

Industrial Internet of Things 2019 impact and adoption

Brett May

@McKinsey

COO IoT service line

Co-lead in Digital M&A/VC consulting efforts

Clients Served- Private Equity, Industrial, High Tech, Telecom

Prior experience

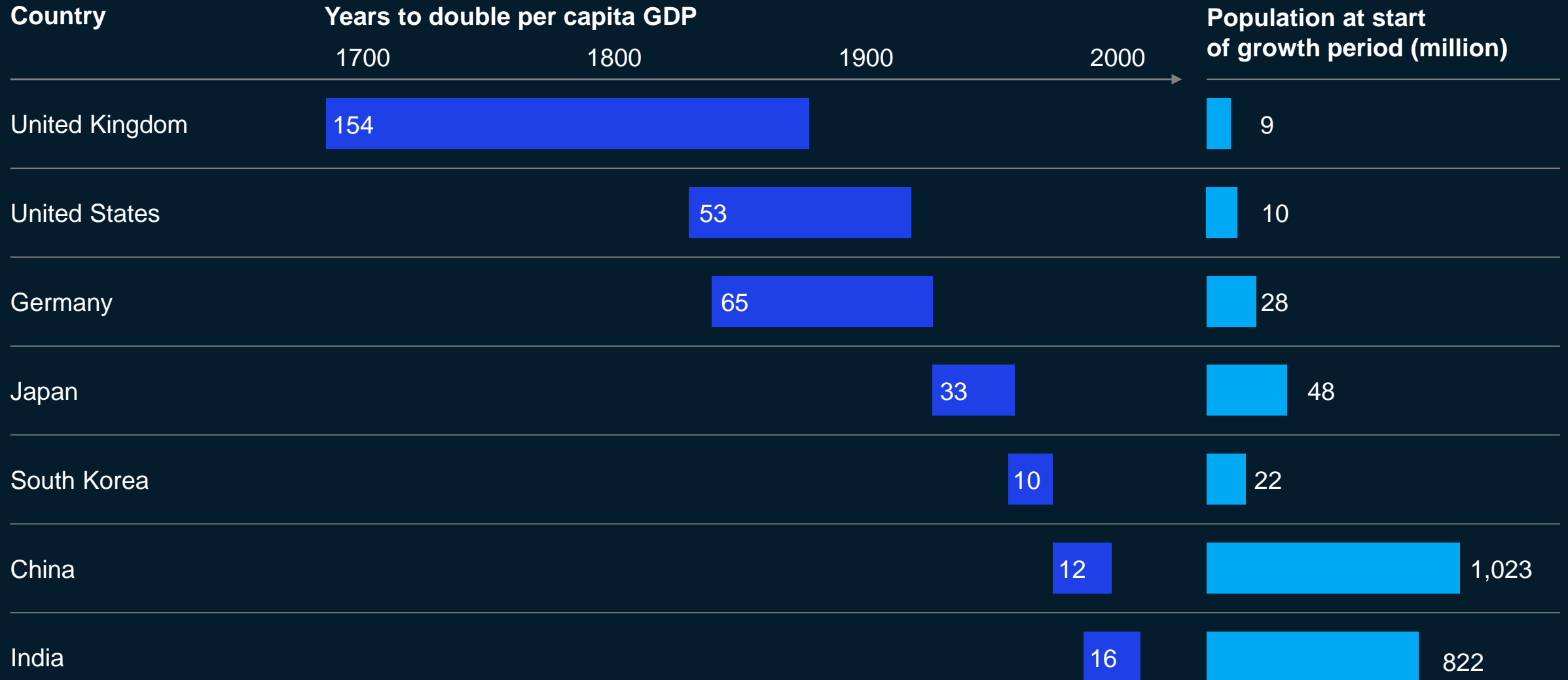
Head of M&A and Venture Capital (GE Software, Cisco Services)

Head of Business Development (Cisco Emerging Technology Group)

COO Big Data Startup (MoodLogic)

Software & Database Developer/Architect (Sparta, Andersen)

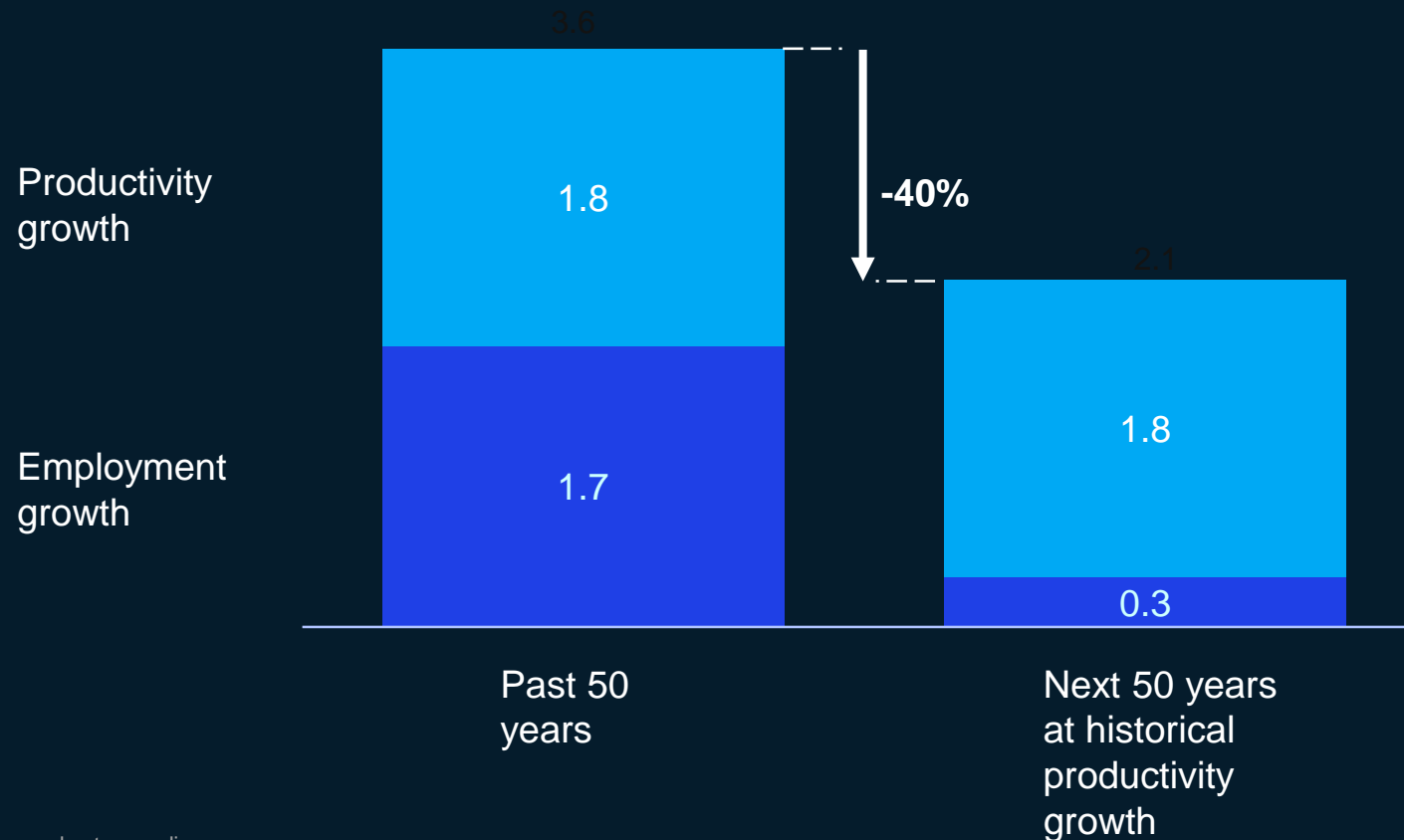
Industrialization happening 10x faster at 300x prior scale



GDP growth would slow by ~40% given shifting demographics, unless productivity were to increase

GDP of G19¹

Compound annual growth rate, %



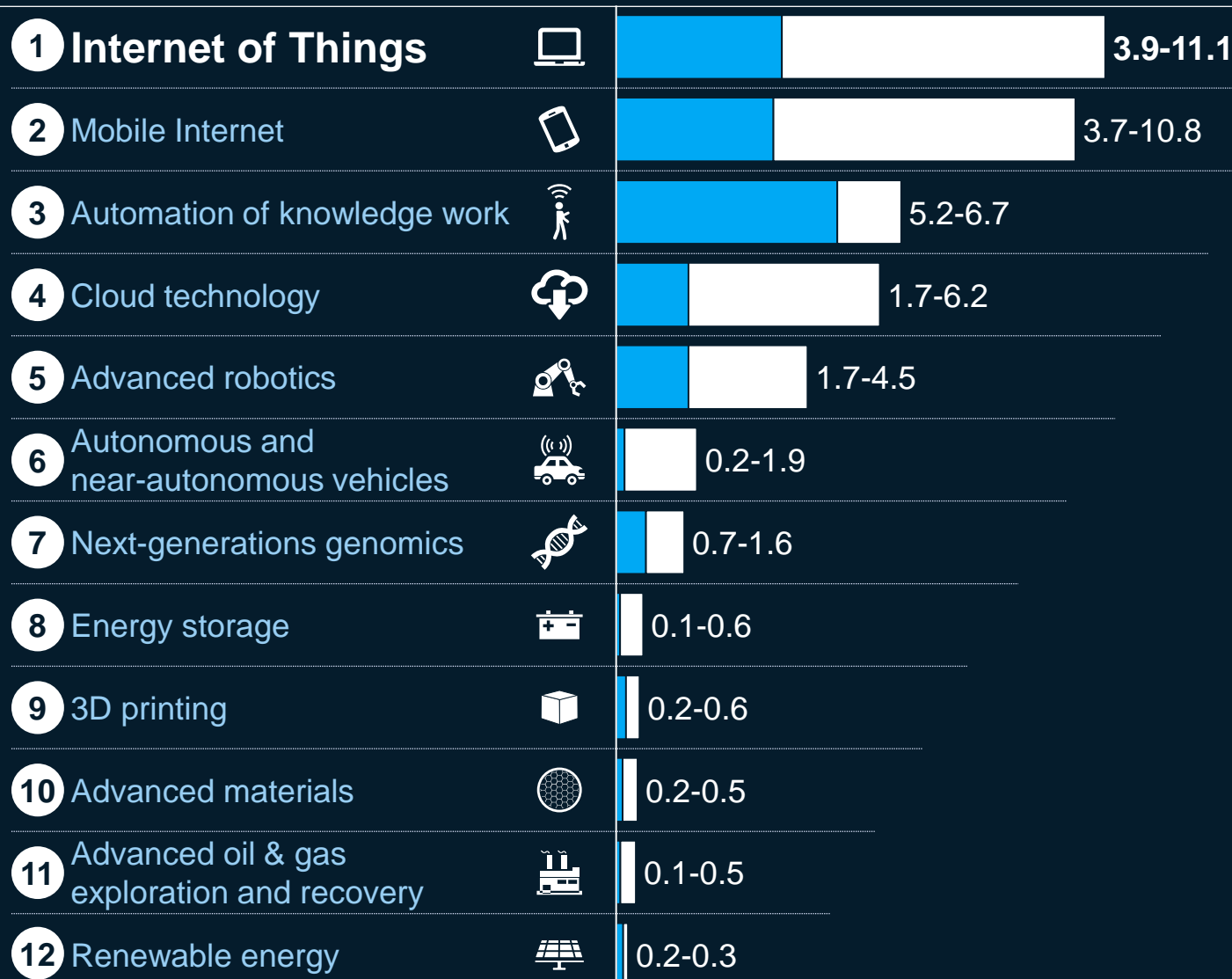
¹ and Nigeria

NOTE: Numbers may not sum due to rounding

SOURCE: The Conference Board Total Economy Database; UN Population Division; McKinsey Global Institute analysis

IoT will be the most impactful technology revolution

Disruptive technologies by 2025, USD Trillions, annual ■ Low estimate ■ High estimate



**9 settings have
\$4-11T of
potential
economic
impact
from IoT...**

**~³/₄ industrial
or enterprise**

Vehicles

Autonomous vehicles
and condition-based maintenance

\$210-740B

Cities

Public health
and transportation

\$930B-1.7T

Outside

Logistics and navigation

\$560-850B

Human

Health and fitness

\$170B-1.6T

Worksites

Operations optimization/
health and safety

\$160-930B

Home

Chore automation and security

\$200-350B

Offices

Security and energy

\$70-150B

Factories

Operations and equipment
optimization

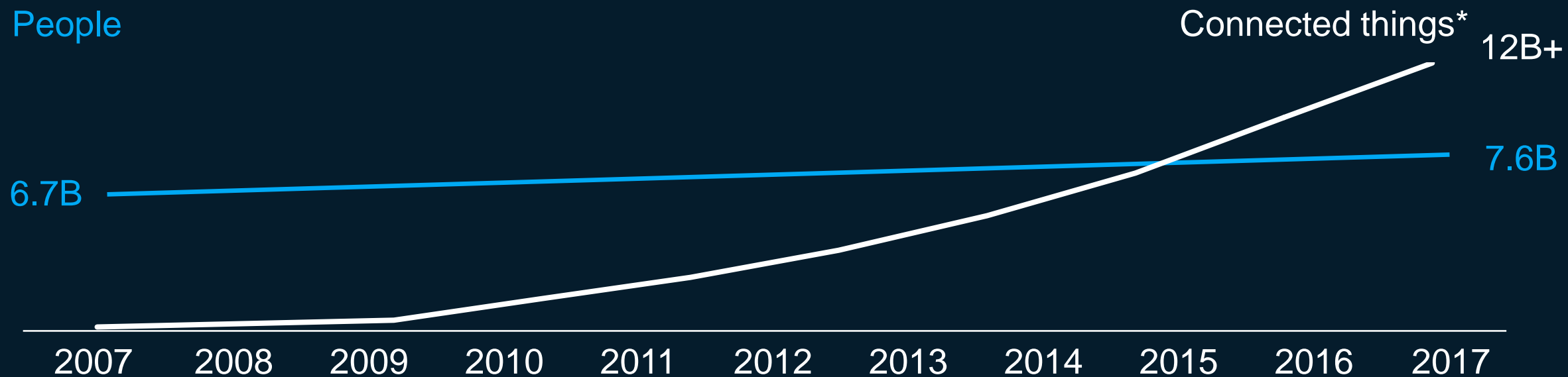
\$1.2-3.7T

Retail environments

Automated checkout

\$410B-1.2T

Now more connected things than people



*Excludes PCs, phones and tablets

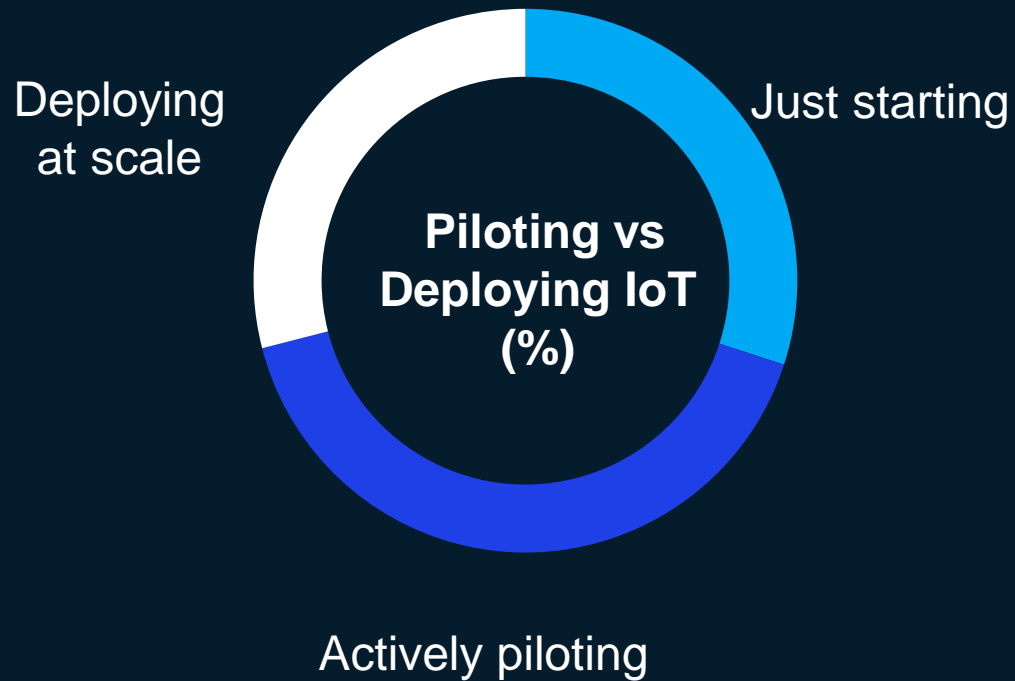
Industrial IoT impact already felt widely



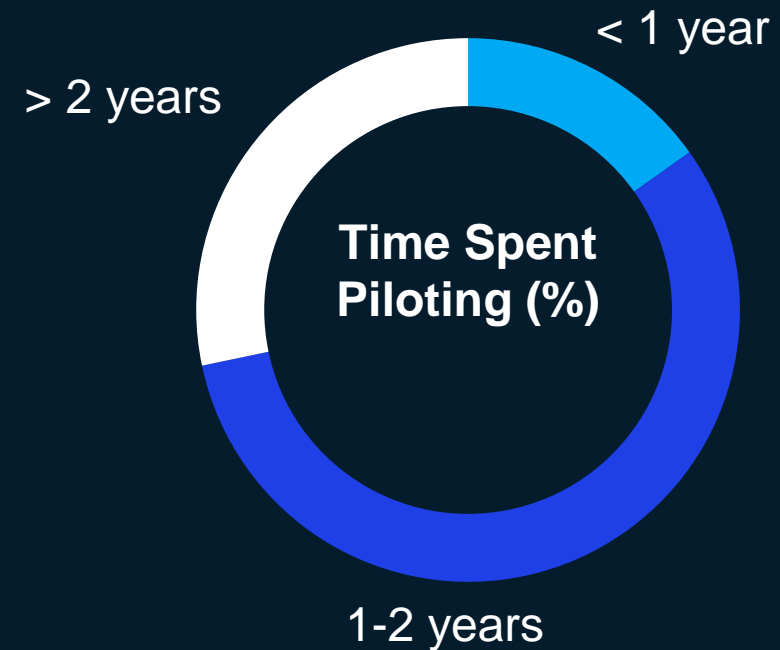
"The Future is already here, it's just not evenly distributed"

— William Gibson

Only **1/3** are beyond pilot



85% of Pilots last over a year



Economic benefit enjoyed by the 1/3 beyond pilot is solid

58% reported 5% or more revenue increase from IoT



46% reported 5% or better cost reduction



Impact

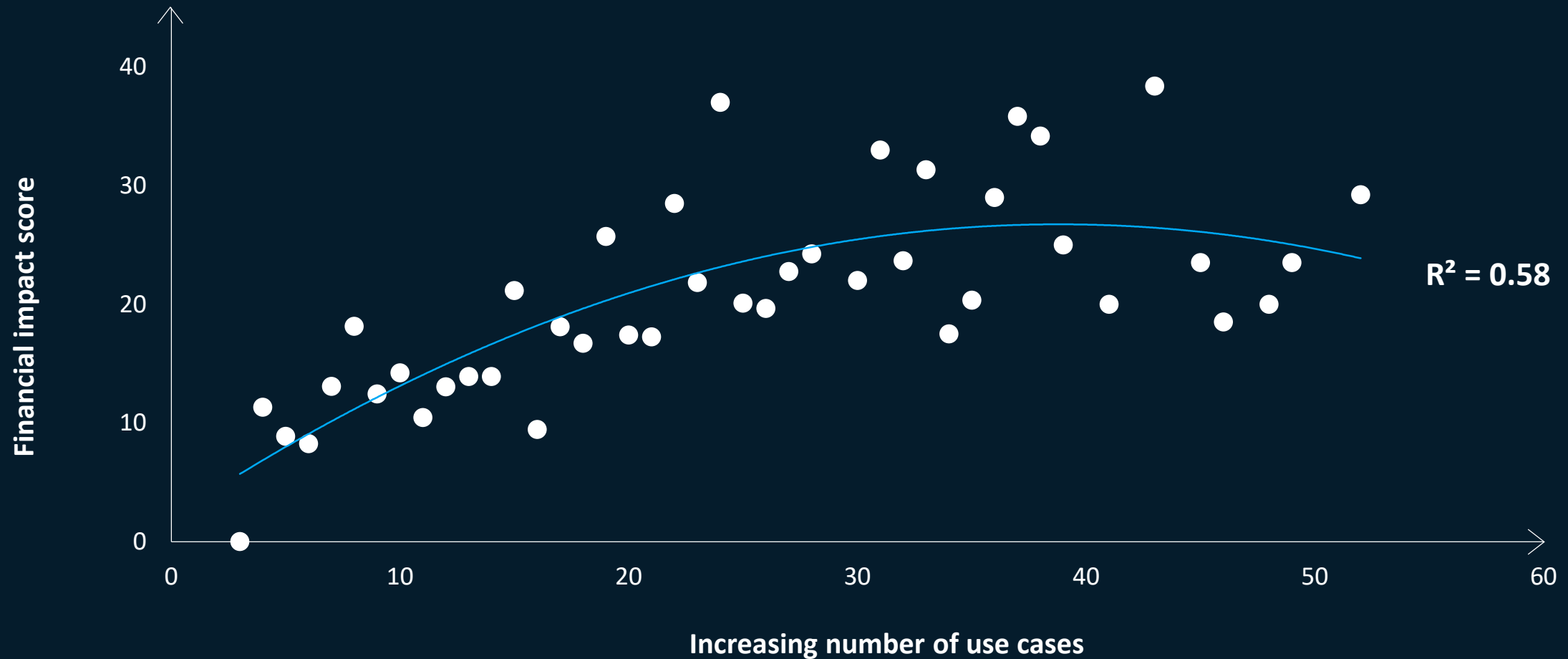
- 10%+
- 5-10%
- 1-5%
- Negligible or negative
- Unknown

Note: >75% of respondents were "well beyond pilot phase" and/or offered "mature IoT solutions"

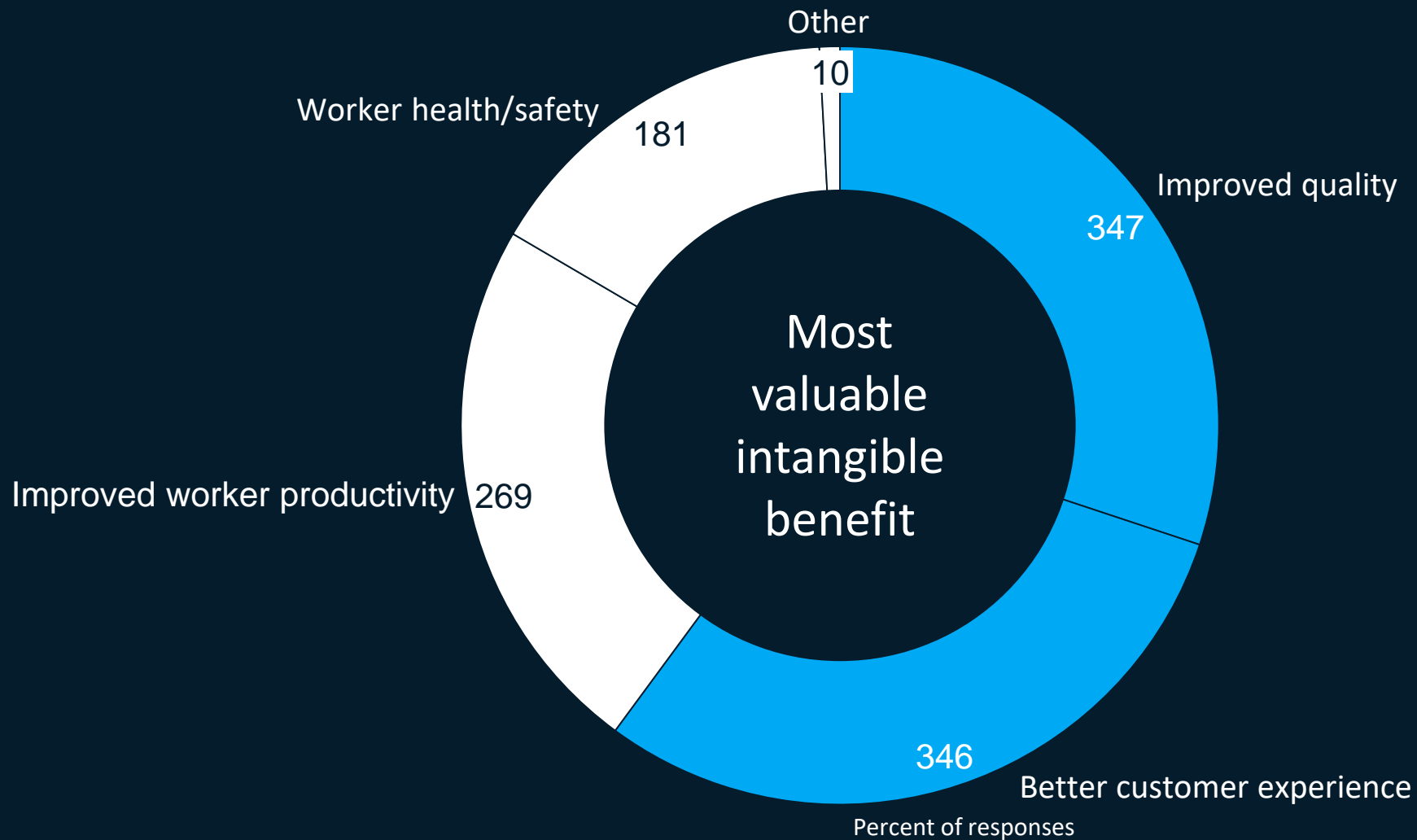
Implementing more IoT use cases correlates with better financial impact

Effect levels out around 30 use cases

Financial impact per use case vs number of use cases



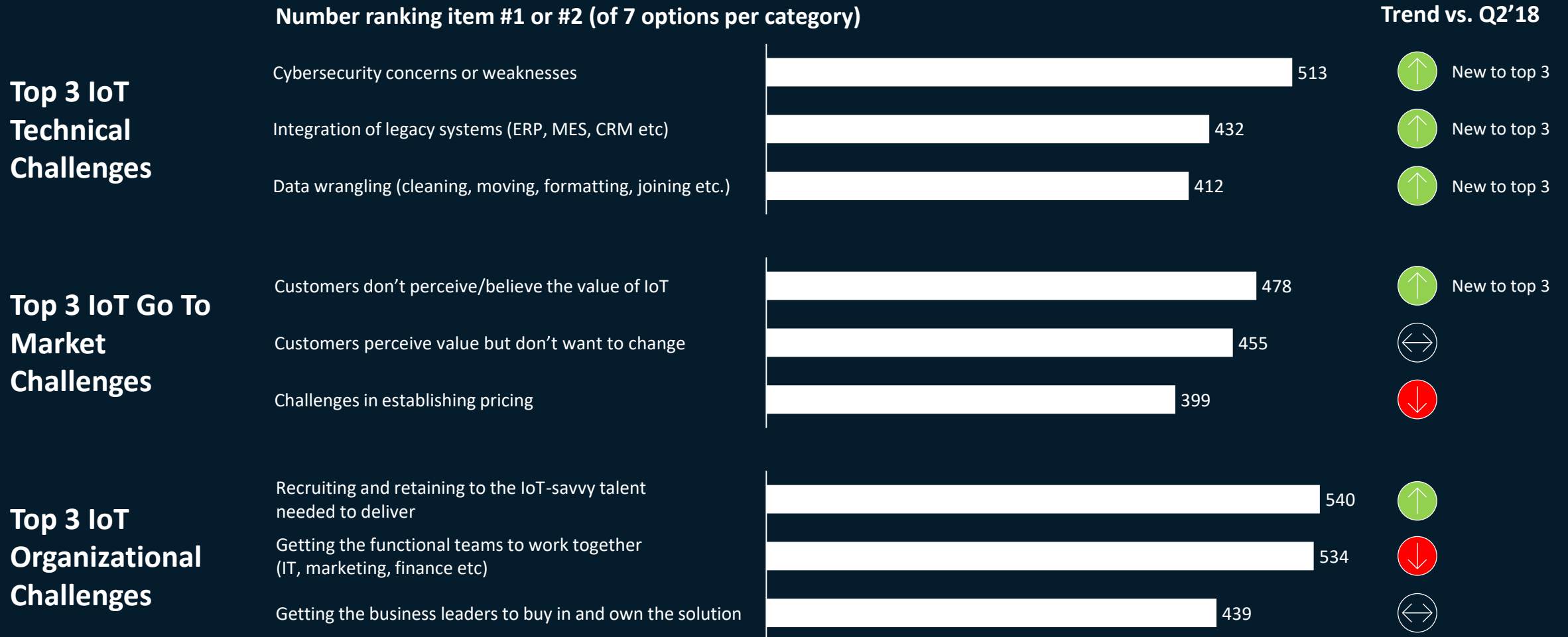
Quality and customer experience are the most cited non-financial benefits





**Non-financial benefit:
The Internet of Macaws**

The top 3 challenges in GTM and Org have been stable over time; Cybersecurity has emerged as a top tech challenge



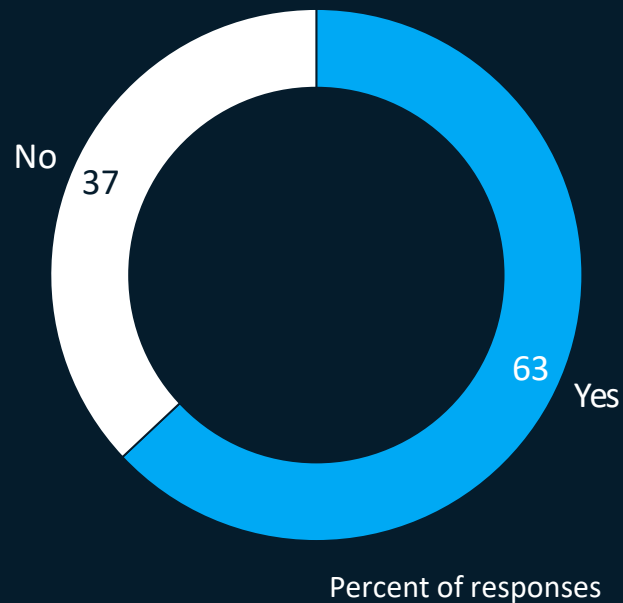
“If you could change only one or two things in order to accelerate your IoT program, what would they be?”

Number of responses



Talent continues to be a barrier with data engineering surpassing data science as scarcest skillset

Hiring and retaining IoT talent a significant barrier to success



What kinds of skillsets are the hardest to attract and retain?

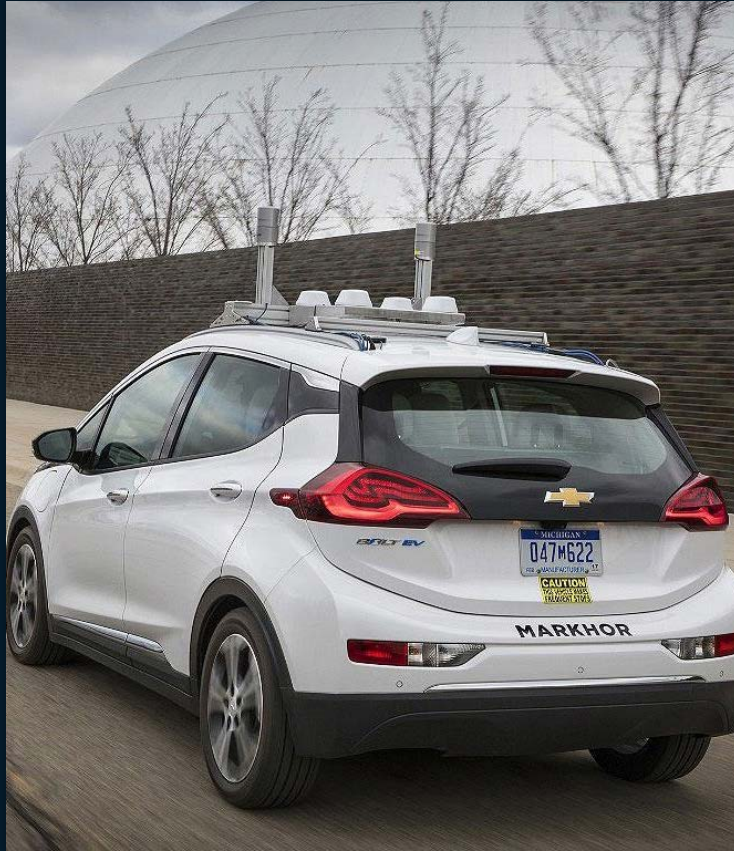


Q3_11 BASE: (Total: N = 1265)

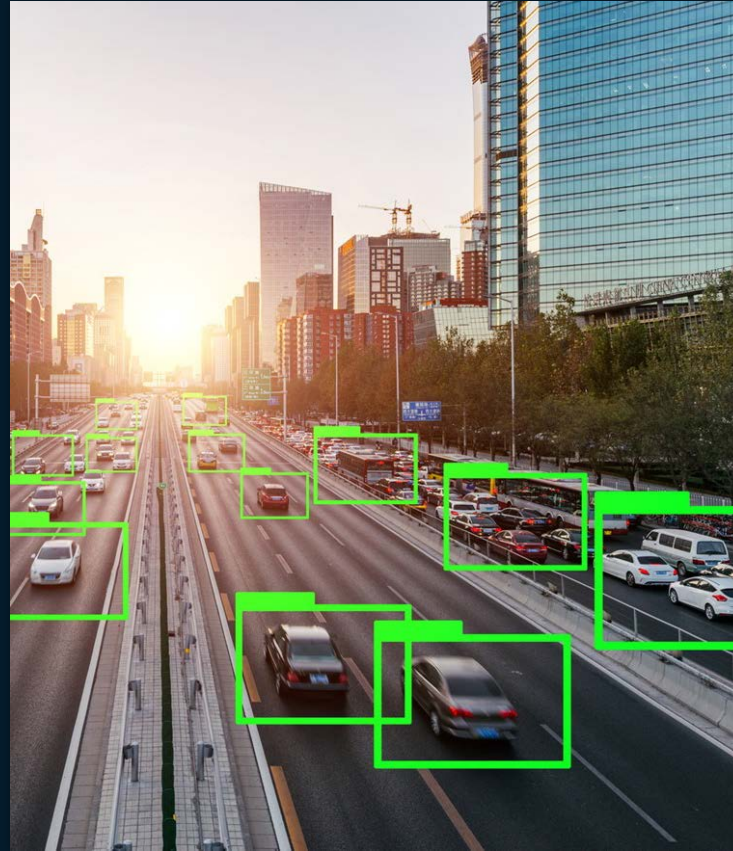
Source: 2019 survey of 1400 IoT practitioners; McKinsey analysis

IIoT at scale requires data engineering even more than data science

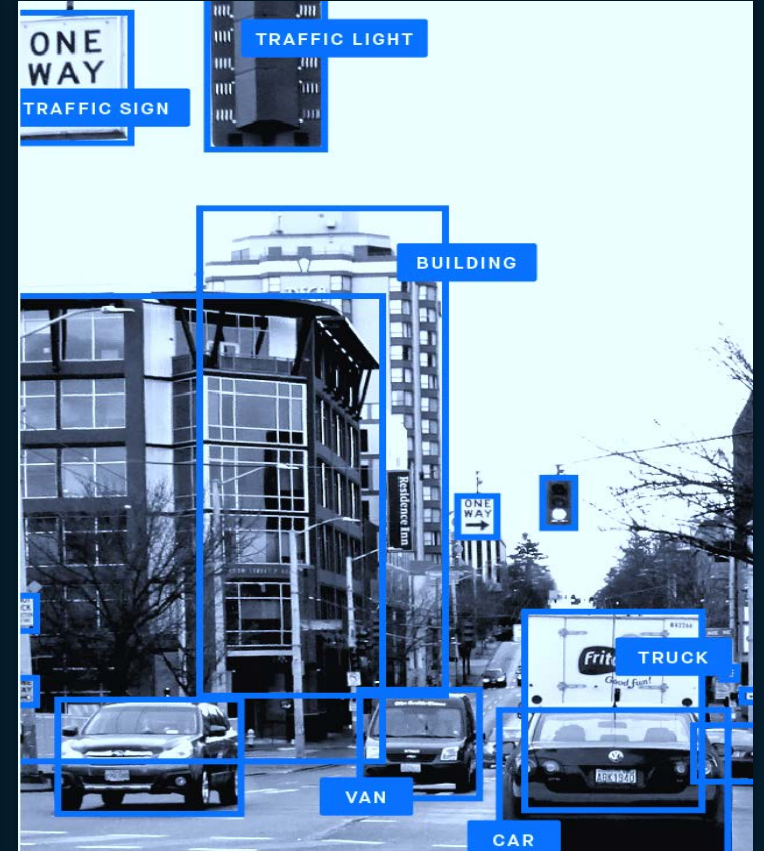
Collection



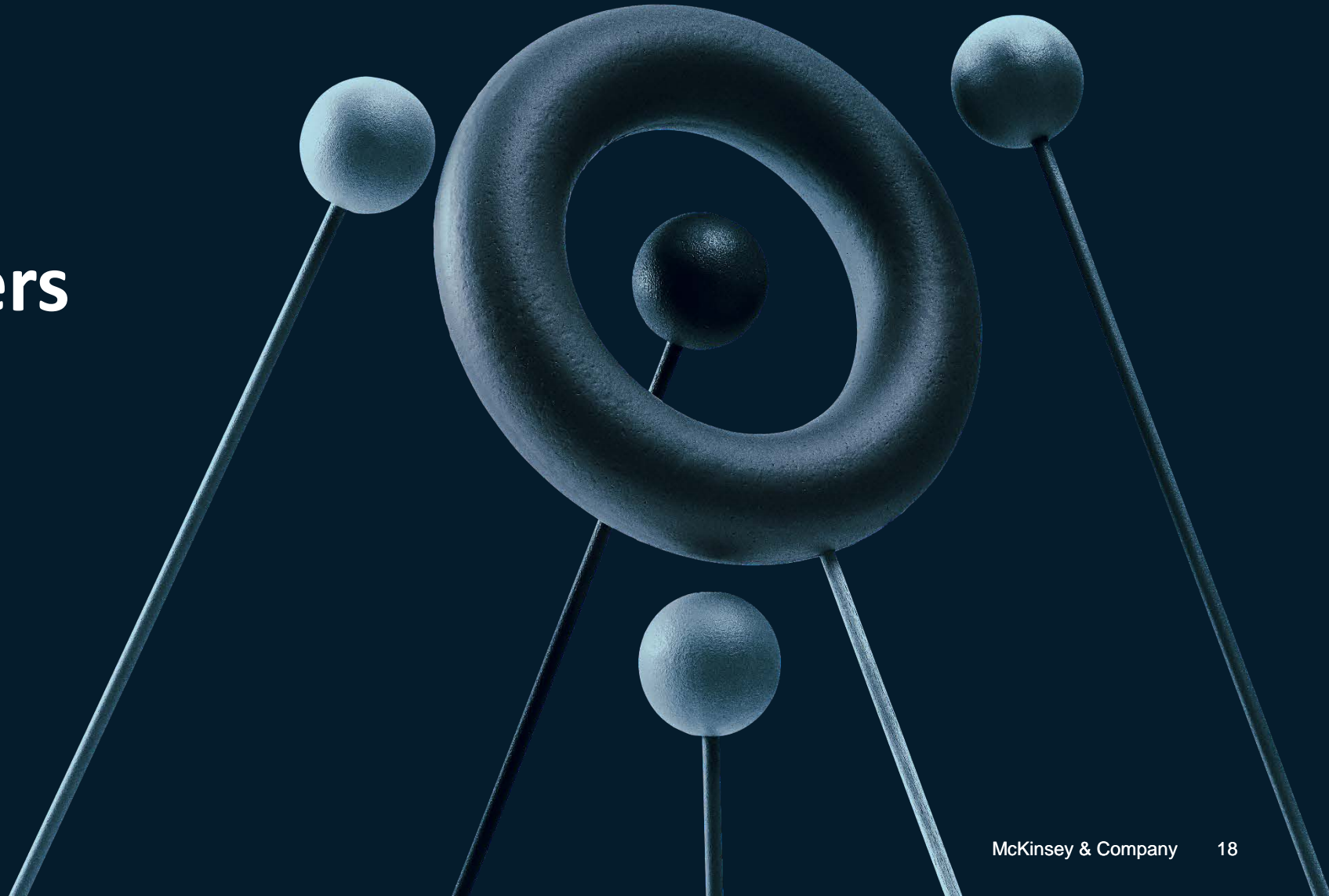
Classification



Interpretation



Separating Leaders from Laggards



We segmented IloT “leaders” from the “laggards” by scope and scale of impact

**% Revenue
impact or Cost
Reduction**

“Laggards”

Got the least
economic
impact from
IoT

< 4% impact

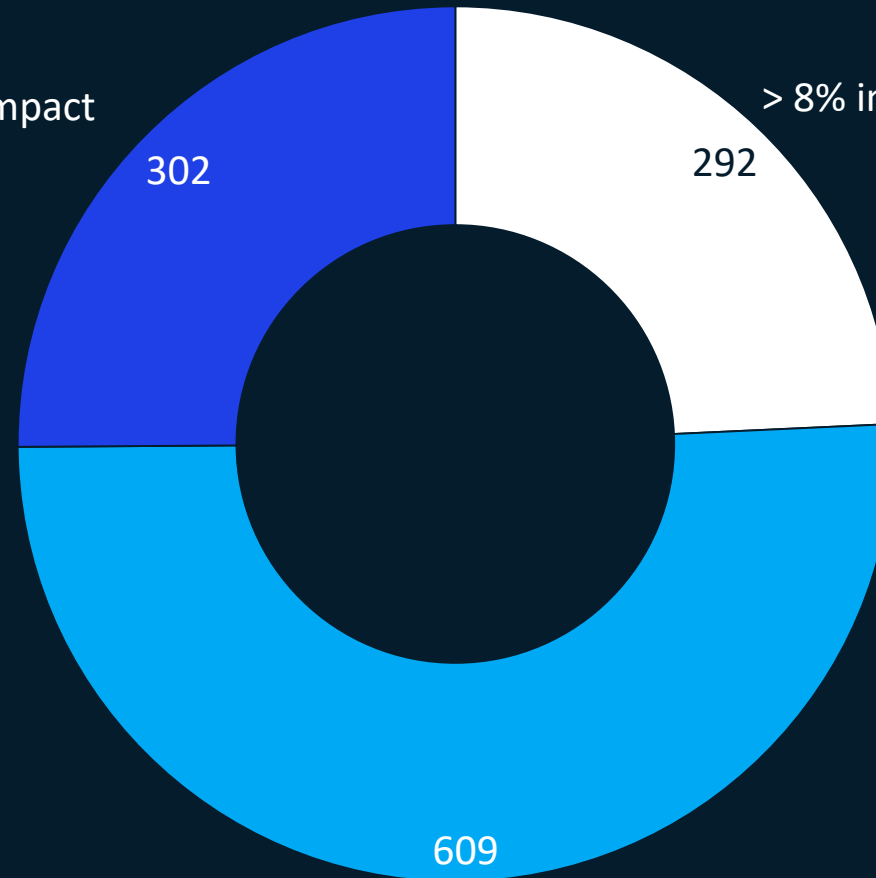
302

> 8% impact

292

“Leaders”

Got the most
economic
impact from
IoT



4-8% impact

609

Some elements separate leaders from laggards

Of those getting highest economic impact...



Leaders lead
from the top

34%

More Likely to have CEO
as champion

28%

More likely to have CEO as day to day lead



Leaders make similar
organization decisions

91%

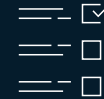
Have a Chief Digital Officer...

but seldom (**17%**) have IoT report there

86%

Have a separate IoT organization..

Are **70%** more likely to have it reporting to
the CEO, CTO or head of products



Leaders value
certain things more

52%

More likely to prioritize dedicated IoT tech
talent #1 priority

30%

More likely to prioritize a strong business
case #1 priority

Leaders look outside for capability acceleration

Those getting highest economic impact...

167%	more likely to require	IoT platform to support an ecosystem for external developers
175%	more likely to	Rely on partners for SW development
39%	<i>less</i> likely to emphasize	In-house system integration capability

*No laggard cited business process change as a key success factor

Top 5 Key Success Factors of Leaders— first 3 all involved design

Financial impact score of those listing this as #1 KSF



Design thinking starts with the user journey

DEEP DIVE USE CASE -
CURRENT STATE JOURNEY

POWER MANAGEMENT + OPTIMIZATION

POWER MANAGEMENT AS A SERVICE:
REDUCING TOTAL COST OF ENERGY INFRASTRUCTURE

ABOUT THE COMPANY

Kennedy College is a prestigious university established in the early 1900s. Their power systems have evolved over the years to support new technologies and accommodate a growing student body drawing increasing amounts of energy year over year. The university Power Plant manages its own microgrid, generating about half of the campus electricity needs (solar and natural gas) and use AEP to supplement what they're not producing. They are considering installing storage at some point.




NADINE, 45
USER ROLE: END USER - DIRECTOR OF FACILITIES
Nadine has worked at Kennedy for 25 years and is the Guru of the electric configuration and new microgrid. Her team spends a lot of time responding to issues and trying to stay up on maintenance, while also supporting building renovations and expansions. She would like to focus more on cost savings and energy efficiency in the near future.



DON, 54
USER ROLE: VENDOR - EATON SERVICE TEAM
Don and Nadine have worked together over the last 30 years. They have, what Nadine calls, a Partnership Alliance - Kennedy uses Eaton products exclusively, and Don takes his responsibility to the client very seriously. As Eaton considers how to innovate and create new products, he wants to make sure to consider Kennedy's considerable investment in Eaton products.



LARRY, 39
USER ROLE: IMPLEMENTER - GENERAL CONTRACTOR, SEE GLOBAL
Larry works for an Industrial General Contracting company. From pre-construction planning and engineering, through procurement, logistics and orchestrating an army of talented subcontractors, Larry's prime focus is on delivering capable, cost-effective industrial solutions - start-to-finish.



1. PLANNING
Kennedy adopted a net-zero 2020 pledge and is exploring options for Distributed Generation and implications for their power system. They're looking to integrate more intelligent power optimization features, such as generation storage during off-peak hours and idling during peak rates. Nadine and team hired a consulting company like an Eaton service team to suggest improvements to power quality, power availability and stability. They work together to plan infrastructure, how to connect to external utility, and where to place sensors on equipment.

PAIN POINT: NO COMPREHENSIVE VISIBILITY INTO THE SYSTEM. Because only certain types of equipment are monitored, there is a lack of data-fueled insights to build a solid business case to provide financial assurance for investing in Carbon Neutrality. It's also difficult to understand how a solution will impact the existing power system.



2. INTEGRATION & COMMISSIONING
Because of their robust grid requirements, Kennedy College hires a General Contractor to complete the planning and physical installation of equipment and sensors. The GC and downstream entities will conduct commissioning & configuration, testing & powering up electrical sub-contractors, and preconfigure a baseline typical to similar installations. This 'pre-design' saves time with on site debugging and troubleshooting.

PAIN POINT: COMMUNICATION NEEDS FACILITATION. There is no centralized communication between stakeholders/actors. Equipment may not arrive as specified or may not function properly for the configuration. Retrofits and new equipment must adhere to local energy codes.



3. SENSING & MONITORING
Nadine and her team routinely perform lots of manual tasks including changing configurations on devices, controlling energy consumption, power generation, power distribution, and optimizing utility reliability and usage, cost of consumption, fault avoidance and alternative power source switching. They're also experimenting with installing solar panels on all new buildings as a way to generate more power.

PAIN POINT: EQUIPMENT IS NOT CONNECTED. There is no visibility into how equipment is configured, no real-time reporting from the equipment, and no options for remote configuration. There is no access to external data (e.g. variable utility rates, forecasted solar/wind generation, store vs. consume tradeoff).



4. PREDICTING & OPTIMIZING
The electrical power systems (including microgrid management and BMS) automate power, HVAC, and other building systems. In general these controls are reactive or schedule-based for maintenance and repair.

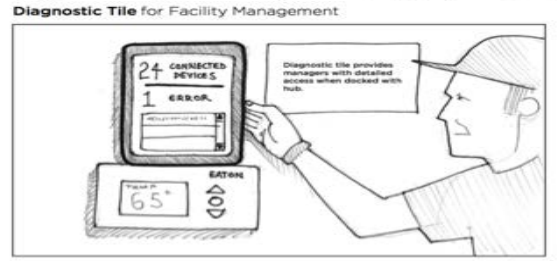
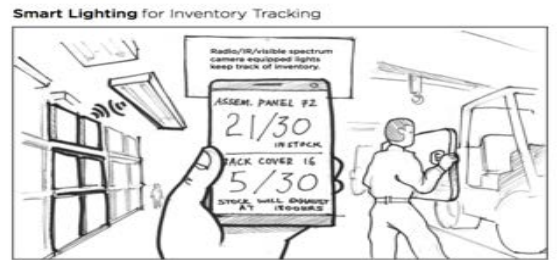
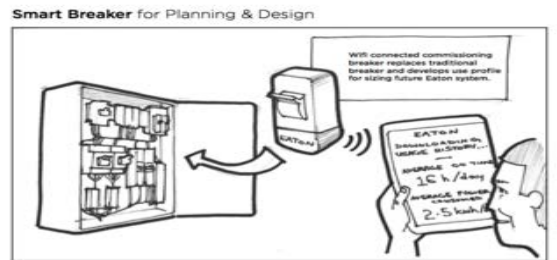
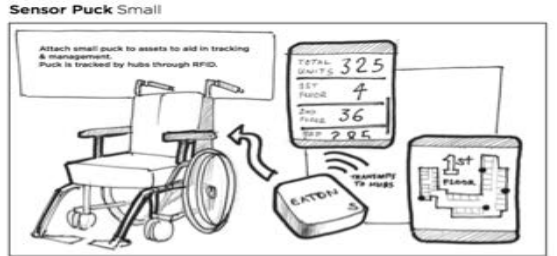
PAIN POINT: NO AUTOMATION, ONLY MANUAL AND REDUNDANT PROCESSES. Routine maintenance is performed on schedule, and is manually adjusted as needed, though infrequently. Unable to voluntarily load-shed or dynamically optimize microgrid operation based on variables like changing demand, fuel costs, weather conditions, and variable utility rates. The staff never knows when a back-up event may be triggered, and have to reactively maintain reliability, safety and efficiency. Energy costs are difficult to keep under control and predictable.

PROVOCATIONS:

- How might we enable our customers, who are dealing with lots of legacy systems, to be less reactive, more proactive, and focused on cost and energy savings in the future?
- How might we drive efficiency through transparency? (more granular metering of energy consumption performance and distribution)
- How might we drive cost savings in moving to preventative maintenance.
- Can we become a provider of all electrical systems data, including:
 - Eaton equipment data (e.g. switchgear, circuit breakers, motor drives, transformers)
 - External data needed for optimization (e.g. variable utility energy pricing, forecasted demand, various fuel source pricing)

OPPORTUNITIES:

- There is a potentially huge unrealized energy and cost-savings opportunity at stake because so many systems aren't metered (no transparency) and adequate internal and external data is not available. An electrical system data platform that incorporates usage and external resources can enable advanced savings strategies.
- There is also a huge liability reduction to this solution - manage and monitor in real time to detect abnormalities, predict failures.
- Self-healing systems that act on predictions to prevent failures aren't even on their radar right now, which means they have no concept of ROI for automating PM&M.
- Sensors that gather data on equipment health.
- Software product
- Tools to help Eaton's customers build business cases for improvements (i.e. metering, intelligent optimization)

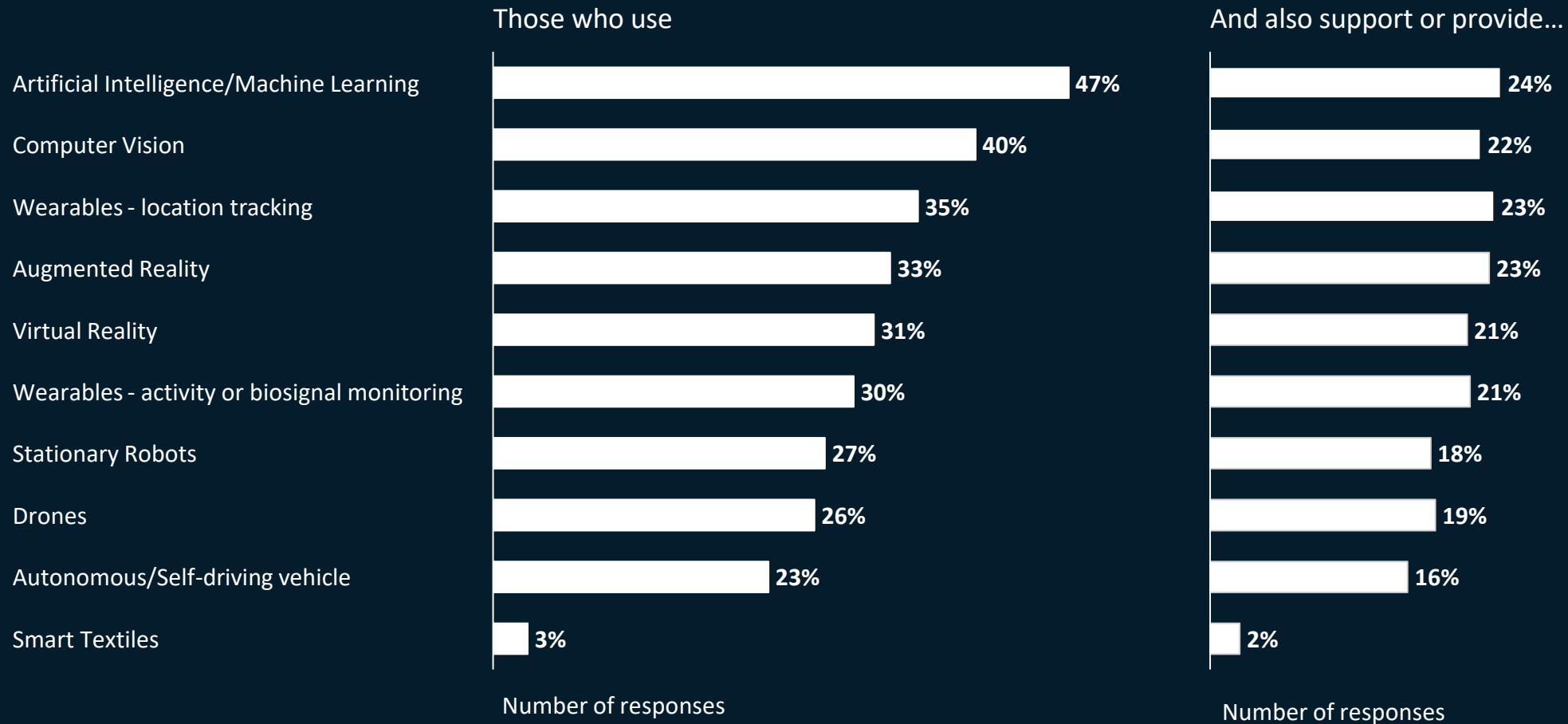


Technology



IIoT practitioners frequently Use and Sell advanced technologies

Advanced technologies being used to develop or IoT or supported for customers



BASE: (We USE this technology for IoT purposes: N = 1400; We provide this technology to others: N = 1036)

Source: 2019 survey of 1400 IIoT practitioners; McKinsey analysis

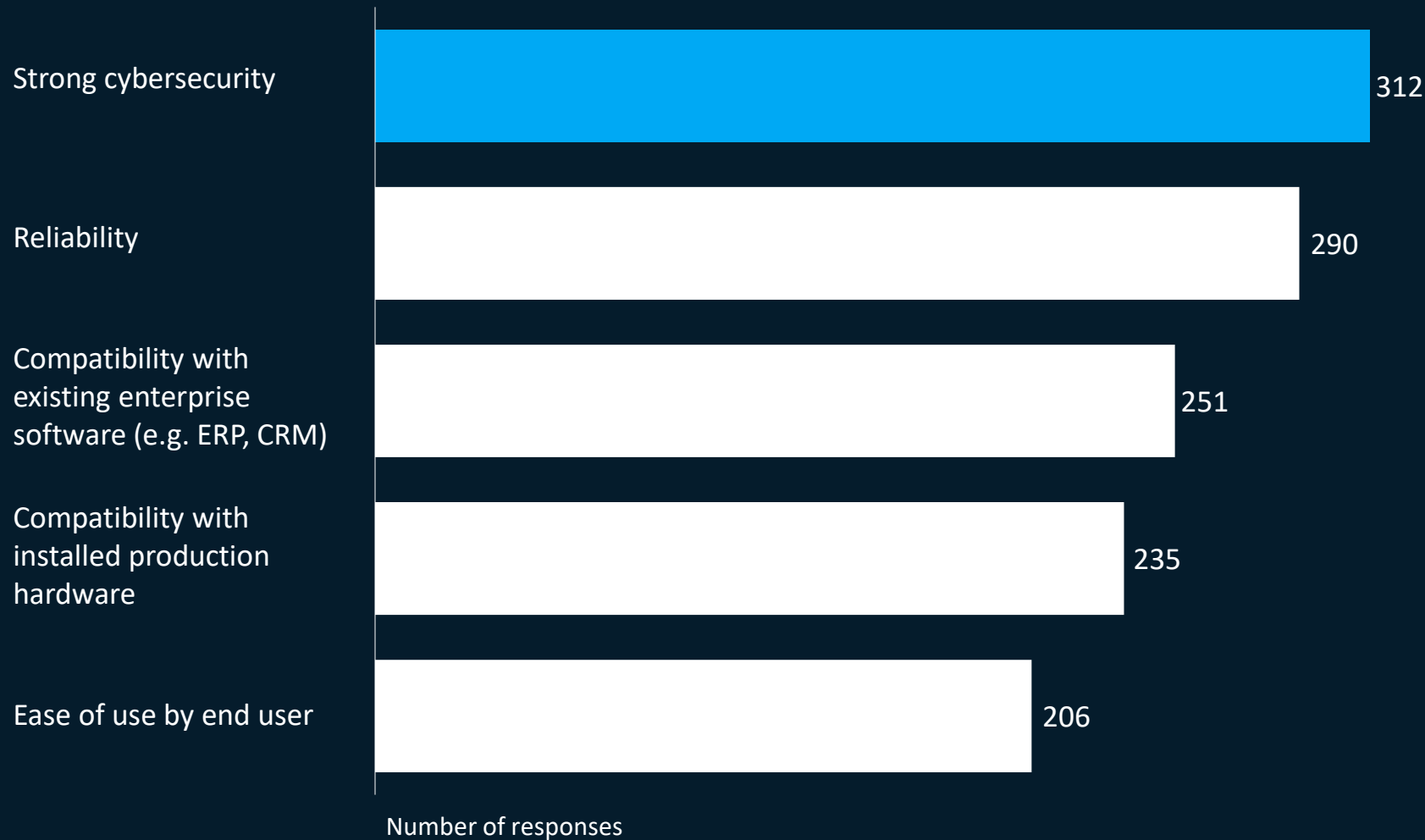
Users and supporters of advanced technologies and endpoints get better returns



Note: Advanced technologies were defined as: Augmented Reality, Virtual Reality, Artificial Intelligence/Machine Learning, Drones, Stationary Robots, Autonomous/Self-driving vehicle, Wearables - activity or biosignal monitoring, Wearables - location tracking, Smart Speaker (e.g., Alexa)

Top 5 priorities when buying industrial IoT products

Priorities have changed over time; Cybersecurity has come to the top



Most important IoT product purchase factors besides basic function

Top 3 of 12 analysis

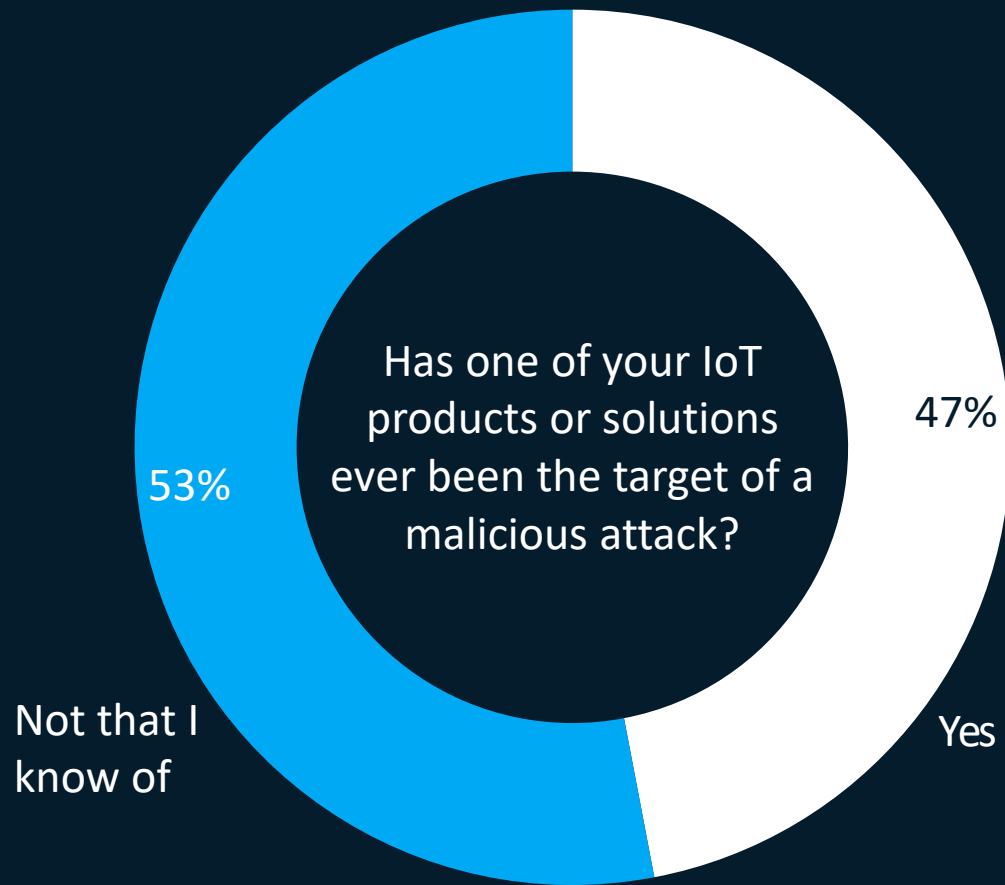
Fish tank or Phish tank?



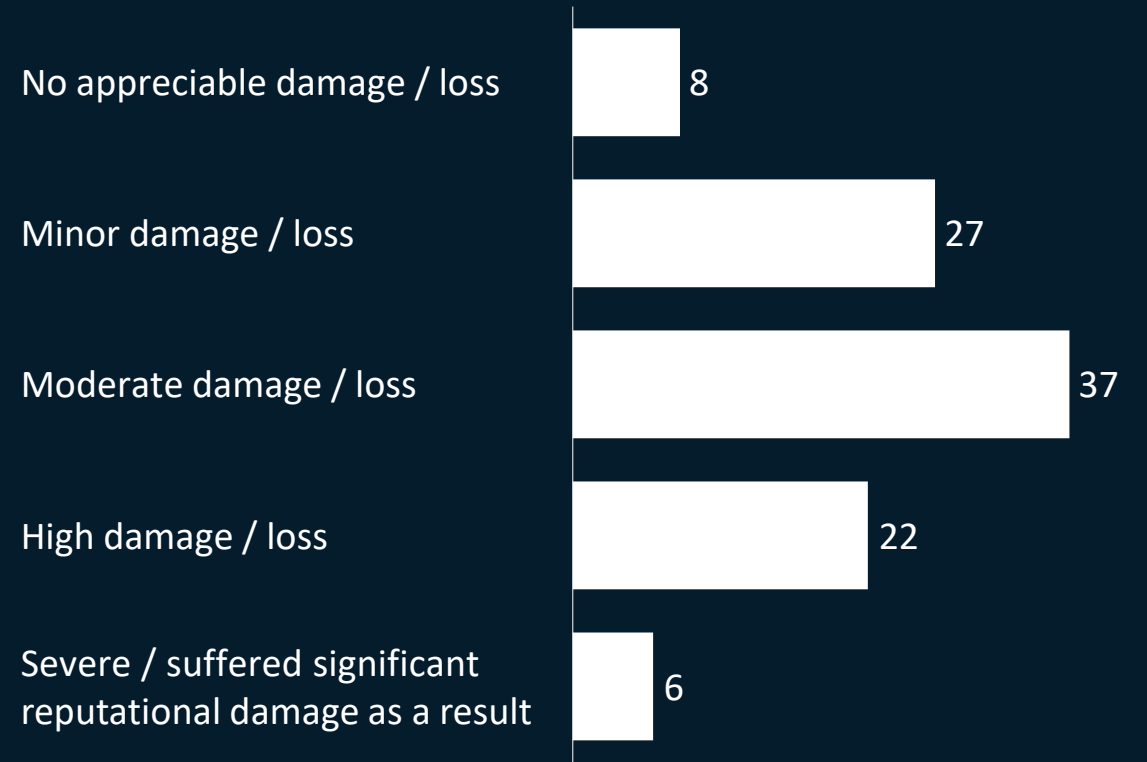
Stalked by Alexa?



About half of IIoT users have suffered malicious cyber hacks and many suffer damage (little changed from 2018)



If yes, how severe was the damage?

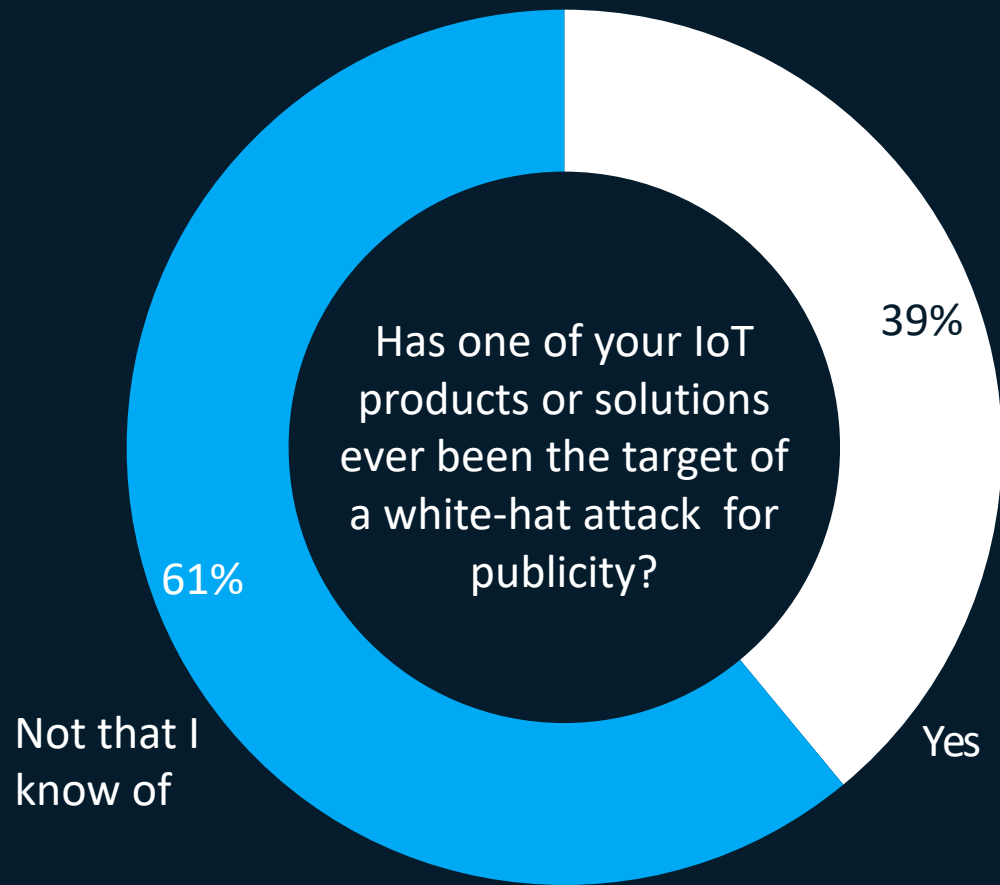


Percent of responses

[Q5_2] To the best of your knowledge, BASE: (Total: N = 1265)

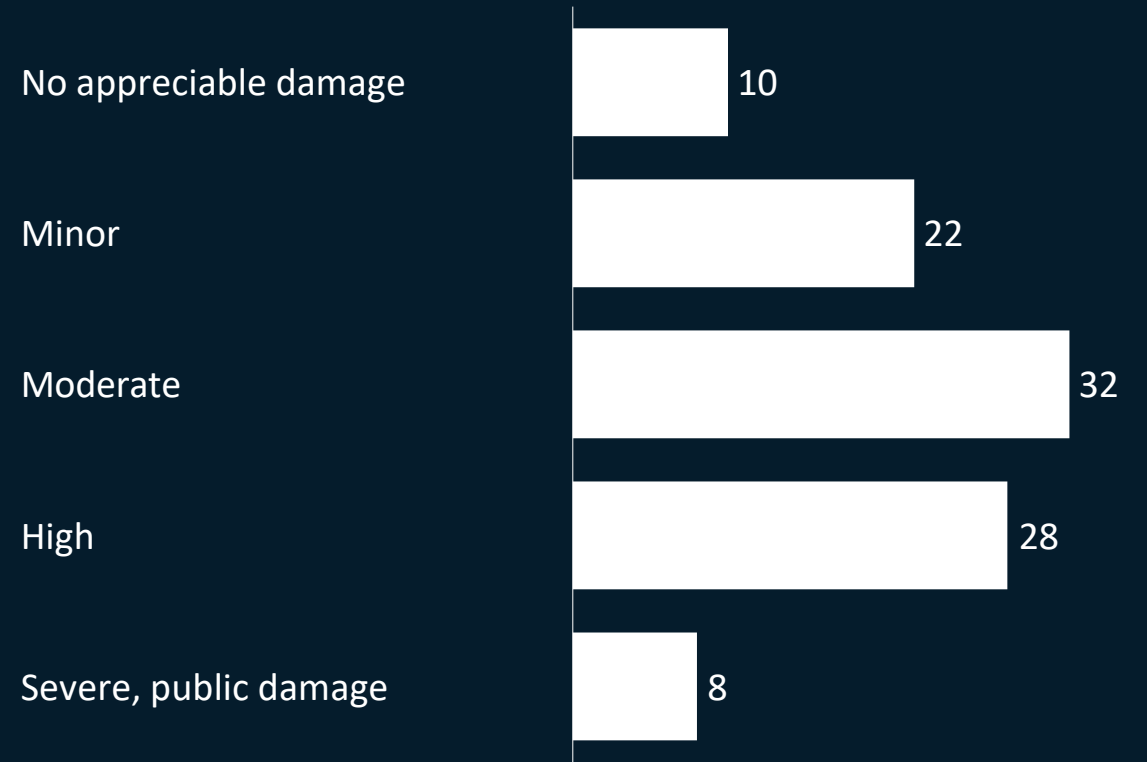
Source: 2019 survey of 1400 IoT practitioners; McKinsey analysis

White Hat hacking has become a threat to reputations in IIoT



Percent of responses

If yes, how severe was the reputational damage?

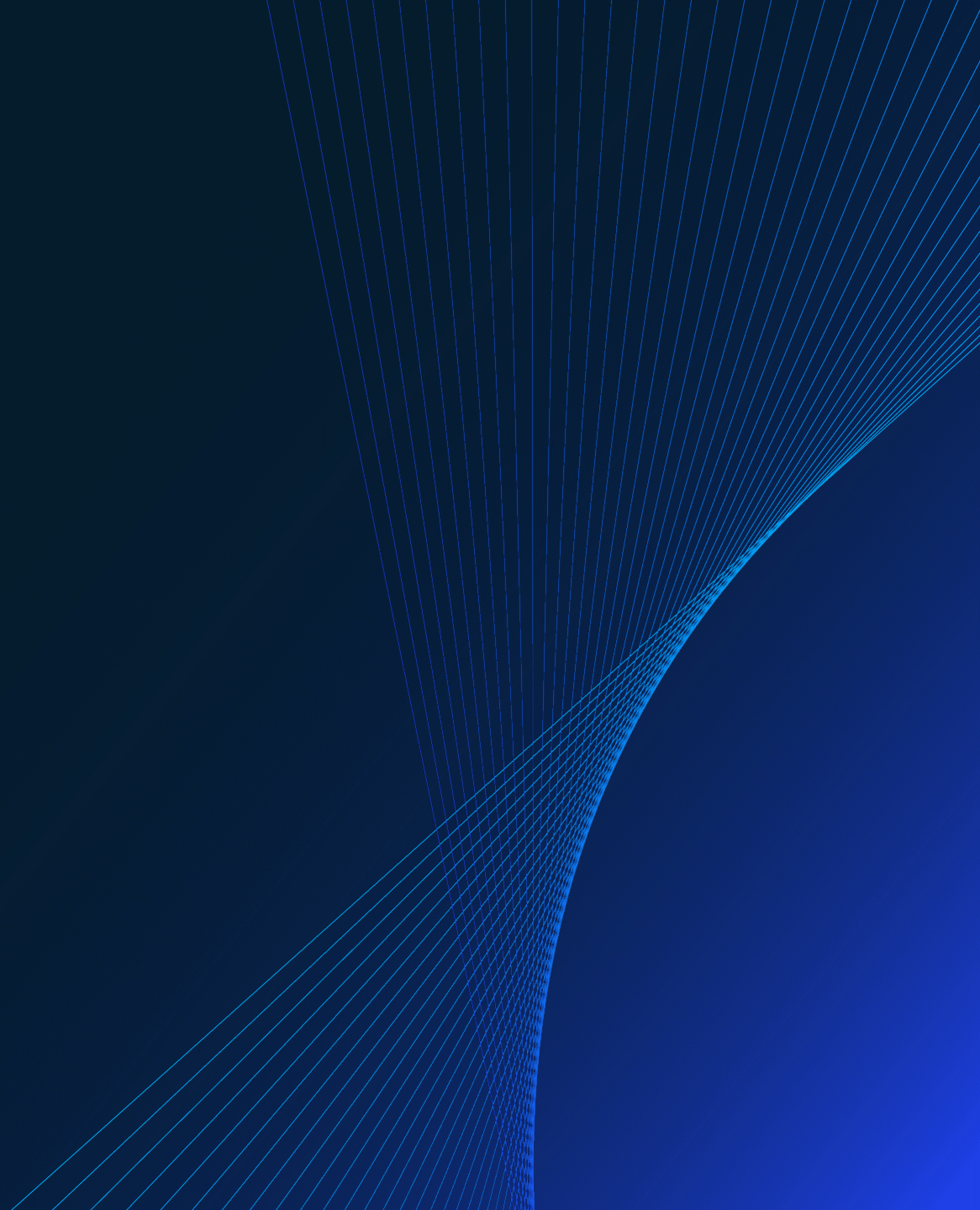


Cyber attackers have not derailed IIoT

54% of IoT Leaders report high confidence in their Cyber security posture vs. only **16%** of laggards....

Even though Leaders report having been attacked **2X** as often

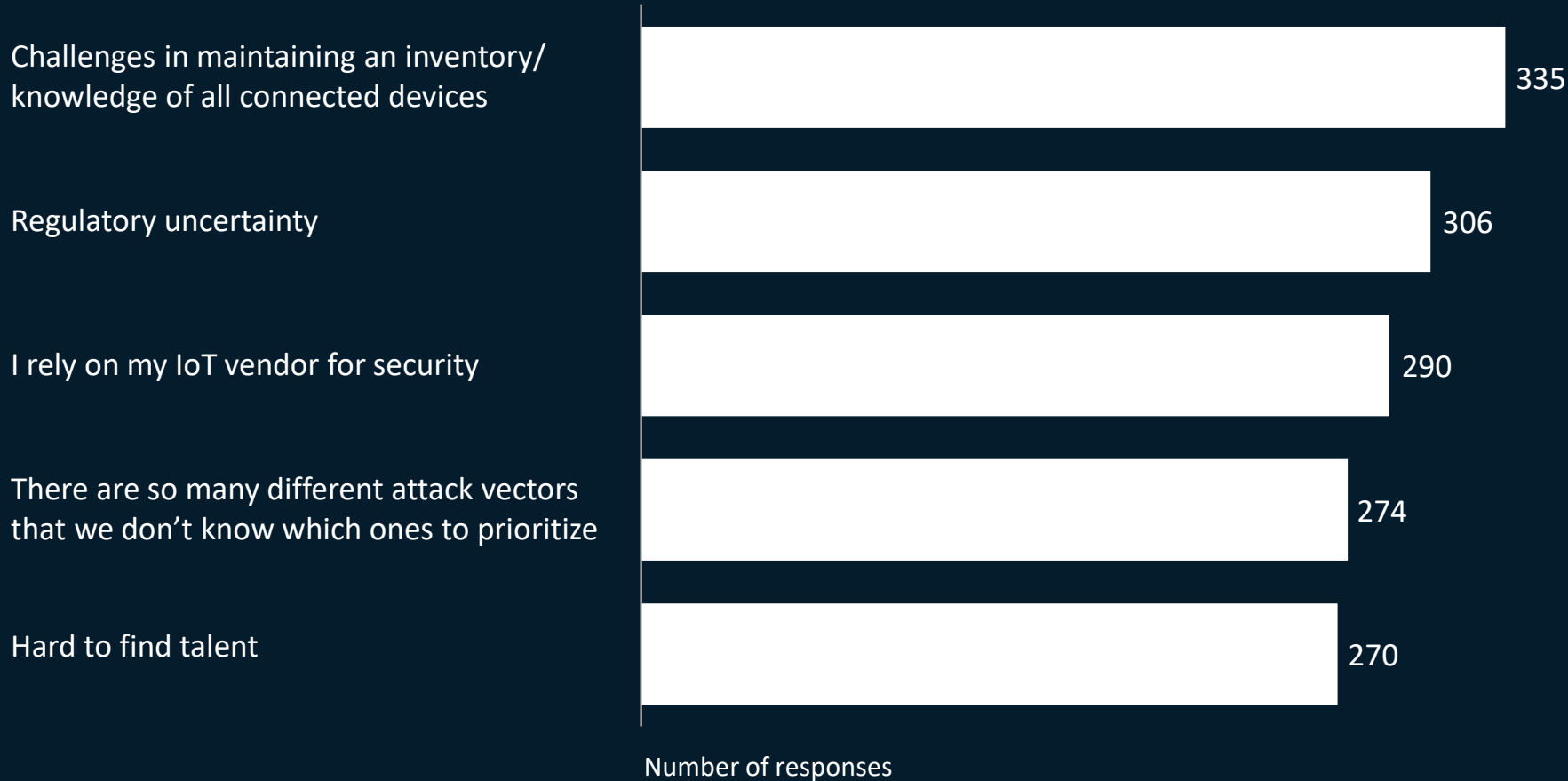
McKinsey
& Company



Extra Slides

Uncertainty deters cyber security spending

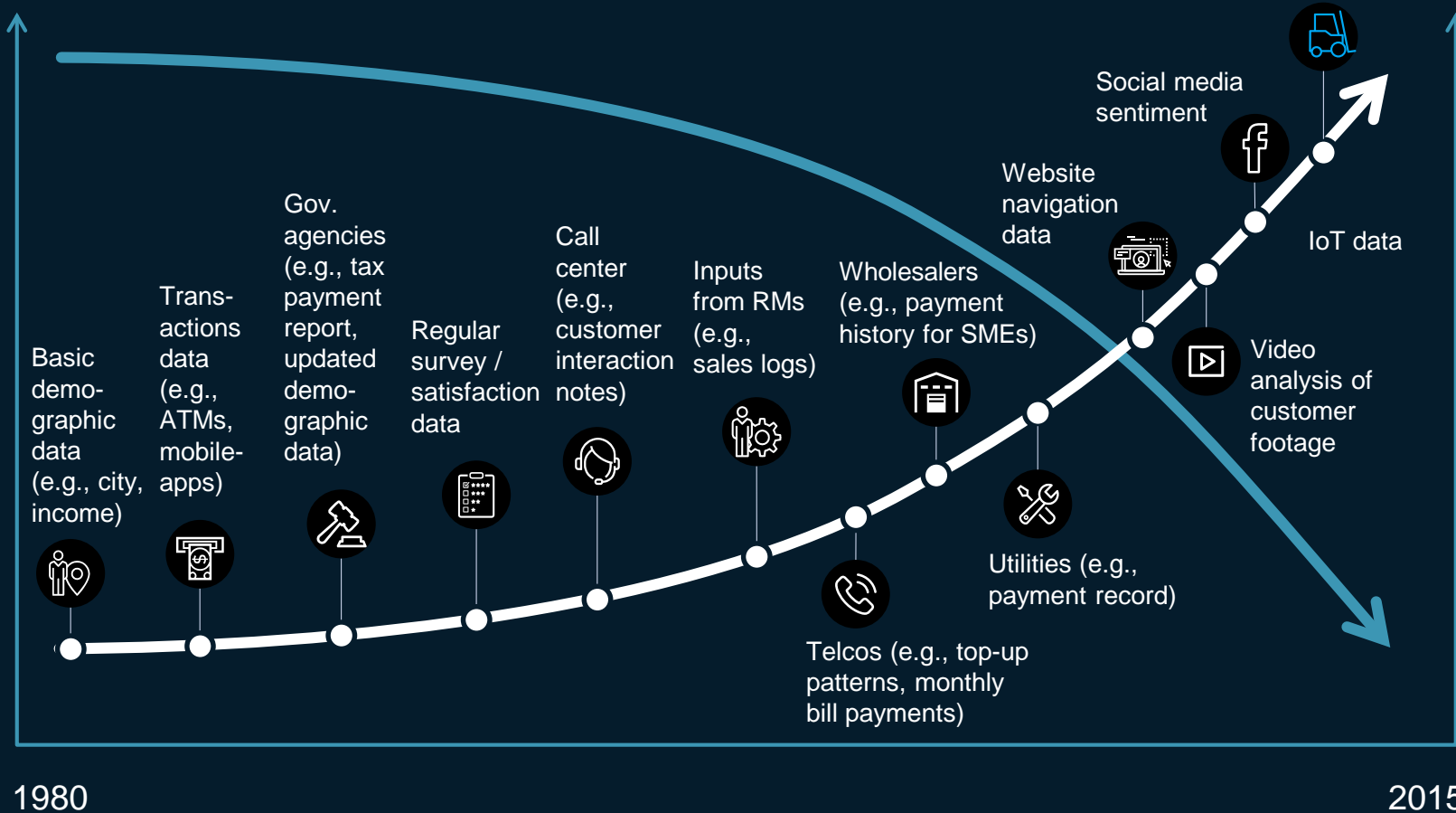
Install base, standards and attack vectors



What deters investing or focusing on security for IoT? (top 3 of 10 analysis)

The AI good news: 2019 ≠ 1980

1 Costs of data storage and processing

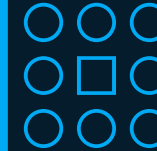


2 Data availability

3 Maths

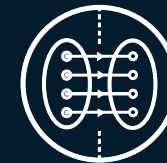
Artificial Intelligence

The science of making intelligent machines



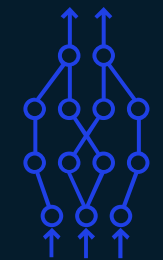
Machine Learning

A major approach to realise AI



Deep Learning

A branch of ML



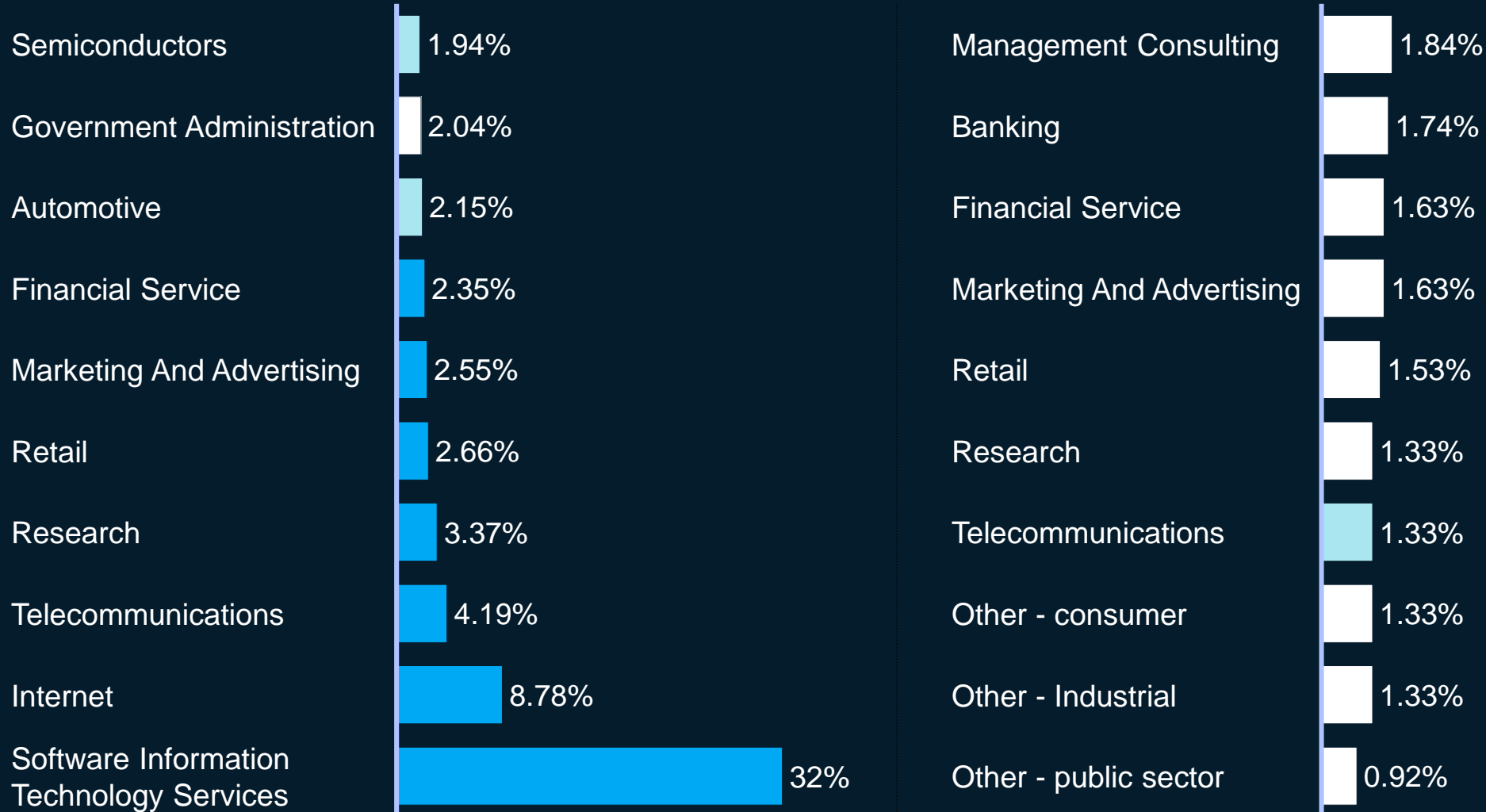
1950's

1980's

2010's

AI is not yet scaling in the physical world

Companies investing in AI by industry



60%

in digital and data based businesses

5 Takeaways about AI/Machine Learning in IoT



- 01
- 02
- 03
- 04
- 05

AI/ML adoption accelerating in IoT: 60%

China leads adoption: 80% at scale use it














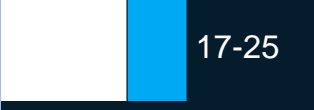



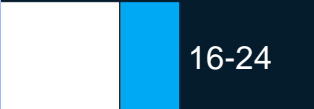






Financial impact comes with volume

Satisfaction comes with solution maturity

Laggards in IoT were much less satisfied (60%) with AI/ML than leaders (97%)

Edge Computing is becoming mainstream

Edge computing represents a potential value of \$175-215B in hardware by 2025

Industry	% of total edge use cases	2025 hardware value ¹ \$B	Industry	% of total edge use cases	2025 hardware value ¹ \$B
 Travel, transport, and logistics	24%	 35-43	 Advanced industries	10%	 5-13
 Cross-vertical	9%	 32-40	 Healthcare	10%	 5-13
 Retail	10%	 20-28	 Infrastructure	6%	 4-11
 Media and entertainment	1%	 17-25	 Chemicals and agriculture	5%	 4-11
 Public sector and utilities	10%	 16-24	 Banking and insurance	1%	 2-7
 Global energy and materials	13%	 9-17	 Consumer	4%	 1-5

¹ Hardware value includes opportunity across the tech stack (i.e., the sensor, on-device firmware, storage, and processor) and for a use case across the value chain (i.e., including edge computers at different points of a McKinsey & Company SOURCE: McKinsey, "New Demands, New Markets: What Edge Computing Means for Hardware Companies" – Oct 2018 McKinsey & Company 38

With IoT transformation, changing the organization brings its own set of pain points



*The **need to radically retrain and upgrade the skills of employees** is the greatest challenge we'll face in our careers*

– CEO, Telecommunications

*We're going to see **more change in financial services** in the next five years than we saw in the past 30*

– CEO, Payments

***Digital talent doesn't stay** here long because there is nowhere for them to grow*

– SVP of Digital BU, Media

*It's not the technology that's the hard part, **it's the culture change***

– CEO, Software

*The innovation committee sits in an ivory tower and **isn't close enough to the customer needs***

– GM of Digital BU, Media

*The business heads **don't take me seriously** – how can I get them to adopt new technology?*

– Chief Digital Officer, Global Bank