EDGE COMPUTING

From the Edge to the Core to the Edge

A look at the transformational opportunity of Edge Computing in the Enterprise and its role in delivering business agility and value.

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BACKGROUND INTRODUCTION

The need for Edge Computing and an introduction to the research.

The late 20th century saw the rise of the Internet, and the ability to *connect* isolated islands of data storage and computing resources (e.g. data centers) to both users and each other. The 21st century has witnessed the rise of the cloud, and the ability to *move* both data storage and computing power from the private, physical datacenter to the shared, virtual cloud, where data, infrastructure, communications, and software all exist within an elastic fabric.

The resulting shift to shared assets-as-a-service (procured through subscriptions) from enterprise-owned assets (procured through purchase) has been profound. This has allowed massive amounts of data to be collected and processed in a centralized approach. But not all data is suited to centralized processing, particularly if the volume of data is large, its use local, and its time-sensitivity short.

Enter Edge Computing, the idea of distributing computing power to process data when and where it is created. While the cloud offers centralized data storage and computing resources, Edge Computing offers decentralized, distributed resources. If it seems like we're in a bit of a cycle here, we are. The pendulum has swung several times back and forth between centralized and distributed computing, each time reaching one extreme only to have new requirements emerge and pull it back.

In today's enterprise, Edge Computing is increasingly used to process the significant volumes of data generated from sensors – the Internet of Things (IoT) and/or Industrial IoT (IIoT) – that increasingly dominate business models, from industrial manufacturing to transportation to financial and insurance systems.

But answers to the questions of *how* and *why* Edge Computing is actually being planned, implemented, and managed within the enterprise were not always clear. As our research will show:

Operations and information technologists have different roles within the enterprise but must often work together in specifying, deploying, and managing technology, including Edge Computing.

We also know from prior research and ongoing client engagement that security is one of the prime drivers in the selection and implementation of technology and the evolution of business processes. But it has been unclear how is was shaping the adoption of Edge Computing. As we now know:

When it comes to Edge Computing, security is a barrier, is needed, and is not being adequately-planned for, but is actually aided by the adoption of Edge Computing.

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To put it simply: Edge Computing is a bit unique in the realm of technology, leveraging the strength and value of other digital technologies while crossing and blurring the barrier between traditional operational groups and information technology groups.

To gain a better sense of the drivers, barriers, and adoption rates for Edge Computing technology, we conducted an in-depth survey, commissioned by HPE and Intel. The survey was designed to *identify the factors influencing and shaping the use of Edge Computing within the enterprise today*.

This survey specifically targeted Edge Computing, defined as "*the distribution and placement of computing resources at the edge of the network where data from devices (e.g. IoT, sensors, controllers) can be processed and refined before it is sent into the cloud or datacenter*." In essence, any device not directly connected to a datacenter, whether in the cloud or in a private facility, is part of the Edge.

Throughout this report we refer to IT and OT: IT refers to Information Technology teams (managing networking, cloud, storage, communications, etc.), and OT refers to Operational Technology teams (managing the hardware & software systems that control and monitor production or processes in a factory, plant, or physical operation).

Our goal throughout this research process was to gather and interpret the data, letting our survey panel inform our analysis and guide us to the right conclusions.

DEMOGRAPHICS

The survey was conducted during Q3/4 of 2018, consisting of a multi-part questionnaire with 15 core questions. Just over 90 percent of our survey panel was located in North America. The survey was completed by 512 respondents (512n survey panelists) that met the following criteria:

Management Role Requirement: A minimum of Director, Manager, or Team Lead and above (SVP, EVP, VP, BU Lead, C-suite, Owner, Partner).

Executives and senior management are evenly represented against mid-level management, who represent a slight 53 percent majority of our survey panel. This provides a well-balanced response base, and the ability to contrast how the different groups view the issues surrounding Edge Computing.

53% Directors, Managers, Team Leads

36% Executive, C-Suite, Owner, Partner
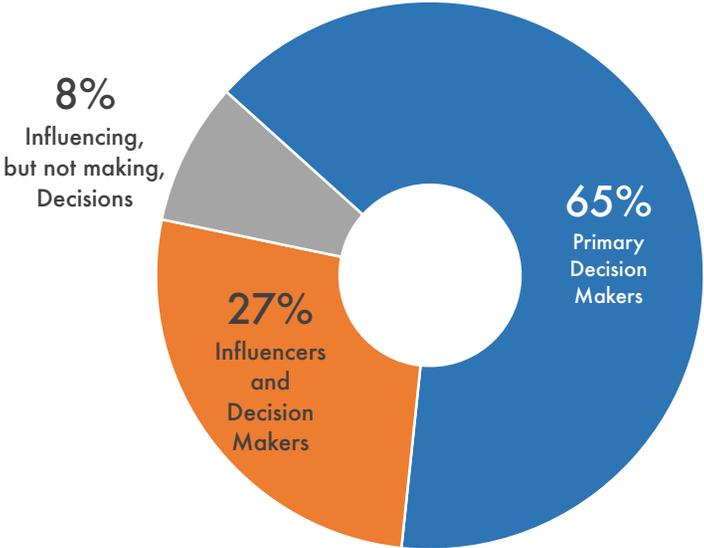
12% SVP, VP, VP, BU Lead
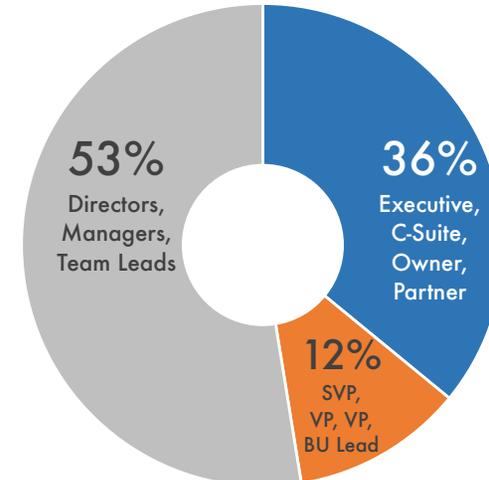
Technology Involvement Requirement: At least a moderate level of involvement in decisions (including influencing decisions) directly relating to the planning, implementation,

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management or oversight of connected or digital technologies and strategies.

We group our survey panel into three decision/influence groups:

- Primary Decision Makers (65 percent): a very high level of involvement in decisions, including being the primary or sole decision maker.
- Decision Influencers (8 percent): a moderate level of involvement, influencing but not making decisions.
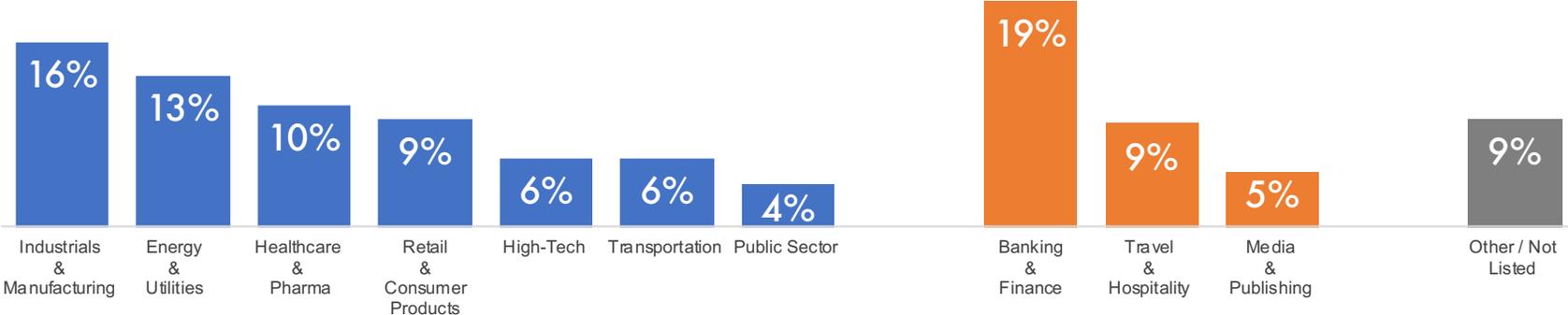- The remaining 27 percent have a more active role with a high level of both influencing and making decisions,

- 14 percent of responses represent firms with 50,000 or more global employees.
- 23 percent of responses represent firms with 5,000 to 49,999 global employees.
- 40 percent of responses represent firms with 1,000 to 4,999 global employees.
- 23 percent of responses represent firms with 500 to 999 global employees.

8%
Influencing, but not making, Decisions

65%
Primary Decision Makers

27%
Influencers and Decision Makers

14%
500,000 or more

23%
5,000 - 49,999

23%
500 - 999

40%
1,000 - 4,999

Size of Organization Requirement: A minimum of 500 employees across all global locations Pie chart here, without text?
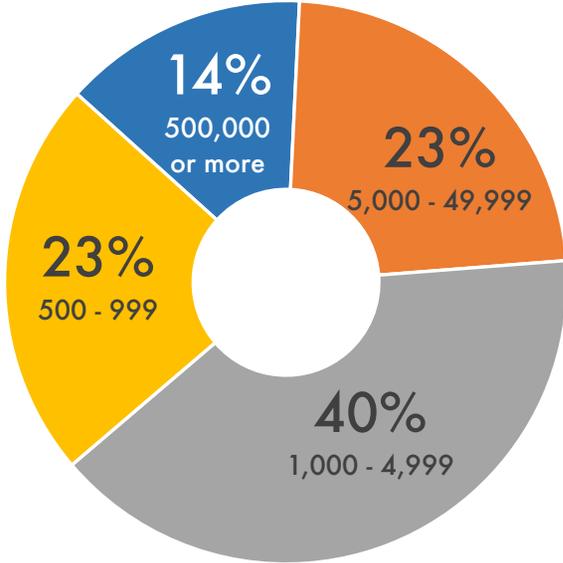
For purposes of this study, we broke apart our survey panel into two groups of industry sectors. The intent was to highlight both overall and specific industry responses, but also break apart responses where the application of IoT and Edge Computing might be sufficiently different as to warrant a slightly different perspective on market.

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The breakdown of responses by industry and sector is as follows:

16%	13%	10%	9%	6%	6%	4%		19%	9%	5%	9%
Industrials & Manufacturing	Energy & Utilities	Healthcare & Pharma	Retail & Consumer Products	High-Tech	Transportation	Public Sector		Banking & Finance	Travel & Hospitality	Media & Publishing	Other / Not Listed

We addressed 10 industries (sectors) within this survey. Of those 10, we group seven as 'industrial' and three as non-industrial, or 'information' sectors. These two groups have somewhat distinct business and product/service models.

INDUSTRIAL-BASED

ENERGY & UTILITIES: Water, Electric, Oil, Gas, Renewable, Nuclear; Discovery, Extraction, Production, Distribution, Consumption, Disposal

HEALTHCARE & PHARMA: Medical, Medical Equipment, Diagnostics, Professional Services, R&D

HIGH-TECH: Telecom, Communications, Computing, Cloud, Mobile, Software, Hardware, Semiconductors

INDUSTRIALS & MATERIALS: Capital Goods, Manufacturing, Machinery & Production Equip; Chemicals, Construction Materials, Metals, Mining

PUBLIC SECTOR: State, Local, Federal Government; Non-government Organizations

RETAIL & CONSUMER GOODS: Discretionary Products, Automotive, Household Goods, Apparel, Hardware, Retail, E-Commerce

TRANSPORTATION: Transportation Freight, Logistics, Roads, Rail, Airlines, Cargo, Shipping, Distribution

INFORMATION-BASED

BANKING & FINANCIAL SERVICES: Capital Markets, Investment Banking, Insurance

MEDIA & PUBLISHING: Internet & Web, Publishing, Advertising, Content

TRAVEL & HOSPITALITY: Consumer-focused Travel, Lodging & Entertainment

512
EXECUTIVES & TECHNOLOGY PROFESSIONALS SURVEYED DURING Q3 2018

65%
PERCENT OF RESPONDENTS ARE PRIMARY DECISION MAKERS

48%
PERCENT OF RESPONDENTS AT SENIOR OR EXECUTIVE LEVELS

77%
PERCENT OF RESPONDENT'S ORGs WITH > 1,000 GLOBAL STAFF

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EXECUTIVE SUMMARY

Edge Computing is transforming the use and value of data within the enterprise and, in the process, highlighting both opportunities and concerns that operational, information, and business executives need to consider moving forward.

Edge Computing has, in a relatively short period of time, made significant inroads into the industrial enterprise. Fueled by the adoption of connected assets and sensors, Edge Computing has been adopted aggressively by operations teams to increase the value of industrial data, time to insight, and to the ability act proactively.

Specifically, and within this survey, *we identify the following top findings:*

1 EMBARKING ON THE EDGE COMPUTING JOURNEY

Edge Computing is being driven by operations, driven not by IT, but by the business.

While many technology implementations today are driven by broad-based performance improvement requirements (faster, more reliable, more secure, etc.), Edge Computing is being driven by operational needs that can best or only be met through the processing of data where it originates, at the edge.

2 THE OPERATIONS CHALLENGE

IT may not be driving the adoption of Edge Computing but ends up owning it.

Edge Computing frequently enters the enterprise through an individual Business Unit or to address a specific operational requirement. But even if IT doesn't initiate the process, it often responsible for the ongoing management (and potentially the purchase as well).

72%

INDICATE THAT EDGE COMPUTING ENTERED THEIR ORGANIZATION THROUGH OPERATIONS AND NOT IT.

58%

INDICATE THAT EDGE COMPUTING IS EXTREMELY IMPORTANT TO ACHIEVING SUCCESS IN DIGITAL TRANSFORMATION, IOT AND INDUSTRY 4.0 INITIATIVES.

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3   EDGE COMPUTING AS AN ENABLER

Edge Computing is more than change itself, it is enabling change – including the value – of other systems.

The value of Edge Computing is not in the technology itself but on where it is delivered, and what it enables. Edge Computing is going where the data is created, transforming it, and giving it new value. And it's doing it in stages.

4   BARRIERS AND DRIVERS

Edge Computing is believed to offer increased Security, Reliability, and Performance to existing IoT and sensor-collected data.

The key drivers of Edge Computing are similar to what we've seen in previous research for other emerging technologies—securing data, improving operational reliability and efficiency, and driving application performance are all important factors. But while security is a top driver, it is also considered a top barrier, and this is an issue that needs to be addressed sooner rather than later.

5   ADOPTION AND BUDGETS

Edge Computing deployment is projected to increase considerably and budgets appear to match.

Close alignment of overall budgets and Edge Computing budgets indicates a proactive approach to funding, particularly as Edge Computing is expected to continue to increase over the coming years. But an overall increase in the amount of data processed at the edge, and a pattern of relying on IT for management expertise, indicates there may be a surprise funding issue down the road.

One of the most important findings of the research is that the cloud, for all of its ubiquity and both real and perceived value, is not the place were all data needs to reside. There are clearly use cases and business cases where data that is more valued—or needed—at the edge should stay at the edge. In the ongoing cloud versus on-premises alignment, hybrid is increasingly the chosen model, and this certainly applies to industrial IoT data and Edge Computing.

69%

CITE SECURITY AS A TOP DECISION FACTOR.

23%

INDICATE THEY EITHER DON'T HAVE OR ARE UNSURE ABOUT A SECURITY STRATEGY IN PLACE TO SECURE EDGE COMPUTING AND IoT DEVICES.

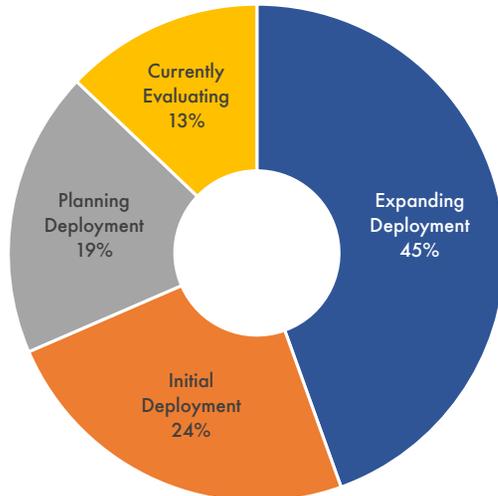**FUTURUM.** TECHNOLOGY INSIGHTS FOR BUSINESS LEADERS

ISSUE ONE THE EDGE COMPUTING JOURNEY

Edge Computing is being driven by processes and applications, , but usually not IT.

Most new data technologies that make their way into the enterprise, are driven by IT. Technologists map the long-term strategy in consultation with operational units and then execute against their internal plan. There are many benefits to IT-driven strategies, both from a digital transformation and digital injection approach. Edge Computing, however, is following a different model and is more likely to be driven by operational needs. While this may vary between industries, the trend is clear: Operations is driving the adoption of Edge Computing, not IT.

We asked our survey panel to identify where they were on the Edge Computing journey, to establish a baseline for this and future research. While IoT (via prior stand-alone sensor technologies) has been living within the operational enterprise for decades, Edge Computing—the idea of processing sensor data locally to drive faster insights and operational awareness—is still relatively new (and goes against the all-in cloud model of bringing all data back to a central system of record).

Our research shows the "newness" of Edge Computing, but 45 percent of enterprises are well along the way and currently expanding existing deployments.

Where this gets interesting is in the breakdown of industries. Industrial sectors (e.g. Energy, Utilities, Manufacturing, High-tech) are behind non-Industrial Information sectors (e.g. Banking & Finance, Media & Publishing) in expanding existing Edge Computing deployments, 43 percent to 51 percent.

OVERALL Results
Where are you on the Edge Computing journey?

Currently Evaluating 13%
Planning Deployment 19%
Initial Deployment 24%
Expanding Deployment 45%

55%

PERCENT OF RESPONDENTS ARE STILL IN THE EVALUATION (13%), PLANNING DEPLOYMENT (19%), OR INITIAL DEPLOYMENT (24%) STAGES.

OBSERVATION
THERE IS PLENTY OF ROOM FOR EDGE COMPUTING TO CONTINUE TO GROW FOR THE FORESEEABLE FUTURE.

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The lack of heavy operational infrastructure and the plethora of 'edge or remote' offices are giving Information sectors a perceived lead in Edge Computing adoption. But this may be due to Information-based enterprises using different definitions of IoT and Edge Computing. For information-based enterprises the edge may involve more branch and back-office operations than industrial organizations.

BOTTOM LINE

While many technology implementations today are driven by broad-based performance improvement requirements (faster, more reliable, more secure, etc.), Edge Computing is being driven by operational needs that can best or only be met through the processing of data where it originates, at the edge.

Regardless of the industry or sector, the levels of expansion, new deployment, and even planned expansion, indicate the Edge Computing is both driven by core enterprise requirements and growing.

OBSERVATION

Leaders in Expanding Existing Deployments:
- Banking & Finance (60%)
- Energy & Utilities (52%)
- Industrials & Manufacturing (46%)

Lagging in Expanding Existing Deployments:
- Media & Publishing (32%)
- Public Sector (11%)

OBSERVATION

Media & Publishing is often considered part of the Tech sector (blended with High-tech). When broken out, however, it becomes clear that it may not be as tech-aggressive in certain areas as core High-tech companies.

We believe Media & Publishing companies may be artificially lowering tech-adoption metrics for pure-play High-tech companies in certain technology areas.
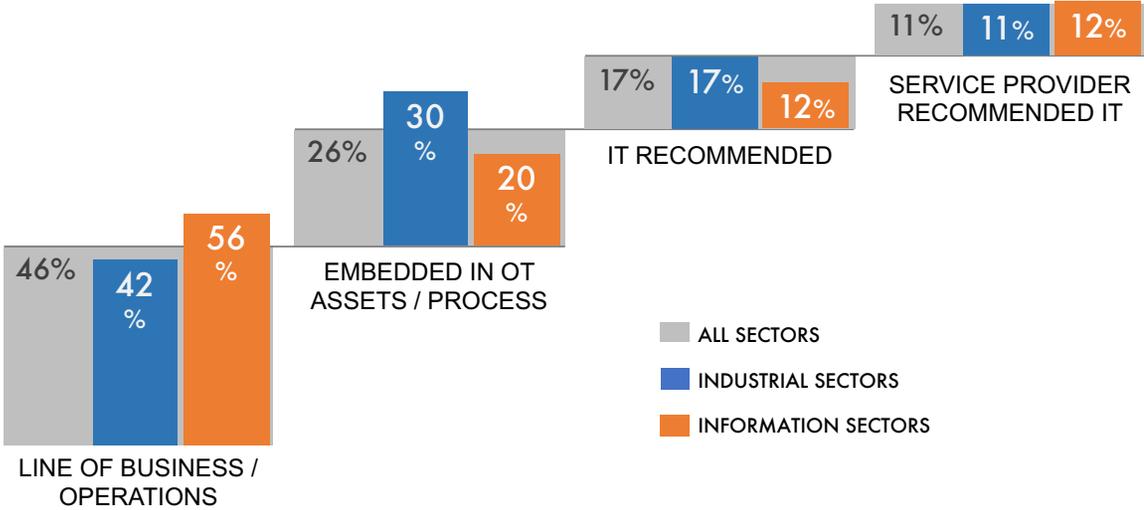
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ISSUE TWO THE OPERATIONAL CHALLENGE

IT may not be driving the adoption of Edge Computing but it ends up owning and maintaining it.

The introduction of new technology into any organization can be a planning and logistical challenge. There are many aspects of the "concept to operations" process that need to be highly coordinated, from needs assessments to vendor evaluations to selection and contract negotiation, not to mention the issues of ongoing operational management and ensuring the technology is meeting (or continues to meet) operational requirements.

In seeking to understand how Edge Computing technologies are being introduced to the enterprise, we asked our panel to identify how Edge Computing being acquired. Not surprisingly, the results showed a high-level of reliance on operations.

OBSERVATION

Edge Computing is NOT being DRIVEN by IT.

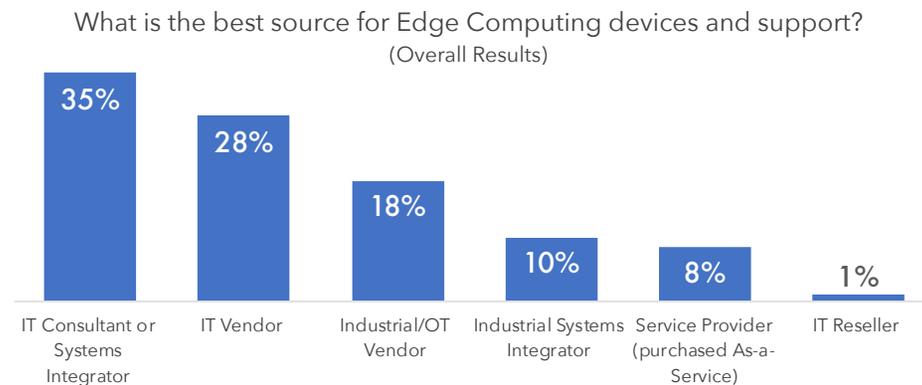Initial implementations of Edge Computing are driven by business needs first.

72 percent of enterprises implementing Edge Computing say the first entry point was from Operations, not IT.

This contrasts strongly to how most IT-associated technologies enter the

72% Percent of the time Edge Computing begins somewhere with an Operations focus.

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In a nod to shadow IT (technology brought into an organization that bypasses IT), the Information sectors have a much greater tendency to implement on their own than Industrial sectors. Overall 46 percent of enterprises report Edge Computing began at the direction of a Line of Business or Operations team, and for Information firms it was 56 percent, with only 12 percent indicating they relied on IT for the recommendation to move to Edge Computing. Similarly, Industrial firms were much more likely to rely on Edge Computing bundled into other or existing Operational assets or processes, which makes sense as systems that create data are increasingly driving the demand for that data to be processed and converted into actionable insights.

THE SOURCING QUESTION

if Edge Computing is being introduced as a result of Business or Operation's needs, is IT involved in that discussion, and who is the preferred source of the technology? It turns out that IT Consultants and/or Systems Integrators (including those specializing in industrial systems) are the preferred source for 45 percent of enterprises.

What is the best source for Edge Computing devices and support?
(Overall Results)

Source	%
IT Consultant or Systems Integrator	35%
IT Vendor	28%
Industrial/OT Vendor	18%
Industrial Systems Integrator	10%
Service Provider (purchased As-a-Service)	8%
IT Reseller	1%

Why are Consultants and Integrators so important in Edge Computing?

Edge Computing is different than traditional server or cloud compute resources, it's highly distributed, often in industrial or operations environments, and is frequently required to process and analyze data or support applications unique to the operations process.

This often requires both a high level of integration with operational systems (both IoT and the devices generating the data) and a high level of specialized expertise unique to the hardware, software, and operational processes in place within different industries. The highly vertical nature of Edge Computing sets it apart from the more generic server or cloud implementations typically handled by IT departments (and supplied by IT vendors). While this is not always the case, as 28 percent of our panel indicated they do purchase from IT Vendors, our research data showed this to be fairly universal across all industries.

Edge Computing, building on IoT implementations, requires tight and ongoing collaboration between IT and operational teams in order to gain maximum value for both individual business units and the overall business.

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Notable exceptions to this trend include High-tech companies, which preferred to purchase direct from an IT Vendor just over 43 percent of the time, Travel & Hospitality businesses which prefer Industrial Systems Integrators 27 percent of the time, and the Public Sector, which purchases Edge Computing "as-a-service" 28 percent of the time.

We view these exceptions as confirmation of larger trends within each of these Industries: High-tech is very tech-savvy with strong IT Vendor relationships, Travel & Hospitality often relies heavily on integrators to provide turnkey solutions, and the Public Sector is highly focused on shifting toward a services-based consumption model.
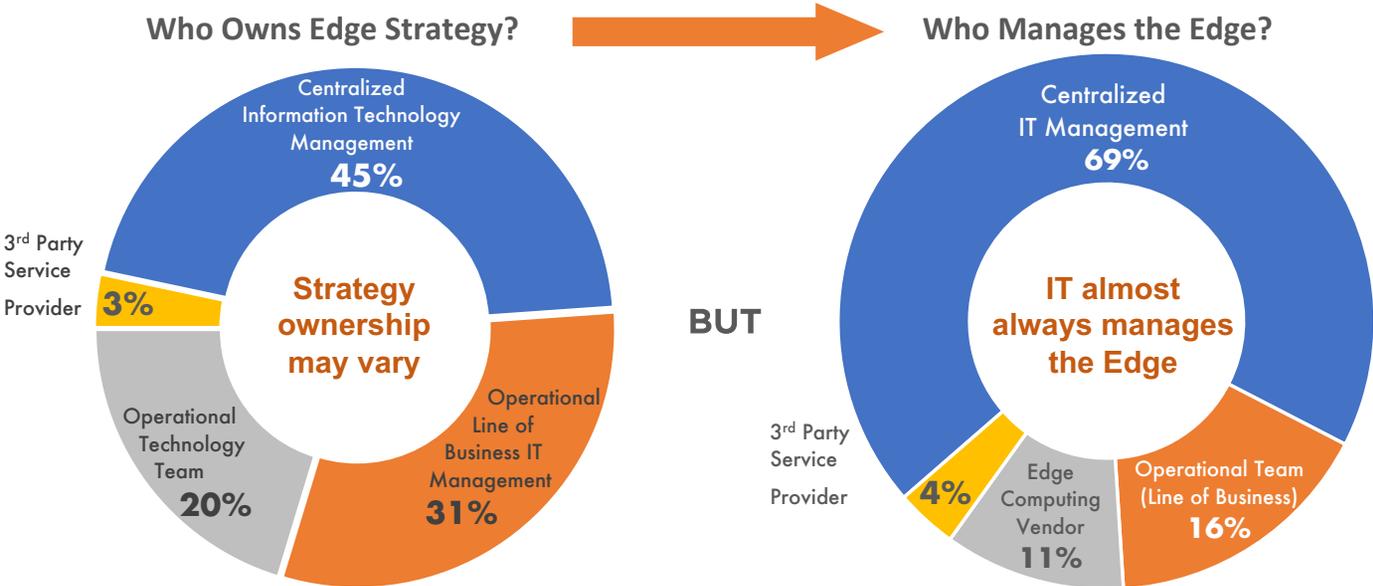
THE MANAGEMENT FACTOR
If Business Units and Operational Teams are driving the introduction of Edge Computing and relying on IT Consultants and Integrators to implement, who ends up owning the management of the devices? Equally important is the question of ongoing expansion: After the initial wave of Edge Computing implementation has taken place, does IT play a role in the ongoing strategy for these computing systems? And if IT is not involved in the strategy or management, who is responsible for those critical actions required to maintain an ongoing and effective Edge Computing implementation?

It turns out that (centralized) IT is heavily involved in setting Edge Computing strategy, but not as much as we see for other types of technology. While 45 percent of enterprises do rely on IT to set, or own, ongoing Edge Computing strategy, 51 percent continue to rely on Operational or Business-specific (embedded technology) resources for Edge Computing strategy.

But when it comes to actually managing existing implementations of Edge Computing devices:

Who Owns Edge Strategy? → **Who Manages the Edge?**

Who Owns Edge Strategy?
- Centralized Information Technology Management **45%**
- 3rd Party Service Provider **3%**
- Operational Technology Team **20%**
- Operational Line of Business IT Management **31%**

Strategy ownership may vary

BUT

Who Manages the Edge?
- Centralized IT Management **69%**
- 3rd Party Service Provider **4%**
- Edge Computing Vendor **11%**
- Operational Team (Line of Business) **16%**

IT almost always manages the Edge

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While it owns Edge Computing strategy only 45 percent of the time, Centralized IT is charged with keeping systems running 69 percent of the time.

This is a major gap between strategy (and procurement) ownership and ongoing maintenance ownership. Potential risks of this gap touch on inadequate skill sets (of IT to manage Operational equipment), conflicts between Operational and IT strategies, and a lack of budget alignment between the two groups.

BOTTOM LINE

Edge Computing frequently enters the enterprise through an individual Business Unit or to address specific operational requirements. But even if IT doesn't initiate the process, it often ends up owning the ongoing management (and potentially the purchase as well).

Is Centralized IT management of Edge Computing (and potentially IoT devices) a virtue or a liability? Perhaps it's a bit of both. Industrial Sector enterprises only rely on Centralized IT 43 percent of the time to manage the Edge, while Information Sector enterprises leverage this resource 51 percent of the time. This appears to be a reflection of a more mature posture with regard to Edge Computing, supported by the increased percentage of Information Sector organizations that are further along the Edge Computing journey.

We believe that even if Centralized IT isn't responsible for Edge Computing management, it MUST be involved in the strategy, selection process, and budget allocation.

Over time, an increasing number of IoT devices will become "smart" devices, with some element of today's Edge Computing woven into the design. For this to provide value, IT needs to be involved if only to ensure interoperability and API integration with other enterprise systems.

As we see occasionally in other markets, we see less than half of respondents are considered C-suite or senior management. And yet, approximately two thirds of our panel are in a position of being primary decision makers for Edge Computing. In this case, middle managers appear to be more responsible for decisions typically associated with upper-management personnel.

Why? When it comes to Edge Computing, it is often driven by operational needs, and not necessarily part of a grand IT or even Business Unit strategy or part of an overall digital transformation strategy. It appears that executive and senior management may be responsible for overall business direction, goals, and results, but they are leaving the technical "how" question to the mid-level operational teams and managers.

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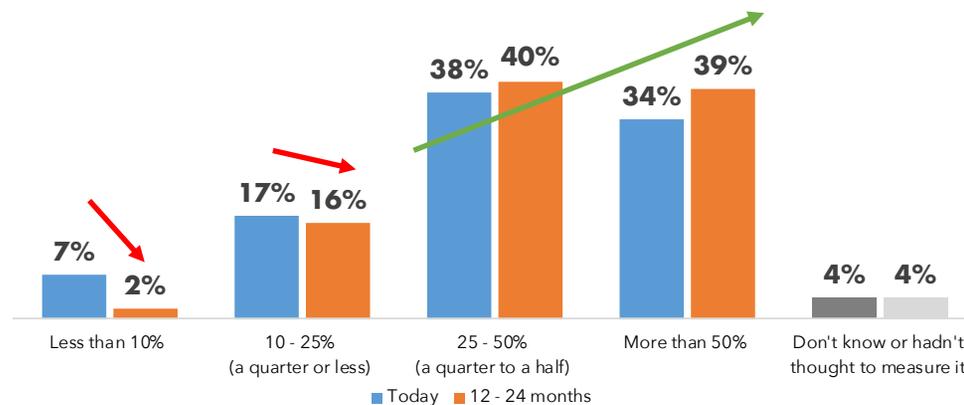
ISSUE THREE EDGE COMPUTING AS AN ENABLER

Edge Computing is more than change itself, it is enabling change – including the value – of other systems.

It is not uncommon to see specific technologies, such as Artificial Intelligence (AI), predictive analytics, Augmented or Virtual Reality (AR/VR), or blockchain, targeted for either research & upgrade or proof-of-concept validation as a transformative technology. But Edge Computing is not considered as much of a transformative technology as other emerging technologies may be today. But the use and value of Edge Computing is there. To determine exactly how Edge Computing is being used within the enterprise and how it will evolve and grow over the coming years, we looked to gain an understanding of how enterprises see their own use evolving from both a capacity and technology perspective.

We know, from this and prior research, that enterprises are aggressively deploying Edge Computing systems to integrate with IoT and other data-generating technologies, allowing data to be processed faster and insights gained more rapidly. But how much of an impact is it having, and what initiatives is it advancing?

We queried our survey panel on the levels of data already being processed at the Edge. By comparing current workloads (as a percent of total workloads) against expected workloads over the coming 24 months, we are able to set a level of expectation for growth in Edge Computing.

Percent of respondents indicating a current/expected percent of data processed at the edge (range).

	Less than 10%	10 - 25% (a quarter or less)	25 - 50% (a quarter to a half)	More than 50%	Don't know or hadn't thought to measure it
Today	7%	17%	38%	34%	4%
12 - 24 months	2%	16%	40%	39%	4%

■ Today ■ 12 - 24 months

We see a clear trend or shift toward an increased amount of edge data being processed where it is generated, at the edge. The number of enterprises processing less than 25 percent of edge data at the edge is expected to decline, particularly for those currently processing less than 10 percent. Additionally, we see an increase among enterprises processing more than 25 percent of data at the edge.

But the question and chart to the left present an incomplete picture, as responses were grouped into predetermined ranges. While those users

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projecting more than 50 percent of data will be processed at the Edge within 12 to 24 months, there is a wide range of possibilities for actual levels.

More importantly, the number of IoT devices at the Edge is expected to increase dramatically over the coming years. Quant-firm HIS projects the number of IoT devices worldwide to increase from 23 billion in 2018 to over 30 billion by 2020, reaching a potential 42 billion by 2022. As these devices increase in number, so too does the data captured and made available to Edge Computing devices.

We believe that true Edge-specific growth numbers are masked, or understated, as a significant level of growth in IoT and other edge devices will increase the total volume of data available to be processed by Edge Computing devices.

TRANSFORMATION THROUGH THE EDGE
To better understand the types of applications and processes benefitting from Edge Computing, either directly or indirectly, we questioned how important Edge Computing was to larger, more transformative initiatives. When asked how important our survey panel viewed the role of Edge Computing in initiatives such as Digital Transformation, IoT, and Industry 4.0, 56 percent cited Edge Computing as Extremely Important (i.e. a focal point of IT/OT strategy). Banking & Finance are slightly ahead, with 68 percent of enterprises citing Extremely Important, while Healthcare & Pharma (38 percent) and Public Sector (33 percent) trail, perhaps in part due to the highly-regulated nature of those sectors and an overall slower migration process.

Which of these initiatives or applications are you targeting with Edge Computing?
(OVERALL RESULTS)

Today (within 12 months)   12 - 24 Months
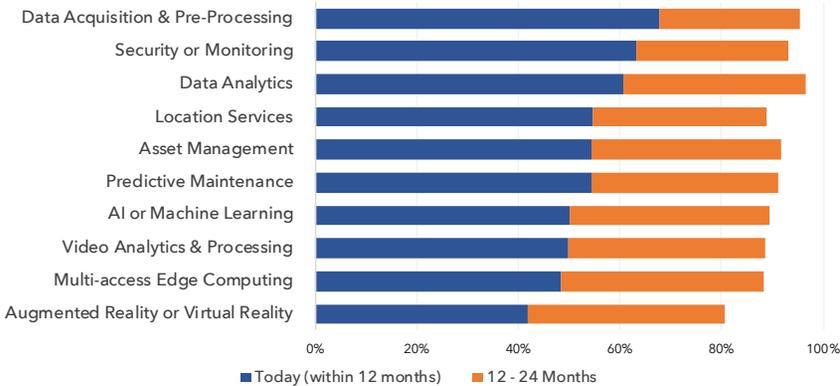
But while most consider Edge Computing a vital to long-term transformative initiatives, the current focus is much more tactical.

The top applications targeted with Edge Computing today are Data Acquisition & Pre-processing, Security and/or Monitoring, Data Analytics, and Location Services.

68%
PERCENT OF RESPONDENTS ARE LEVERAGING EDGE COMPUTING TO IMPROVE DATA ACQUISITION AND PRE-PROCESSING.

63%
PERCENT OF RESPONDENTS ARE LEVERAGING EDGE COMPUTING TO IMPROVE SECURITY AND/OR MONITORING.

FOLLOWED BY

DATA ANAYTICS
(61 PERCENT),

LOCATION SERVCIES
(55 PERCENT),

ASSET MANAGEMENT & PREDICTIVE MAINTENANCE
(54 PERCENT EACH).

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Looking ahead 12 to 24 months, these applications are likely to be considered robust, making way for initiatives supporting more emerging technology and use cases, with Multi-access Edge Computing (40 percent) and AI/ML, AR/VR & Video Analytics all around 39 percent).

We see an anticipated shift in the focus of Edge Computing from initial foundational technologies to emerging technologies over the coming 24 months.

Notably, we do not see a significant different between the top priorities between the Industrial and Information Sectors – both are focused on Data Acquisition and Security as key efforts, with Information firms placing a slightly higher emphasis on Location Services (which makes sense given the importance of mobility to those industries) and Industrial firms placing a slightly higher emphasis on Asset Management (supporting their reliance of physical equipment core to operations activities).

BOTTOM LINE

The value of Edge Computing is not in the technology itself but on where it is delivered, and what it enables. And it's not just the shift to the Edge but the growth of the Edge, not just in terms of percentage of overall load but as IoT and other systems drive massive ongoing growth in devices and data at the Edge.

Edge Computing is going to where the data is created, transforming it, and giving it new value. And it's doing it in stages, or waves. Edge Computing is considered extremely important to the successful implementation of Digital Transformation, IoT, and Industry 4.0 initiatives, but the current focus is squarely on Data Acquisition, Security, and Analytics. This will shift to over time to include greater emphasis on still-emerging needs such as AI, Augmented/Virtual Reality, Multi-cloud, and Video Analytics, over the coming two years.

ISSUE FOUR DRIVERS AND BARRIERS

Edge Computing is believed to offer increased Security, Reliability, and Performance to existing IoT and sensor-collected data.

Implementing any technology simply for technology's sake rarely affords any value. Technology with a purpose, however, can be extremely valuable. When implemented as part of a Digital Transformation effort, technology helps increase overall business performance and agility, and enable long-term business value that is greater than the sum of the individual parts. Understanding the key drivers, barriers, and challenges enterprises face while implementing Edge Computing can help assess the role that it plays in the larger strategic picture, as well as identify areas where business goals and barriers may not be properly addressed.

To gain an insight into the implementation and operational status of Edge Computing, we asked our panel a series of questions, dealing with their perceptions on:

- Technology and Edge Computing,
- Key implementation drivers,
- Business drivers leading to increased value and adoption of Edge Computing that would deliver the most value, and
- Key barriers they faced when implementing Edge Computing.

88%	**69**%	**81**%	**81**%	**19**%
BELIEVE DATA PROCESSED AT THE EDGE IS EASIER TO SECURE THAN DATA SENT TO THE CLOUD OR DATACENTER	CITE SECURITY AS A TOP FACTOR TO IMPLEMENT EDGE COMPUTING, YET 23% EITHER DON'T HAVE OR ARE UNSURE OF AN EDGE/IOT SECURITY POLICY IN PLACE	SAY EDGE COMPUTING HAS HELPED IMPROVE EMPLOYEE AND CUSTOMER EXPERIENCES	SAY IT IS (OR WILL BE) RESPONSIBLE FOR DEPLOYING AND MANAGING EDGE COMPUTING SYSTEMS	CITE IMPROVED SECURITY AS A TOP THREE DRIVER OF INCREASED BUSINESS VALUE FOR EDGE COMPUTING

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PERCEPTIONS FROM THE EDGE

We asked our panel if they agreed or disagreed with a series of statements about Edge Computing and compared the responses by industry.

Do enterprises view the world differently based on industry? Perhaps. Only 76 percent in the Banking & Finance, Media & Publishing, and Travel & Hospitality sectors expect IT to deploy and manage Edge Computing. 93 percent of same group solidly agree that data processed at the edge is easier to secure, and yet only 76% of them have a strategy in place to do exactly that.
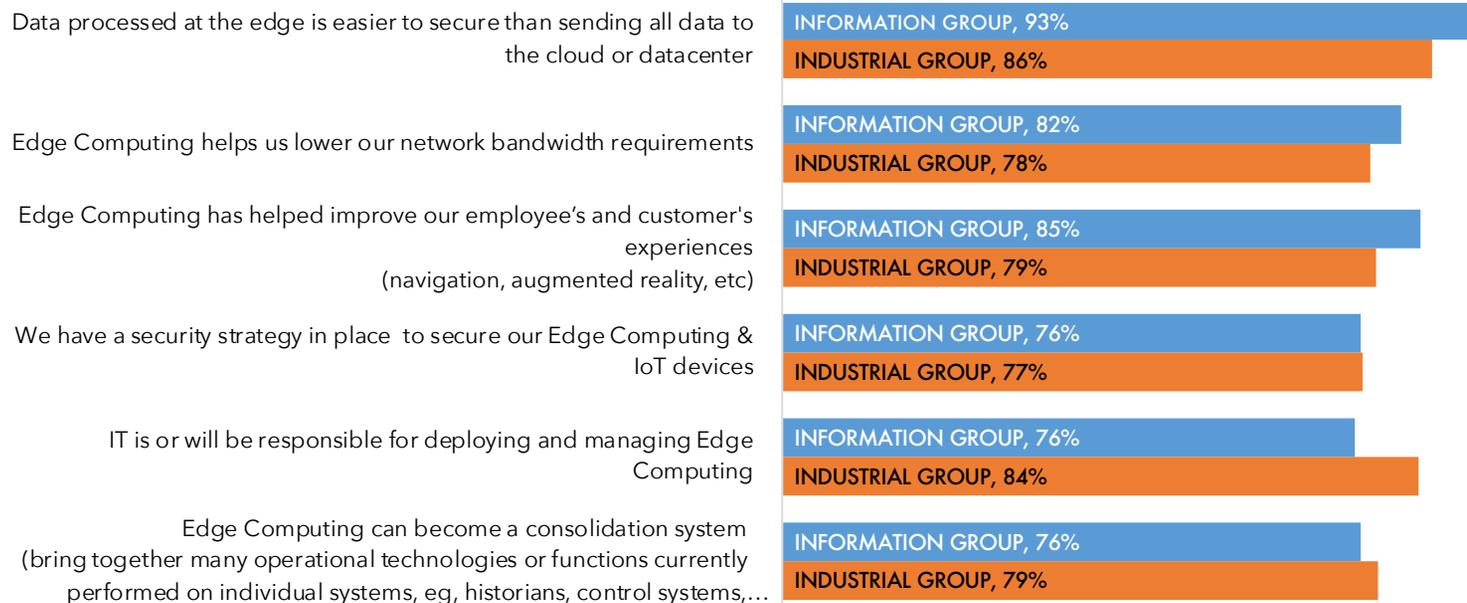
IMPLEMENTATION DRIVERS VS. BUSINESS VALUE DRIVERS

By comparing select implementation and business value drivers, we can identify gaps. Security is one such gap. When we

asked our survey panel to identify Critically Important factors (goals) in the decision to implement Edge Computing, 32 percent cited Increased Security and Improved Reliability almost equal as their top factors. This was followed by Application Performance at 27 percent (a key point we hear in client conversations when discussing both Edge Computing and on-premises hybrid implementations), Lower Operating Costs at 26 percent, Faster Data Insights at 26 percent, and Limited Bandwidth at 21 percent.

It's worth pointing out that while the ultimate goal of any data system should be Faster Data Insights, Security and Reliability are viewed as greater factors. We believe this is due in large part to the ongoing persistent threats posed by cyber security attacks and the business, financial, and brand damage that

Percent of respondents who agree with the following statements.

Data processed at the edge is easier to secure than sending all data to the cloud or datacenter
- INFORMATION GROUP, 93%
- INDUSTRIAL GROUP, 86%

Edge Computing helps us lower our network bandwidth requirements
- INFORMATION GROUP, 82%
- INDUSTRIAL GROUP, 78%

Edge Computing has helped improve our employee's and customer's experiences (navigation, augmented reality, etc)
- INFORMATION GROUP, 85%
- INDUSTRIAL GROUP, 79%

We have a security strategy in place to secure our Edge Computing & IoT devices
- INFORMATION GROUP, 76%
- INDUSTRIAL GROUP, 77%

IT is or will be responsible for deploying and managing Edge Computing
- INFORMATION GROUP, 76%
- INDUSTRIAL GROUP, 84%

Edge Computing can become a consolidation system (bring together many operational technologies or functions currently performed on individual systems, eg, historians, control systems,…
- INFORMATION GROUP, 76%
- INDUSTRIAL GROUP, 79%
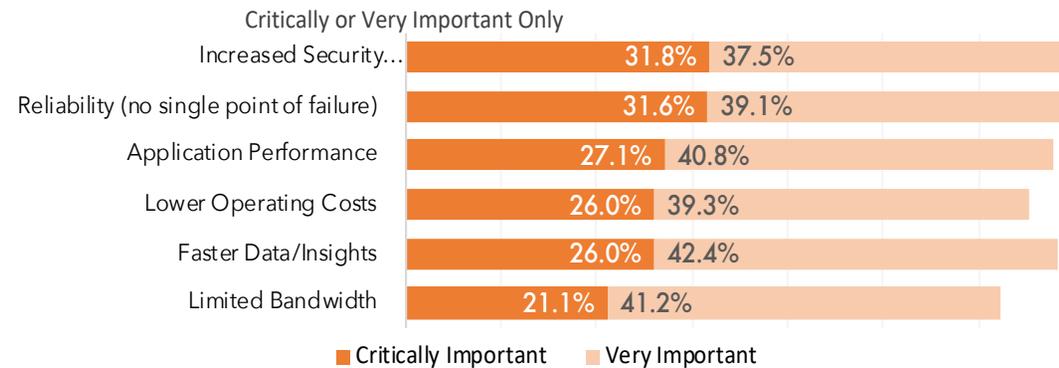
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could result if compromised. This type of attack goes beyond the more common user data breach and can result in a substantial impact. Only when Very and Critically Important responses are combined do Faster Data Insights become a top three choice.

When we asked our survey panel to select their top three business drivers for increased value, Improved Security was the least-selected option. While 67 percent cited the Adoption of New Technologies and 55 percent cited Improved Operational Agility, only 19 percent believed that Improved Security would
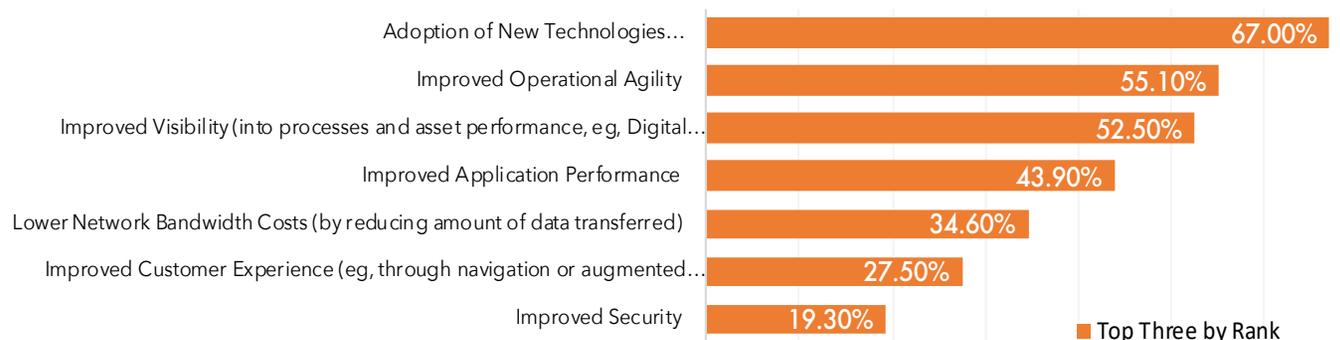
provide increased value. We believe this is a major disconnect and highlights the difference between what users may say they are looking for versus what they will actually purchase and pay for.

At the end of the day, business value is believed to derive primarily from the leveraging of New Technology to drive Business Agility and Improved Visibility. Application Performance, Lower Network Bandwidth Costs, Improved Customer Experience, and Improved Security are secondary factors.

How important are the following factors in your decision to implement Edge Computing?

Critically or Very Important Only

Factor	Critically Important	Very Important
Increased Security…	31.8%	37.5%
Reliability (no single point of failure)	31.6%	39.1%
Application Performance	27.1%	40.8%
Lower Operating Costs	26.0%	39.3%
Faster Data/Insights	26.0%	42.4%
Limited Bandwidth	21.1%	41.2%

■ Critically Important ■ Very Important

What are the TOP 3 business drivers that will lead to increased value and adoption of Edge Computing?

Business Driver	Top Three by Rank
Adoption of New Technologies…	67.00%
Improved Operational Agility	55.10%
Improved Visibility (into processes and asset performance, eg, Digital…	52.50%
Improved Application Performance	43.90%
Lower Network Bandwidth Costs (by reducing amount of data transferred)	34.60%
Improved Customer Experience (eg, through navigation or augmented…	27.50%
Improved Security	19.30%

■ Top Three by Rank

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While Security may be an important decision factor for Edge Computing implementations, it clearly is NOT considered a driver of business value.

Of note, the Media & Publishing sector ranked Improved Operational Agility (84 percent) and Improved Application Performance (63 percent) as its top two Business Drivers, well above the comparable rankings of other industries. We believe this is a result of the highly competitive nature and fluidity of this sector. It is also worth noting that Improved Customer Experience was the lowest ranked item for this sector, lower than all other sectors.
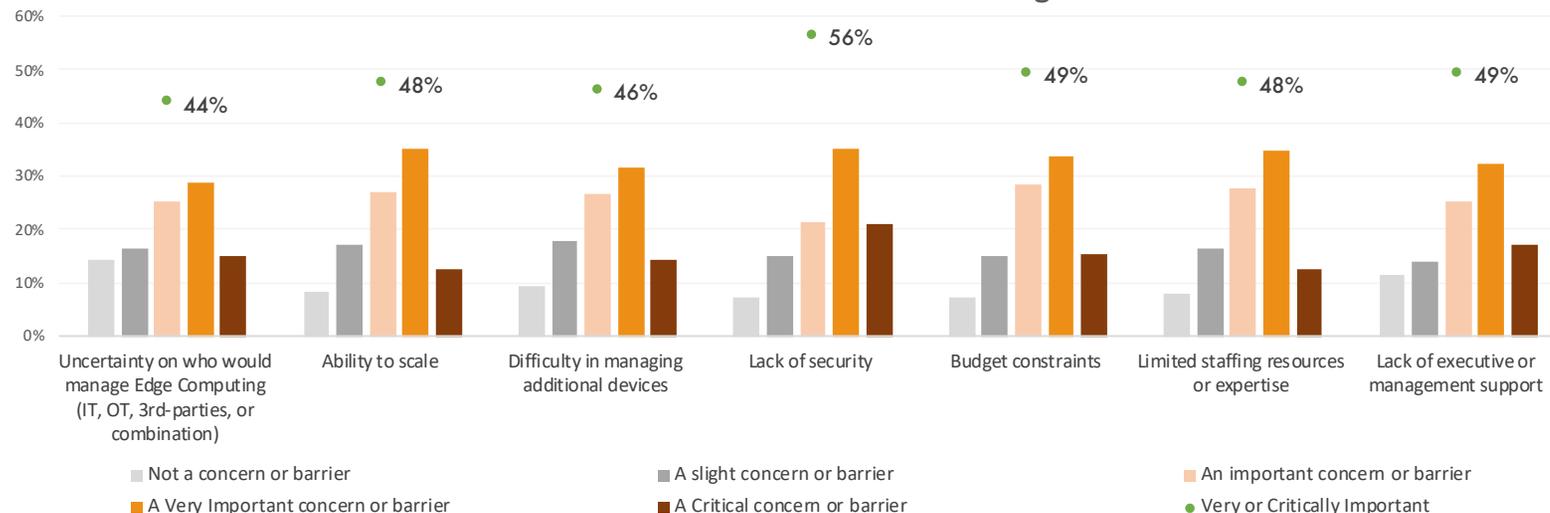
BARRIERS TO SUCCESS

Identifying key barriers to success is critical if the goal is to understand the operational pain points of an industry relative to any particular technology or business initiative.

We asked our panel to indicate which common barriers they believed to be Very or Critically Important impediments to the success of Edge Computing implementations. The response options covered issues such as operational management, scalability, security, budgets, staffing, and management support.

In line with previous responses, Lack of Security was cited by 56 percent of our survey panel as the most significant barrier, followed by Lack of Executive Management Support and Budget Constraints, each at 49 percent.

However, when we asked our survey panel to select their top three barriers from the same list, Ability to Scale topped the list, followed by Lack of Security, and Budget Constraints.

As you implement Edge Computing, how much of a concern or barrier to success are the following?

Legend:
- Not a concern or barrier
- A slight concern or barrier
- An important concern or barrier
- A Very Important concern or barrier
- A Critical concern or barrier
- Very or Critically Important

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This response is very much in line with rankings that we see in other areas, including many transformation initiatives, where scalability, security, and cost are consistent impediments to successful initiatives.

Surprisingly, Lack of Executive Management Support, the number two cited barrier, was the least-frequently selected top three barriers to success, with only 19 percent selecting this response. This is reinforced by both the distributed level of decisions from executive to middle management and the operational focus of Edge Computing.

For comparison, when we evaluated the top barriers to success between Industrial and Information sectors, we found some variances. For Information-focused enterprises, the Ability to Scale was notably more of a barrier than with Industrial-based enterprises, which actually favored Lack of Security over Ability to Scale.

The Information sectors were also slightly more concerned with Uncertainty over Edge Computing Management, citing that as the third-most selected barrier over the Industrial sector's choice, Budget constraints.

BOTTOM LINE
The key drivers of Edge Computing, are very similar to what we see in other industries. Securing data, improving operational reliability and efficiency, and driving application performance are all important factors. But while security is a top driver, it is also considered a top barrier, and this is an issue that needs to be addressed sooner rather than later.

Security, Reliability, and Performance are considered key drivers in the decision to implement Edge Computing. But when it comes to business drivers that lead to value, it's New Technology, Agility, and Visibility that rule (and where Security becomes a non-factor). At times, the Edge Computing market can highlight some significant contradictions, which is not at all surprising for a market that is relatively new and crosses the IT/OT barrier.

ISSUE FIVE BUDGETS AND GROWTH EXPECTATIONS

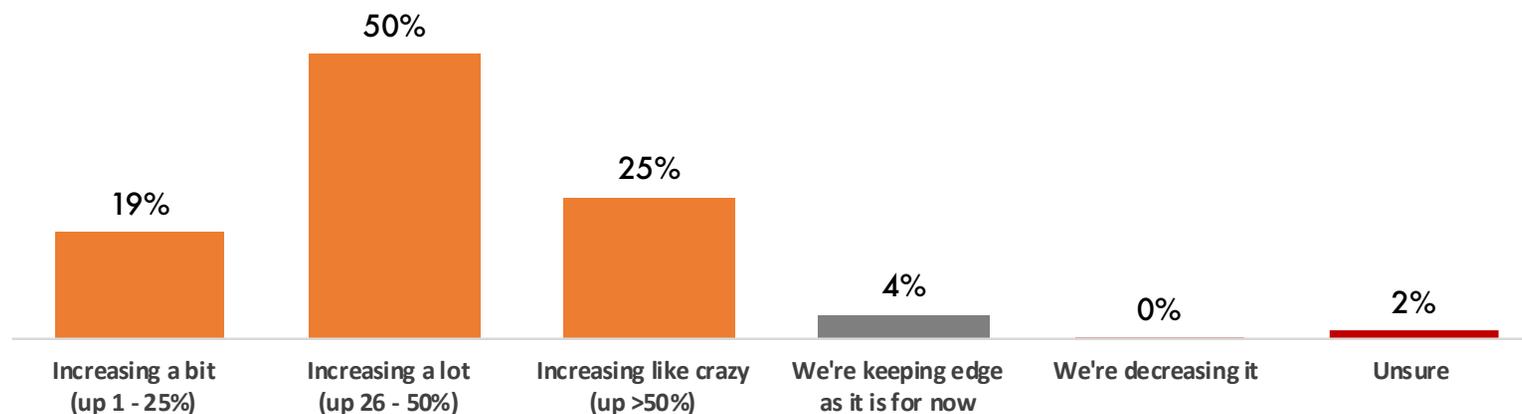*Edge Computing deployment is projected to increase considerably and budgets appear to match.*

As we've seen highlighted in our research, budget constraints are definitely a concern and a barrier for many enterprises to overcome before they can embark on a full Edge Computing initiative. While budgets may not be the top concern or barrier, nothing can be accomplished without it.

To better gauge the actual risk budgets play in Edge Computing, particularly given the high level of IT/OT support required and the expectations that IT will manage these systems, we asked our survey panel to estimate both adoption and budget growth.
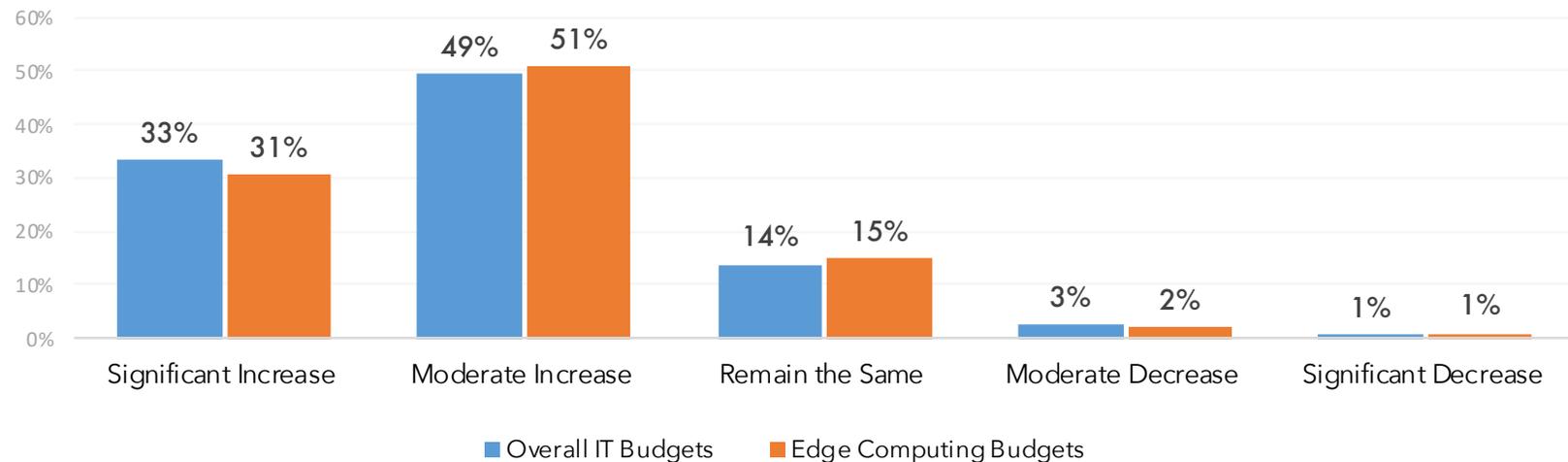
We first asked our panel if they planned to increase the use of Edge Computing over the coming 12 to 24 months, and if so, by how much over existing levels.

Roughly 94 percent of our panel expect to increase their use of Edge Computing over the next two years, with 69 percent anticipating usage to increase up to 50 percent and 25 percent anticipating Edge Computing usage to increase more than 50 percent. This is a significant increase. But it is in line with our overall Digital Transformation and IoT research, where we see similar expectations of future growth.

Over the coming 12 - 24 months do you plan to increase your use of Edge Computing?

Increasing a bit (up 1 - 25%)	Increasing a lot (up 26 - 50%)	Increasing like crazy (up >50%)	We're keeping edge as it is for now	We're decreasing it	Unsure
19%	50%	25%	4%	0%	2%

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What are your budget expectations for Edge Computing over the coming 12 - 24 months?

Legend: ■ Overall IT Budgets   ■ Edge Computing Budgets

For comparison, we asked our panel to estimate their expectations for Edge Computing budgets over the same period. While 25 percent expect usage to increase significantly, this appears to be matched by over 30 percent that expect Significant Increases in Edge-related budgets over the same time period.

BOTTOM LINE

Close alignment of overall budgets and Edge Computing budgets indicates a proactive approach to funding, particularly as Edge Computing is expected to continue to increase over the coming years. As mentioned earlier, an overall increase in the amount of data processed at the edge, and a pattern of relying on IT for management expertise, indicates that funding may be an issue down the road, and it's something to keep firmly in mind moving forward.

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CONCLUSION SUMMARY RECOMMENDATIONS AND PREDICTIONS

Edge Computing is transforming the enterprise from within, leveraging an operations-focused need to deliver faster data insights to drive greater business value.

The need for a computing is clear. As technology advances and the ability to monitor, measure, and analyze becomes increasingly embedded into business and consumer behavior, real-time insights will become part of all business processes. And as intelligent and autonomous systems become more commonplace, the need for computing resources at the point of data generation will become critical. While the cloud has many benefits, and is often favored as the centralized single source of record, we believe Edge Computing offers a complimentary type of value that extends and augments the cloud, or hybrid cloud, value proposition.

Based on our research, *we offer the following:*

1   **OPERATIONAL REQUIREMENTS MUST DRIVE THE EDGE AND VALUE**

Edge Computing is currently being implemented and reliance on Edge will continue to increase based on real-world operational requirements. It's a driver of tactical business value at the operational level and strategic business value at the corporate level. While Edge Computing has become a core approach for many enterprises, over half of all enterprises have yet to fully commit, with many still in the early stages of evaluation and planning.

2   **IT AND OPERATIONAL TEAMS MUST BE EQUAL PARTNERS**

While Edge Computing is primarily driven by operational teams today, IT teams are responsible for managing these systems in over two-thirds of enterprises. For Edge Computing to grow and increase its overall business value, IT must become more of a strategic collaborator with operational teams, not just managing Edge Computing resources but being involved in the long-term strategy, budgeting, and sourcing to ensure these systems are in line with larger, enterprise-wide strategic and transformational initiatives

3   **IOT DATA WILL DRIVE EDGE COMPUTING WHICH WILL ENABLE GREATER IOT ADOPTION**

Not only are we anticipating an increase in the overall percentage of data generated at the edge being processed at the edge, but we see an ongoing increase in the volume of data being created throughout the enterprise, and particularly in the intelligent edge of the future.

As Edge Computing expands to support operational IoT devices and data, the implementation of Edge Computing will make it easier to derive value from new IoT-based data sources. While applications involving data acquisition, security, analytics, and asset

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management are driving decisions and value today, we anticipate a shift toward more emerging applications, such as AI, machine learning, video analytics, and mixed reality, will become primary focal points over the next couple of years.

4   SECURITY IS A REQUIREMENT AND A BARRIER THAT MUST BE ADDRESSED

Security, reliability, and performance are critical to the success of Edge Computing systems as they increasingly will be called upon to drive near real-time actions based on real-time analysis of data. In this scenario, the margin for error is slim, and the risk is high. We are concerned about the ability of enterprises to actually provide these capabilities, particularly in the area of security and risk management. While enterprises seem to understand the significance of security as an underlying driver of business success, we feel that too many enterprises lack planning and strategy to properly secure IoT devices and Edge Computing systems.

5   BUDGET PLANNING IS GOOD BUT NEEDS TO BE REVISITED

Our research has revealed a very close relationship between overall technology and Edge Computing budgets. However, our concerns in the areas of security and IT/OT collaboration warrant a note of caution. The true cost and expense of Edge Computing systems may not be properly understood.

RECOMMENDATIONS

We offer the following recommendations as guidance, or action items, to help businesses and brands plan for, execute, and get the most value from the use of Edge Computing:

Focus on collaboration between IT and OT teams to future-proof and properly manage Edge Computing systems.

QUESTIONS: Are IT resources collaborating with OT teams such that they can anticipate future needs and work to ensure value and synergy between Edge Computing systems and larger, more strategic or transformative initiatives at the overall corporate level?

Recognize that security, performance, and reliability are intrinsically linked and must be addressed from a holistic perspective—failure in one is a failure in all.

QUESTIONS: Do we have a security strategy in place to properly security both IoT and Edge Computing systems, from a physical and logical perspective, including data that is processed and remains at the edge?

Understand the value drivers and implementation barriers that are unique to your enterprise in advance of implementation.

QUESTIONS: Do we know what systems we have in place today, how they are funded, procured, and managed, and is that sustainable given our own digital journey?

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PREDICTIONS

We offer three predictions on the future of business and Edge computing.

ONE EDGE COMPUTING GROWTH

Assuming a 25 percent CAGR (compounded annual growth rate) for data growth, based on expected growth of IoT devices, *we anticipate a 1.56x increase in Edge Computing implementations by 2020 alone*. This market will continue to grow at a rate required to keep pace with the growth of IoT and data generated at the edge.

TWO EDGE AND IOT MERGE

Within the next three years, Edge Computing and IoT will have begun merging considerably as advances in computing systems continue to drive smaller and more highly-integrated systems. We project that *within three to five years, more than 25 percent of all new IoT devices will feature some level of computing capability to augment overall Edge Computing architectures*.

THREE EDGE COMPUTING REFRAMES THE CLOUD

Within five years, *the volume of data initially processed at the edge will have fundamentally reshaped the value proposition of cloud computing*, as centralized compute resources become less significant as intelligent and autonomous systems capable of collecting, analyzing, and sharing data insights become the driving force in most enterprise computing systems.

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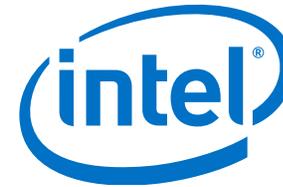
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