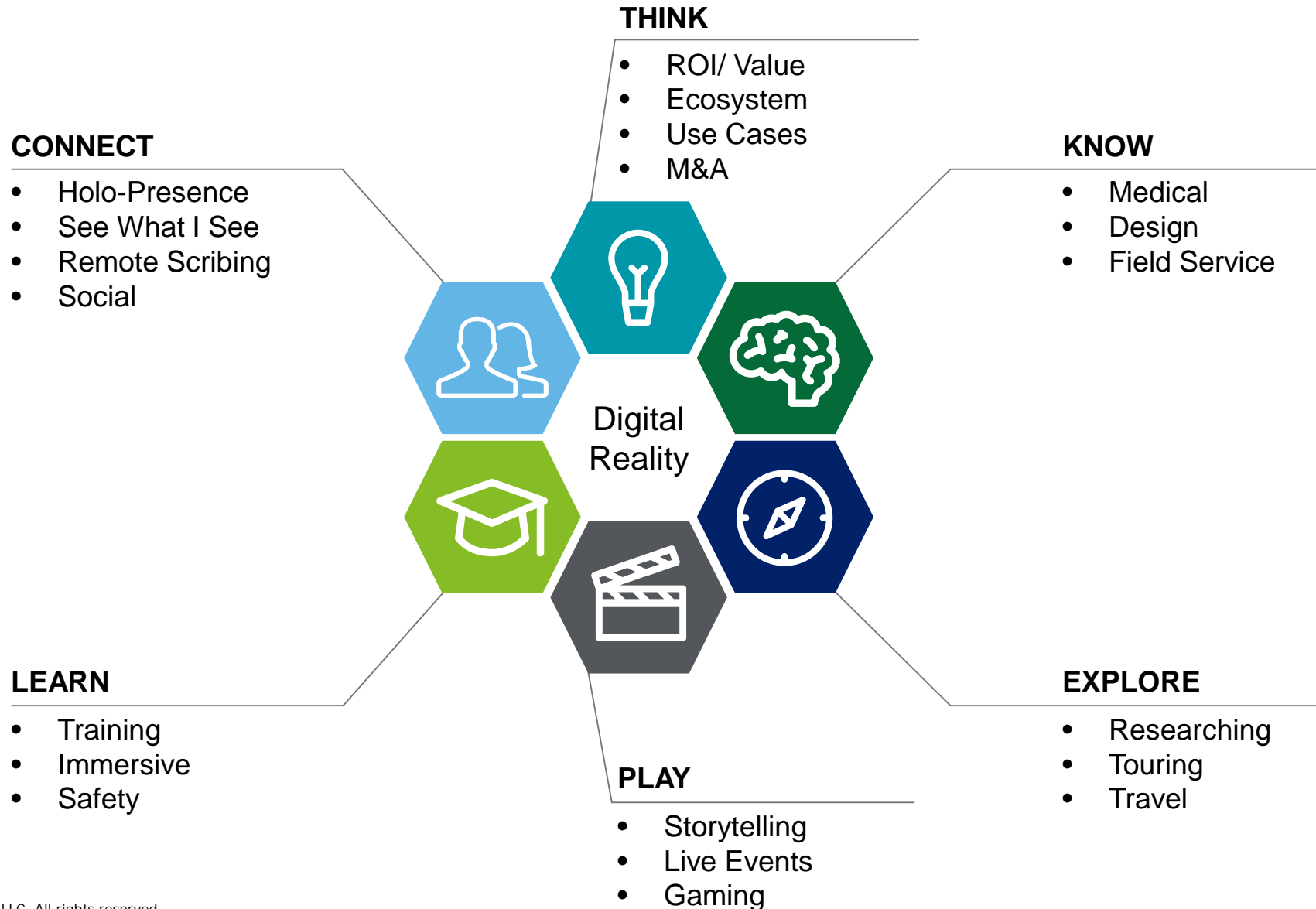
... because it's about to happen...



- **VR & AR in the Lead** – Leading the exponentials (e.g. blockchain, cognitive, connected home, IoT, commercial drones, autonomous vehicles, etc.). VR is the only one to have left the “trough of disillusionment” & pushing to “slope of enlightenment”
- **Some Disillusionment Today** – Because this is where we are in the hype cycle – need to realize the potential is still there, just the previous wave set expectations too high
- **Now is the Opportunity** – If we wait for the “plateau of productivity,” we will be too late– this is the time when we can become the dominant player

The Fourth Transformation – PC | Web | Mobile | Digital Reality

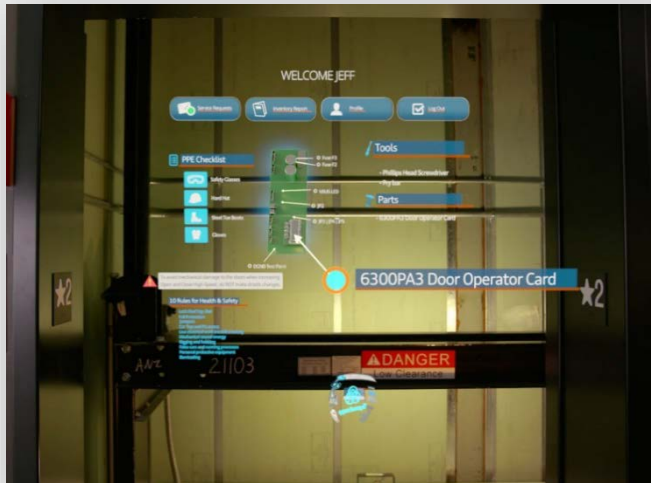
... across a broad range of applications



Emergent technologies can transform job-site labor

Data Audit

Record what was done, by who, at what time, with visual and audio record per action



Work Instruction

Allow workers to minimize issue triage by providing instruction specific to the task at hand



Remote SME

Allow remote operations to access subject matter experts and enable see-what-I-see



Emergent technologies can transform operations

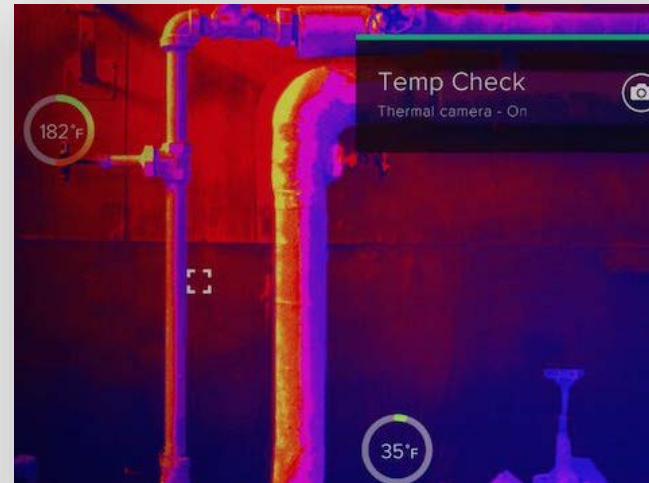
Equipment Management

Access data that is being gathered about a facility to facilitate preemptive maintenance



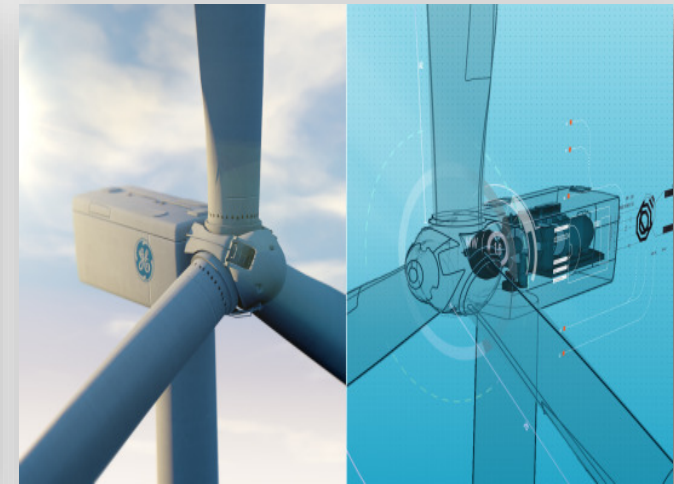
Safety

Deliver contextual awareness to workers through providing thermal, air, and equipment data



Digital Twin

Allow workers to identify inconsistencies and enact reconciliation with digital twin processes



Emergent technologies can transform the selling process

Real Estate

Allow for previsualization of high cost assets, configuration & user acceptance



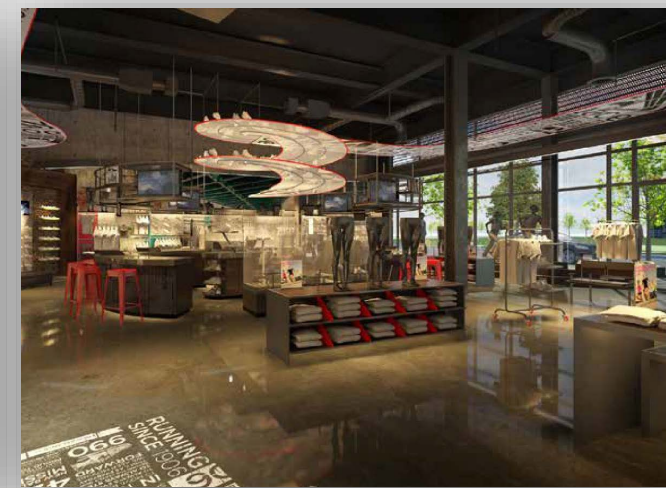
Options & Layouts

Allow for visualization of multiple options, layouts and finishes



Staff Training

Allow customers to onboard with new complex hardware without needing physical sales support



Stores

Solution

Virtual Store Concept
Visualize the flagship store to a level of detail that allowed all departments to clearly preview and understand if the concept would work.

Value

Efficiency - Enabling stakeholders to preview and sign off the concept before costly real world build began.

Training - VR tool became the primary training facility for retail staff to feel confident in how to interact in the space from day one.



Homes

Solution

Bring to life a series of house styles, developed by a specialist residential architect, to allow prospective buyers and developers to literally walk through the new home concept.

Value

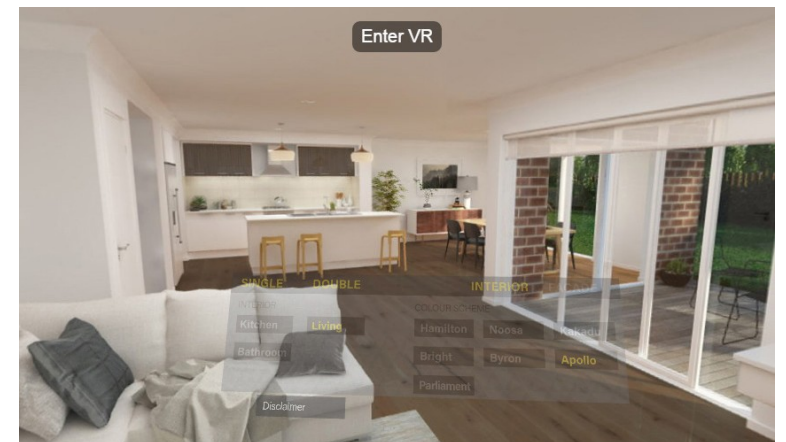
Sales - Enabling prospect buyers 'walk through' a home before purchase before construction is completed – making sales conversations easier for the developers.

Tools

Google tools

Google cardboard apps Web VR 360

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Mall

Solution

Over a three-year period, brought to life refreshed designs from multiple interior design and architecture firms into one holistic view.

Value

Alignment - Enabling stakeholders to preview and sign off multiple vendor works in one cohesive vision for the shopping center.

Tools

Google tools

Google cardboard apps Web VR 360

500+ 2D images & 50+ 360VR images



But, this can be huge

Augmented/Mixed/Virtual Realities reduce errors and increase worker effectiveness from concept to completion of building projects

Engineering

Visualize building parts, models, and progress with Virtual/Mixed Reality



3D Renders & Fly-Throughs

Generate photorealistic, volumetric visualizations of 3D retail, commercial, and architectural concepts

Collaborative Decision-making

Eliminate ambiguity in procurement or entitlement with virtual models of materials, parts, or structures for architects, engineers, and stakeholders

Simulation based Analytics

Leverage massively distributed virtual worlds to learn and iterate from simulated foot traffic, parking, or retail behavior

Construction

Connect human operators with data systems to enable a data driven workforce



Work Instruction

Connect workers to BIM system information to enable step-by-step adherence to building plans

Inspection

Apply computer vision to recognize building materials, existing structures, or construction progress while identifying errors for remediation

On-site Visualization

Enable the 'digital twin' by connecting physical construction progress with digital renderings of precast structures to ensure just-in-time fit

Customer

Let buyers experience buildings before they exist and track behaviors to shape design



Accelerate Sales Cycle

Allow customers to step into rooms see views in order to facilitate quicker commitment to space

Behavioral Analytics

Track user behavior in navigating new or hypothetical spaces to discover movement patterns and visual cues

Employee Training

Open new buildings faster by delivering virtual spatial training while the building is still being constructed

... and there's more to think about!

Digital Reality

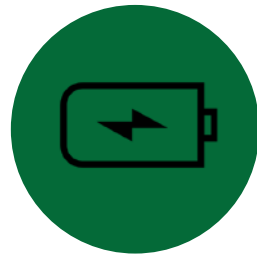
- Digital Strategy
- Systems Integration
- Content Management Systems
- Workforce Transformation & Training
- Business Model Transformation
- Infrastructure & Connectivity
- Operate – Managed Services
- Advertising & Marketing
- V-commerce & V-tail
- Personalization
- Cloud Services
- Analytics
- M&A

CONNECTIVITY

What else is stopping us?

Tipping POINTS

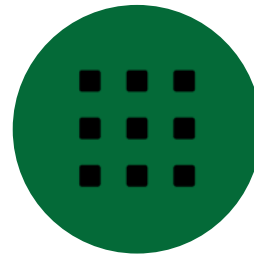
FIVE MAJOR CHALLENGES TO CONQUER FOR MASS ADOPTION



**Extended
Battery Life**



**Mobile
Computing**



**App
Ecosystem**



**Decrease
Latency**



**Price
Point**

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