Vodafone IoT Barometer 2016

Benchmarks and best practices to help achieve the greatest return from Internet of Things projects

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Welcome

This is the fourth year that we've published the Barometer, our annual study of how the Internet of Things (IoT) is transforming business. In that time, the market for connected devices has truly come of age.

"76% of businesses say that IoT will be 'critical' for the future success of any organisation in their sector."

Erik Brenneis
Director, Internet of Things, Vodafone
CEO Vodafone Global Enterprise

Our research has found that 28% of organisations already use IoT. A further 35% are less than a year away from launching their own projects, and more than three-quarters of businesses say that IoT will be "critical" for the future success of any organisation in their sector.

So what matters now is not whether a business should adopt IoT, but how. Organisations planning and implementing their own initiatives need benchmarks and best practices that can help them maximise their returns.

In 2015's report we started exploring these best practices through our Sophistication Index, which proved to be one of the most popular elements of the Barometer. This year we've gone further: right across the report we've looked in much more detail at exactly which approaches businesses are taking in their IoT projects, and which aspects have the biggest impact on return on investment (ROI).

We've identified five key areas that are shaping the story of successful IoT projects today, and within each we've identified best practices that you can apply in your own IoT projects now.

The Barometer has always been a large, global study. This year we've expanded the scope further, including organisations from Ireland, the United Arab Emirates and the public sector. With nearly 1,100 total interviews, our sample is about 70% bigger than in 2015.

As in previous years, we've turned to an independent analyst to provide additional perspective on our findings; this year, it's Matt Hatton of Machina Research. We've also conducted in-depth interviews with leading companies that have adopted IoT, including Philips Lighting. You'll find extracts from those interviews throughout the report, giving you a unique insight into their successes.

Whether you're one of the many organisations already using IoT, or are still making plans, we hope you find the Barometer valuable. If you have any comments or questions about the findings or how to drive your own initiatives, please contact us at **iot@vodafone.com**, or connect with us on Twitter at **@VodafoneIoT**.

Contents

Defining the Internet of Things

The Barometer is an in-depth global study into how enterprises are using Internet of Things (IoT) technologies. Here's how we define IoT:

IoT connects objects such as cars, buildings and machines to the internet, turning them into 'intelligent' assets that can communicate with people, applications and each other.

IoT is a broad concept, capable of making all kinds of assets smart and connected, from the smallest wearables and consumer devices to the largest vehicles and industrial installations.

Despite this diversity, organisations that are setting out to build connectivity into their facilities, infrastructures, products and processes face many of the same decisions — and see many of the same results. It's these common experiences that the Barometer explores.
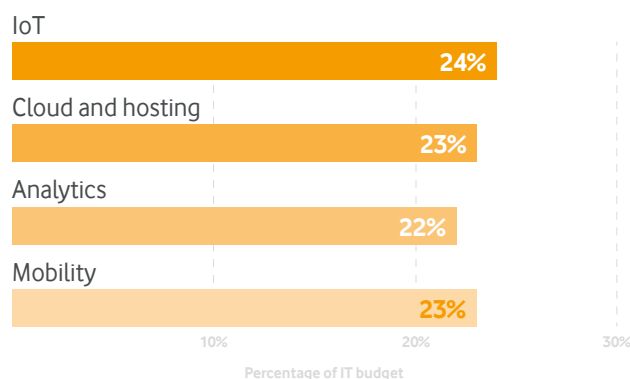
Executive summary

Interest in IoT is higher than ever: 28% of businesses already have live projects, with a further 35% less than a year away from launch. We've explored how these businesses are using IoT in 2016, and which best practices are driving success. Here are our five key findings.

1. Bigger commitment produces better results

IoT remains a top business focus, and adopters are increasing their investment. Those that make a bigger commitment see better results.

- **IoT is at the heart of IT strategies.** Adopters assign 24% of the entire IT budget to IoT — on a par with mobile, cloud and analytics (see chart, right). Businesses that allocate more budget and run more projects see stronger ROI.

- **Interest in IoT is higher than ever.** 76% of businesses say that IoT will be "critical" to future success, and 63% expect to have live projects within the next year.

- **Adopters see strong results.** 63% are seeing "significant" return on investment, up from 59% in 2015.

What percentage of your overall IT budget do you spend on the following technologies?

IoT
24%

Cloud and hosting
23%

Analytics
22%

Mobility
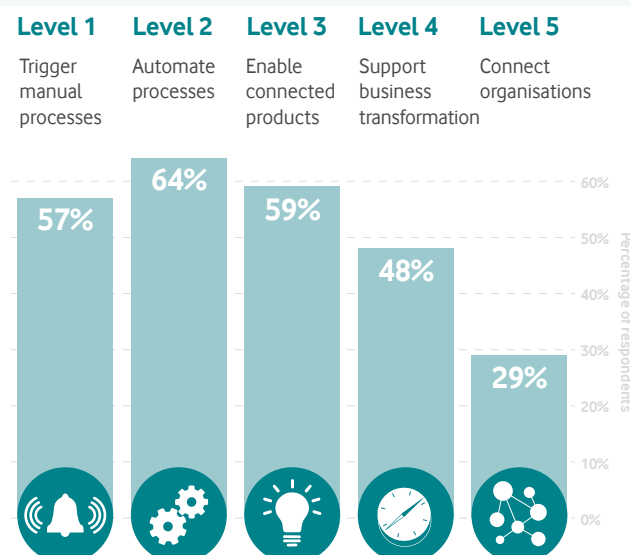**23%**

10%   20%   30%

Percentage of IT budget

2. IoT supports business transformation

You can use IoT just to optimise operational processes. But when you build it into your products and use it to transform your business, you'll see greater results.

- **IoT is driving transformation.** 48% of adopters say they're using IoT to support large-scale business transformation and 29% say they're using it to connect multiple organisations into ecosystems (see chart, right).

- **Connected products are the growth area.** Top performers are using IoT to create connected products and services. 46% of all adopters plan to launch connected solutions in the next two years.

- **IoT improves customer experience.** 44% of adopters say IoT has enhanced customer or user experience, making it the most popular benefit seen.

Are you currently using your IoT solutions to … ?

Level 1	Level 2	Level 3	Level 4	Level 5
Trigger manual processes	Automate processes	Enable connected products	Support business transformation	Connect organisations
57%	64%	59%	48%	29%

Percentage of respondents
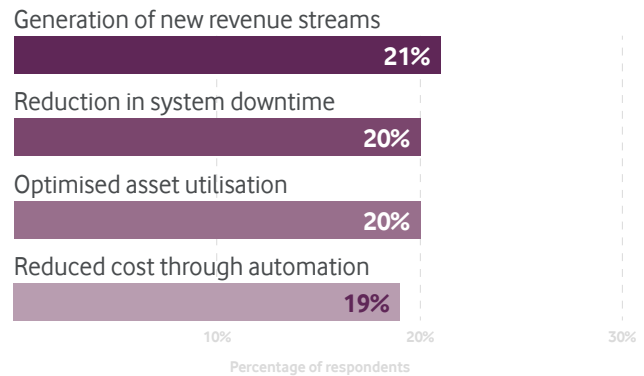60%   50%   40%   30%   20%   10%   0%

3. Leaders measure IoT within business processes

Most adopters have clear goals, but the top performers are those that treat their IoT initiatives as business projects instead of IT purchases.

- **IoT produces measurable results.** Adopters measure on average a 20% improvement in key business indicators like revenue, system uptime, cost and asset utilisation as a result of using IoT (see chart, right).

- **Effective planning is critical.** 68% of adopters say they set "clear targets" for their IoT projects — top performers were more likely to have done so.

- **IoT is a business initiative, not technology.** 61% of businesses say they consistently see IoT as an integral part of wider business initiatives.

What percentage improvement have you measured?

Generation of new revenue streams
21%

Reduction in system downtime
20%

Optimised asset utilisation
20%

Reduced cost through automation
19%

10%   20%   30%
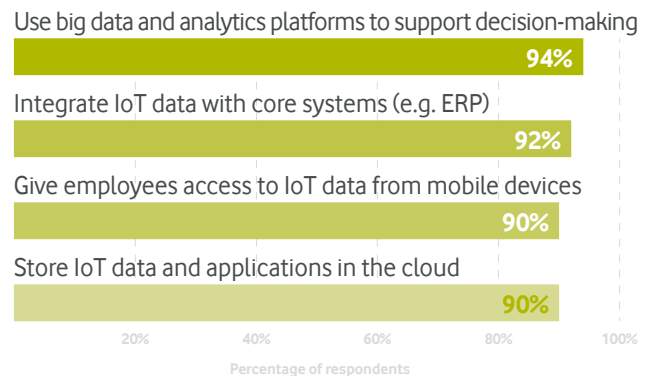
Percentage of respondents

4. IT integration is key to using IoT data effectively

Adopters see that IoT applications are a gold mine of data, and are focused on getting that data to the people and applications that need it.

- **Businesses are integrating IoT with business systems.** More than 90% of adopters say they store IoT data in the cloud, use analytics to support decision-making, integrate IoT data with core systems like enterprise resource planning (ERP), and use mobile devices to give employees access to IoT data (see chart, right).

- **IoT is all about data.** 81% of all businesses say that IoT can only deliver real value if you effectively use the data it generates.

- **Sharing data is part of ecosystems.** More than two-thirds of those that use IoT say they feel safe sharing their IoT data with other organisations.

How do you integrate your IoT solutions with other areas of IT?

Use big data and analytics platforms to support decision-making
94%

Integrate IoT data with core systems (e.g. ERP)
92%

Give employees access to IoT data from mobile devices
90%

Store IoT data and applications in the cloud
90%

20%   40%   60%   80%   100%

Percentage of respondents

5. Security needs end-to-end attention

Security and privacy can't be ignored. Most adopters are cautiously optimistic, working with their IoT providers to control the risk.

- **Organisations are investing widely in improving security.** They're focusing on staff recruitment and training, process improvements and their relationships with providers (see chart, right).

- **Businesses are cautiously optimistic.** While 30% say they have changed or restricted the scope of IoT projects to limit security risks, 75% say that security risks are a fact of life, and more than 60% say they already have the necessary skills, processes and technology to manage IoT security.

- **Providers have a big role to play.** 76% of businesses say that IoT should be secured end-to-end, and 91% say that it's important for them to work with an end-to-end IoT provider.

What action is your business taking to improve the security of your IoT projects?

Training staff
42%

Recruiting security specialists
41%

Establishing a clear contingency plan
38%

Establishing clear security best practice and guidelines for staff
45%

Making security a major part of RFP requirements
42%

Working with a specialist security provider
40%

10%   20%   30%   40%   50%

Percentage of respondents

Continuity and change

Over the past four years, our research has stayed true to our central focus of exploring the impact of connected machines — but we've evolved, shifting from looking at awareness and adoption to impact and best practices.

2013: The first M2M Adoption Barometer

- Interviewed 327 qualified respondents
- 12% had already launched M2M projects
- 55% said M2M was a "key priority"
- Americas ahead in adoption, at 14%
- 36% saw significant return from M2M

2014: Awareness and adoption get serious

- Interviewed 365 qualified respondents
- 61% of businesses had heard of M2M, 53% had heard of IoT
- Adoption rose to 22%
- 66% said they'd seen return on investment (ROI) within 12 months
- 75% said they were focusing on external-facing projects

2015: Measuring return and sophistication

- Interviewed 659 qualified respondents
- 78% of businesses had heard of IoT
- Adoption rose to 27%
- 81% of adopters increased their use of M2M year on year
- 59% said they'd seen **significant** ROI
- 79% said that M2M was about improving business processes, not about buying technology

2016: The keys to IoT's business value

- Interviewed 1,096 qualified respondents
- 89% have increased their use of IoT in the past 12 months
- 63% have achieved **significant** ROI
- 24% of IT budgets spent on IoT
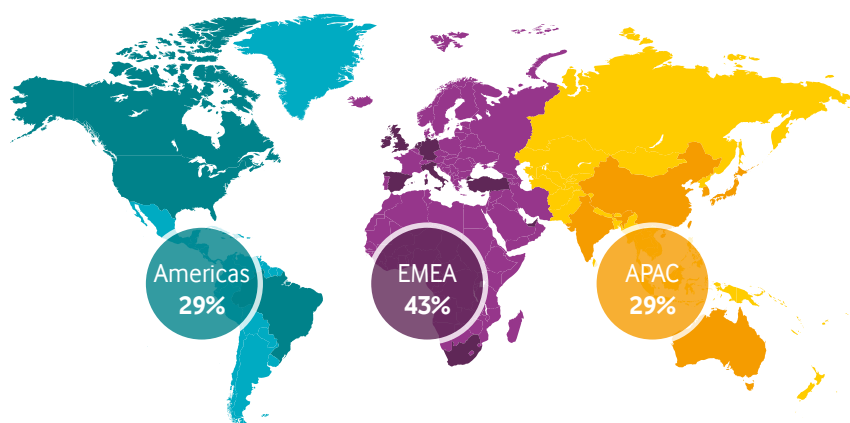- 48% use IoT to support large-scale business transformation

About the research

In this, the Barometer's fourth year, it's bigger than ever. We enlisted an independent research company to interview decision-makers on a global scale about their use of IoT.

This year, we interviewed more people than ever: 1,096 qualified respondents. These respondents were carefully selected to represent all kinds of:

- **Regions:** We surveyed 17 countries across all major regions: Australia, Brazil, Canada, China, Germany, India, Ireland, Italy, Japan, the Netherlands, South Africa, South Korea, Spain, Turkey, the UAE, the UK and the USA.

- **Industries:** Respondents represented retail, manufacturing, energy and utilities, healthcare, transport and logistics, automotive, consumer electronics, and industrials. For the first time we also surveyed public sector organisations.

- **Sizes:** We spoke to both SMEs and the largest multinationals. 15% of those we surveyed have more than 10,000 employees; we also included SMEs with as few as 10 employees.

- **IT spending:** Overall IT budgets ranged from under €10,000 to more than €50m.

- **Roles:** We only surveyed qualified decision-makers at senior manager level or above, but they represented a mix of departments. 40% of our respondents were from IT functions; 13% were senior business leaders; 9% were from sales and marketing; and 8% from finance.
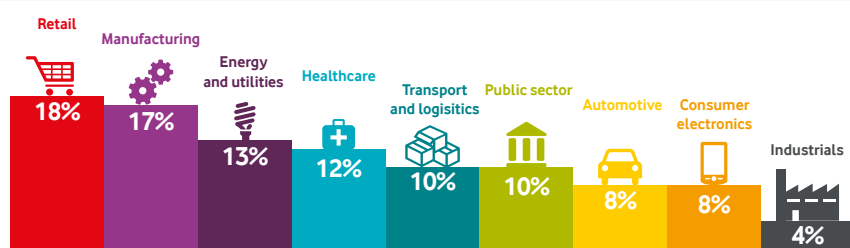
Percentage of interviews across all regions

Americas 29%
EMEA 43%
APAC 29%

Percentage of interviews across all business sizes

15%
24%
28%
33%

10–249 employees
250–999 employees
1,000–9,999 employees
10,000+ employees

Percentage of interviews across all sectors

Retail 18%
Manufacturing 17%
Energy and utilities 13%
Healthcare 12%
Transport and logistics 10%
Public sector 10%
Automotive 8%
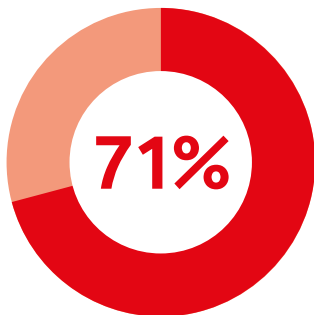Consumer electronics 8%
Industrials 4%

1 Bigger commitment, better results

Businesses are making IoT a priority. Our research shows that they report stronger results when they commit more budget and run a greater number of IoT projects.

86%

86% of businesses in the industrials sector — including companies in mining, construction and waste management — say they've seen "significant" return from implementing IoT.

71%

71% of adopters that run their business on IoT say they see a significant return, compared to 42% of those that only have "a few" IoT projects.

IoT is a bigger priority than ever

76% of all the companies we interviewed say that IoT will be "critical" for the future success of any organisation in their sector. When IoT is so important to your future prospects, the pressure is on to get results.

Organisations are working hard to bring IoT to life. Already 28% of businesses have live projects, with a further 35% less than a year away from launch. And for most adopters, the results are impressive. 63% of adopters are seeing "significant" return on their IoT investment, up from 59% in 2015. (For the regional view, take a look at the chart on the next page.)

We found a strong link between the ROI that businesses see from their IoT initiatives and two key factors: the number of projects they have underway, and the share of the overall IT budget they allocate to IoT.

Half of adopters have "many" IoT projects

When a business is truly committed to IoT, it sees opportunities to use it right across the organisation. For instance, one Spain-based utilities company told us that it was "boiling" with IoT initiatives:

"IoT technology is universal in this company and definitely not an ICT prerogative; we're open to all types of suggestions. We have several 'tele' projects such as telemeasurement or smart metering, we're looking at smart security cameras to replace security guards, and we have a pilot scheme of electric cars that we can fully manage remotely."

Already, 13% of all adopters say they have "many" IoT projects, and a further 37% say they "run their entire business on IoT". Organisations with multiple IoT projects see better ROI, and those that say they run their business entirely on IoT report the greatest benefits of all.

Netherlands-based Philips Lighting is a perfect example of a business that has put IoT at the heart of its strategy. It offers IoT-based solutions that enable public sector and corporate customers to remotely monitor and control street and building lighting, driving down energy costs and improving quality of service. It told us:

"IoT is becoming critical to our sector. There are compelling reasons for our customers to demand connected lighting, and we have decided to be part of it and to lead it. **IoT is at the core of our strategy of becoming a systems and services company.**"

Businesses spend 24% of their IT budget on IoT

Many businesses already assign as much budget to IoT as they do to other high-profile technologies, such as mobile, cloud and analytics — as Figure 1 shows.

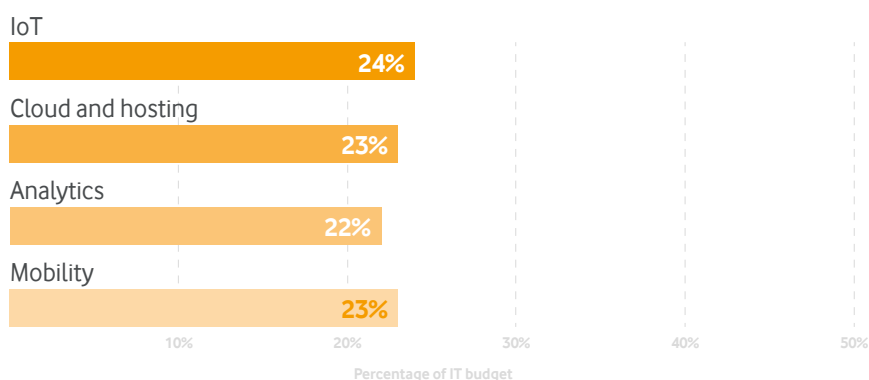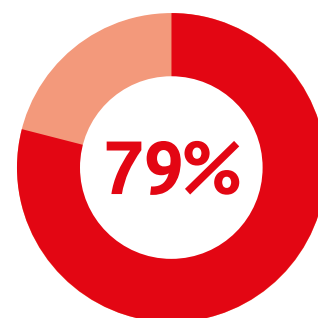**What percentage of your overall IT budget do you spend on the following technologies?**

IoT — 24%
Cloud and hosting — 23%
Analytics — 22%
Mobility — 23%

Percentage of IT budget

Fig 1. Adopters allocate similar budget to IoT as to cloud, analytics and mobility.

79%

79% of businesses that allocate more than 40% of their IT budgets to IoT report seeing "significant" ROI.

On average, businesses spend 24% of their IT budgets on IoT. And more than four in ten businesses spend over 20% of their IT budget on IoT.
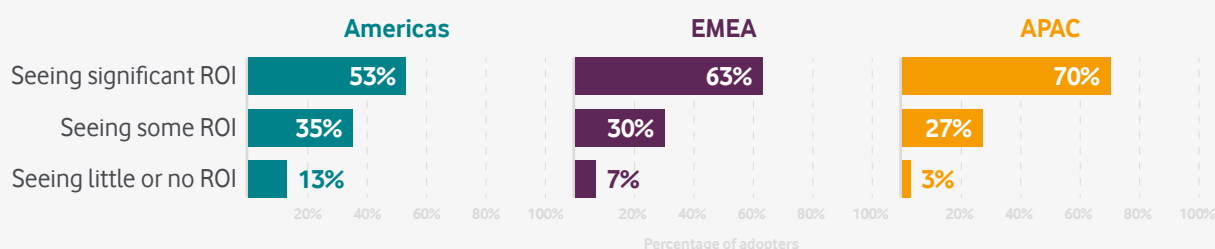
There is a clear link between how much of the total enterprise IT budget is allocated to IoT and the results produced. At one extreme there are those businesses that allocate more than 40% of their IT budgets to IoT. 79% of them say they have seen "significant" return on investment. On the other hand, those that allocate less than 10% of their IT budgets to IoT still see good results, but only 45% of them say the results are "significant".

Regional perspective: All regions see strong ROI from using IoT, but APAC leads

	Americas	EMEA	APAC
Seeing significant ROI	53%	63%	70%
Seeing some ROI	35%	30%	27%
Seeing little or no ROI	13%	7%	3%

Percentage of adopters

86%

86% of businesses that involve the Board in their IoT decisions say that IoT is "critical" to their success.

Leadership backing helps to drive growth

Getting the business's leadership on side is a vital ingredient in the success of IoT projects. Cultural resistance can derail any new technology adoption, particularly where, as with IoT, change is involved to how teams do their jobs. As one UK-based transportation company told us:

> "Some departments love IoT, and you can't deliver projects fast enough for them. But the biggest problem we have is when other departments look at IoT saying, '**Why do I need to adopt, why do I need to change?**'"

In some cases, only board-level backing can overcome cultural resistance and ensure that various IoT projects are being orchestrated effectively to avoid fragmentation.

One China-headquartered distributor told us that it was committing a significant — and growing — budget to IoT, and that senior management was taking a leadership role in the initiative:

> "Our senior management sees that IoT projects are worthy of our investment as they help us attract new customers. **The Board is pushing us to integrate our projects** and establishing a new functional unit to handle the requirements."

Businesses where the Board is involved in IoT purchases are more likely to have increased their number of IoT projects in the past 12 months. They're also significantly more likely to say that IoT is "critical" to their success, at 86% versus an average of 77%.

IoT projects come in all shapes and sizes

Some IoT projects are small: a quarter of adopters have fewer than 100 devices connected. Others are huge: around one in ten organisations have more than 10,000 connections.

The number of connected devices varies significantly by sector: 12% of consumer electronics adopters, for example, say they have more than 50,000 connected devices; conversely, 44% of manufacturers have fewer than 100 connections. These extremes of scale naturally reflect the variety of projects that sectors may be engaged in and the kinds of infrastructure and products they manage.

Machina Research

The analyst view: Commitment and outcomes

Many businesses are still just dipping their toes in the water of IoT, with proofs-of-concept and trials. For other, more progressive, companies it has become a strategically critical issue permeating the entire operation as they recognise that the additional capabilities, feedback mechanisms, closer client relations and business models facilitated by the IoT will be essential to their future success.

Enterprises that have, with the explicit backing of senior management, committed their future to IoT will inevitably assign greater resources, and the impact of their schemes will almost inevitably be proportionately greater. In fact, the more sophisticated the IoT implementation and the more ingrained it becomes in the enterprise's operations, the more difficult it becomes to identify a discrete 'IoT' element of IT, or any other, budget. IoT is just the way that these companies work.

Even small rollouts produce strong ROI

The number of connections involved in a rollout does not have the same level of impact on ROI as budget and number of projects.

Our data shows that while larger projects — particularly with between 100 and 1,000 connected devices — are more likely to see significant ROI, small projects and pilots also perform well, as Figure 2 shows.

Percentage of businesses seeing "significant" ROI at different sizes of IoT deployment
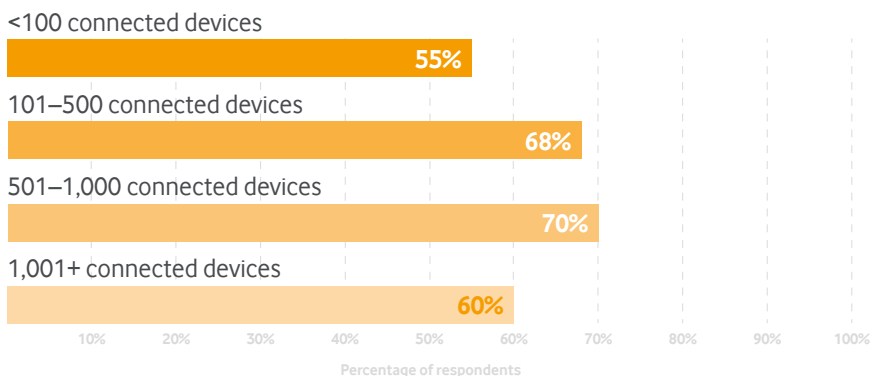

Fig 2.   Businesses see "significant" ROI no matter what size their IoT deployments.

That may be counterintuitive, but it's logical. For example, you might be an energy company remotely monitoring 100 expensive wind turbines and avoiding days of unplanned downtime, or a retailer with 500 digital signs driving increased sales through real-time promotions. In each case, the quantity of connections may be low, but the impact on the efficiency and effectiveness of a business process could be tremendous.
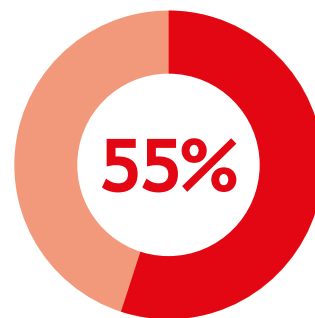
One China-based distributor we spoke to has an IoT project that gathers retail sales data. This application is small, but the impact has been great:

"At the moment, this system is being used by only 100 major outlets selling our consumer products. When a product has been sold in one of those outlets, the POS terminal transmits the data, giving sales managers the ability to get real-time information on their mobile devices.

It enables our senior heads in our strategy division to understand how consumers react towards a product and its price so they can advise the respective marketing and sales people to guide the retailer to implement the appropriate product placement and pricing tactics. The outcome is that our products become more marketable."

Another benefit of smaller, simpler projects is that they're a great way to quickly demonstrate ROI and get the business on side as you progress toward larger and more ambitious projects, as one UK-based transportation company found:

"We started off three years ago with some big-bang type projects, but justifying a programme on a regular basis is tough, it wastes money and the business gets disappointed. **So we've now gone to delivering in incremental steps. This helps with proving that your spend is correct**, because you start to get some early return on investments and build people's confidence in the programme."
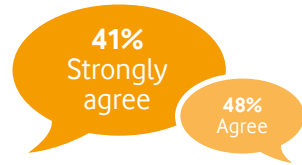

55% of businesses with fewer than 100 connected devices in their IoT projects report seeing "significant" ROI.

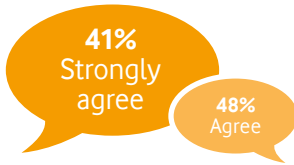## Adopters increase their investment year on year

The vast majority of adopters say they've grown their use of IoT according to all three of the indicators we've looked at, as Figure 3 shows.

In the past 12 months …

"Our organisation's spend on IoT has increased"

41% Strongly agree
48% Agree

"The number of IoT connections in our organisation has increased"

41% Strongly agree
48% Agree

"The number of IoT projects in our organisation has increased"
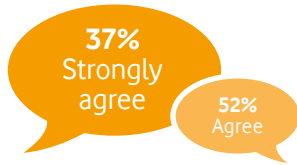
37% Strongly agree
52% Agree

Fig 3.   Adopters strongly agree that they're increasing their investment in IoT, in terms of budget, connections and number of projects.

This is clear evidence that commitment pays off, and that IoT is becoming a central focus for the IT department. As one China-based aviation component manufacturer put it, after experimenting with IoT for the first time:

"In 2015, our first IoT project was proven successful and we won some new clients. That's when **the CEO decided to incorporate IoT into our regular IT development strategy**."
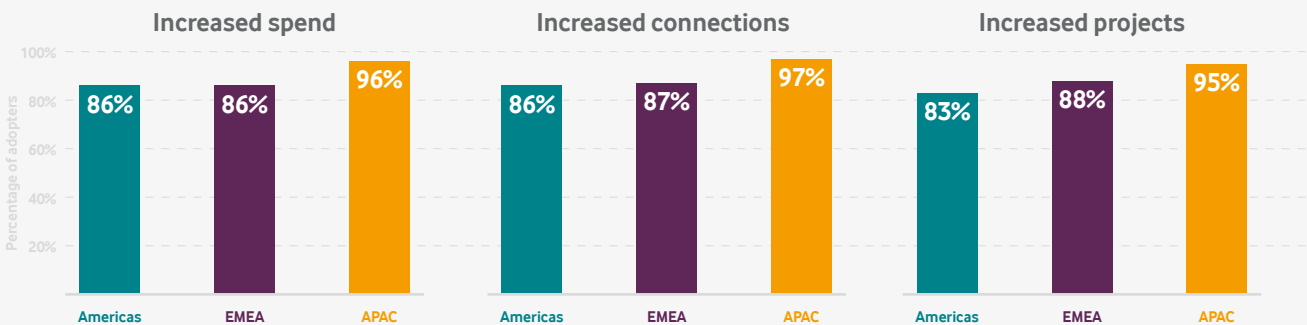
The research suggests that the rate of year-on-year growth is actually accelerating. In last year's Barometer, we asked adopters if they'd increased their overall use of IoT in the past 12 months. 81% agreed. This year, 89% say they've increased their spend, projects and connections. In fact, many respondents told us that they have more opportunities to use IoT than they can possibly work on. As one Germany-based premium car manufacturer put it:

"We already have 24 IoT-driven features across our cars, and I keep saying I have enough ideas for the next 5–10 years; I just need to implement them in the car!"

It's important to note that as businesses increase their use of IoT, they're not just doing "more of the same". For instance, one large US-headquartered food manufacturer told us that as it added more projects, it actually evolved how it procured and managed its IoT.

"We're gradually moving from small scale, one-off purchases of technology to bigger investments. **It's certainly larger in scale, but also more structured, more strategic.** And I think we'll continue to grow and refine this over time as we move up the curve."

In the past 12 months:

95% of transport and logistics adopters have increased their IoT spend.

97% of public sector adopters have increased their number of devices connected.

93% of energy and utilities adopters have increased their number of IoT projects.

Regional perspective: Adopters around the world are increasing their commitment

Increased spend

	Americas	EMEA	APAC
	86%	86%	96%

Increased connections

	Americas	EMEA	APAC
	86%	87%	97%

Increased projects

	Americas	EMEA	APAC
	83%	88%	95%

Percentage of adopters

2 IoT supports business transformation

Enterprises are using IoT in many different ways. Results are strong across all applications at all levels of maturity, but businesses that are more visionary in the way they use IoT see broader benefits.

Adopters are using IoT in many different ways

There are now countless different IoT applications, from smart parking to pet tracking, remote healthcare to connected cars, and smart grid to lone-worker safety. And new ones are emerging all the time.

To find out which ones enterprises are using, we grouped IoT applications into six broad categories that cover the vast majority of solutions. Figure 4 shows these categories and what percentage of IoT adopters have a project in each of them.

Which kinds of IoT projects have you launched?

51%

Optimising the utilisation of assets and vehicles: for example, fleet management solutions or remote machinery monitoring.

48%

Reducing facilities operating costs: for example, building automation.

46%

Improving the safety and security of people and sites: for example, connected security cameras, lone-worker tracking, or pipeline monitoring.

42%

Automating supply-chain processes from manufacturing to consumption: for example, asset tracking, connected vending or digital signage.

41%

Building new connected product and service categories: for example, connected home solutions, usage-based insurance or remote health.

40%

Improving the efficiency, safety and sustainability of public space: for example, smart bins, connected street lighting or other smart cities applications.
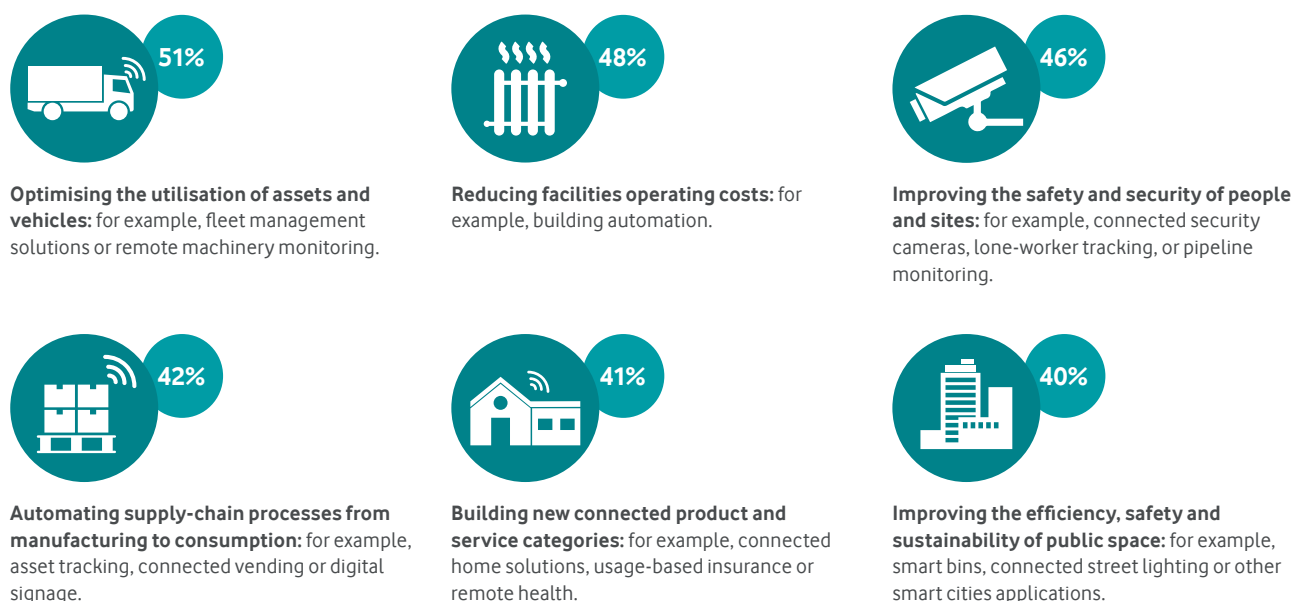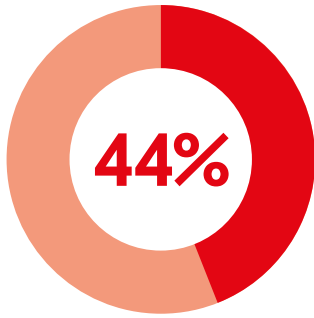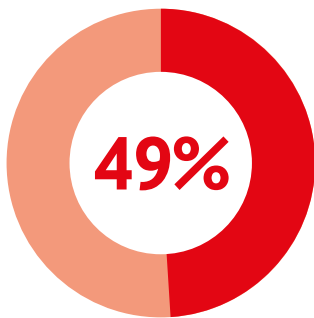
Fig 4. Enterprises are adopting many different kinds of IoT solution.

44%

44% of IoT adopters report "enhanced customer or user experience" as a benefit.

49%

49% of organisations with "significant" ROI say they're building new connected solutions, compared to 29% of those seeing "some" or "little" ROI.

Public sector and energy and utilities organisations are most likely to have new connected product and service initiatives in the pipeline — more than 50% say they plan to launch within two years.

Operational projects drive customer experience

Businesses are using IoT applications in all six of our categories. The most popular categories are "operational": they relate to asset utilisation, operating costs, and safety and security. Nearly half of adopters say they have at least one live project within each of those three categories.

Adopters told us that these applications aren't purely about saving money. In fact, "enhanced customer or user experience" — CX — is the benefit most commonly reported by IoT adopters across all kinds of projects, with improved employee productivity a close second.

One Germany-headquartered multinational automotive manufacturer describes its connected car projects as being wholly motivated by a desire to improve the customer experience:

> "IoT has become an **integral part of the customer strategy**. IoT is not just a technical discussion: we talk about what can be made possible, how we can use it to make customers loyal."

A UK-headquartered transportation company similarly explains how its vehicle-monitoring solution is having an impact on staff and passengers:

> "**IoT affects everything we do.** It's supporting a different way of working, right the way from back-office through to front-office productivity, with staff on platforms and in bus stations, helping out the travelling public."
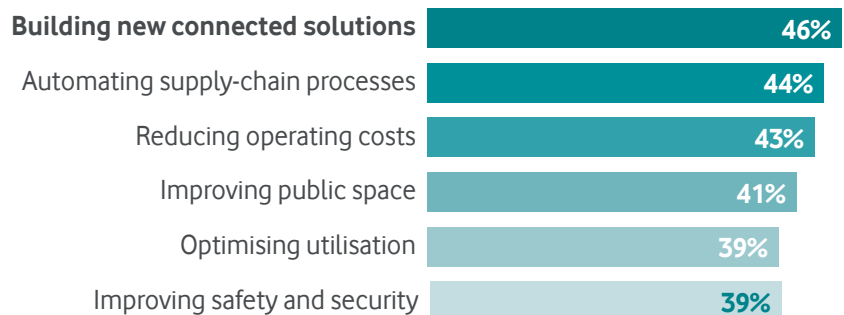
Connected products are the top growth area

Adopters that report "significant" ROI from their IoT projects are much further ahead in launching new connected products and services using IoT.

49% of top performers say they have already launched new connected products and services, compared to only 29% of those reporting "some" or "little" ROI. This suggests that connected products are a strong contributor to ROI.

Other organisations are following these leading adopters, creating new connected solutions of their own. Figure 5 shows what percentage of organisations plan to launch each category of IoT project within the next two years. New connected products and services are at the top of the list, picked by 46% of businesses.

Which IoT applications do you plan to launch in the next two years?

Building new connected solutions	**46%**
Automating supply-chain processes	**44%**
Reducing operating costs	**43%**
Improving public space	**41%**
Optimising utilisation	**39%**
Improving safety and security	**39%**

Percentage of respondents

Fig 5. New connected solutions are the top priority for future development.

Many adopters are far along the IoT maturity curve

Just as there's a whole landscape of IoT solutions, so there's a whole spectrum of ways in which businesses can apply them. We devised a simple five-step maturity scale, from using IoT simply to trigger an existing manual process, right up to enabling large-scale business transformation and the creation of cross-industry ecosystems. Take a manufacturer of generators, for example:

- **Level 1** might involve connecting generators in the field so that they raise the alarm when they break down.
- **Level 2** might connect IoT services directly to engineer job allocation systems and book in a repair automatically.
- **Level 3** might allow the manufacturer to charge customers "as a service" for each hour of power generated.
- At **Levels 4 and 5**, the possibilities expand: the manufacturer might connect its smart generators to facilities disaster recovery tools and position itself as a provider of business continuity services to mission-critical industries.

Figure 6 shows how businesses identified with one or more of these five levels.

Are you currently using your IoT solutions to … ?

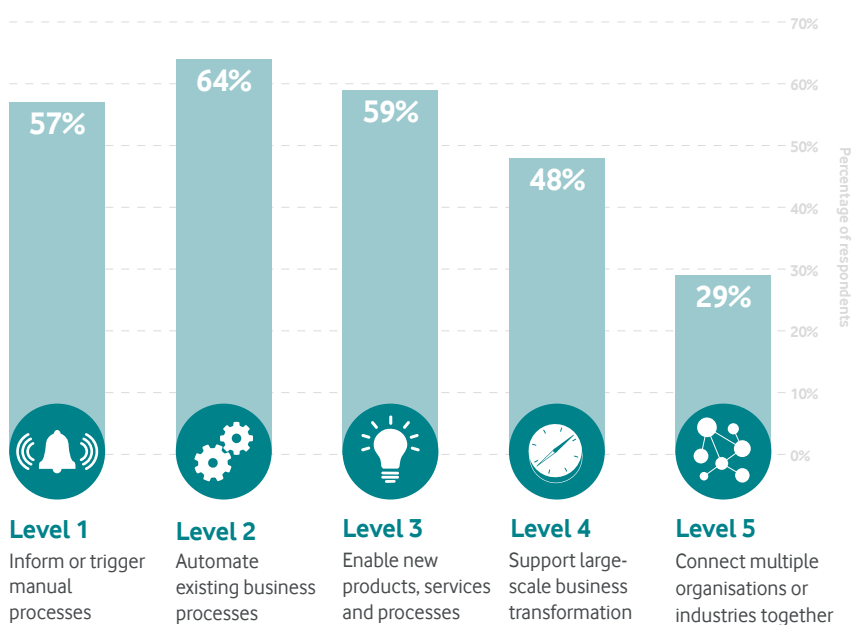|				
Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Inform or trigger manual processes	Automate existing business processes	Enable new products, services and processes	Support large-scale business transformation	Connect multiple organisations or industries together

Fig 6. Nearly half of adopters are using IoT to drive business transformation.

As you might expect, the majority of businesses say they are using IoT in the context of existing processes, with nearly two-thirds saying that their goal is to automate (Level 2). But nearly half said they are using IoT to drive business transformation (Level 4), and three in ten are working on connecting wider ecosystems (Level 5).

Businesses in the Americas are most likely to be involved in creating cross-organisation ecosystems with IoT (33%); those in the APAC region are more likely to be engaged in large-scale business transformation (61%).

In terms of sectors, 52% of consumer electronics companies are working on ecosystems. This perhaps reflects their participation in areas such as the smart home, where cross-company collaboration is fundamental.

At the other end of the spectrum, 82% of transport and logistics companies are working on process automation — reflecting the incredible value to be gained by optimising high-volume movement of goods and people.

IoT supports business transformation

ROI is clear at each stage of maturity

Organisations report strong ROI at every stage of our five-step maturity scale. It's important not to neglect the value that even simple applications can deliver, as one large US-based electronics manufacturer told us:

> "There is a lot of value in just being able to connect to an asset such as a turbine and showing customers its data. **There are different ROIs as you move up the curve to analytics. But there is a lot of value in that first part** — gaining visibility into how assets are running."

Simply being able to monitor and control a single device, or respond to a single incident, can have big effects.

However, that hasn't stopped organisations from thinking bigger. Building on those initial benefits, they see grander possibilities, many of which need extensive scoping and organisational change to capture. In our interviews with businesses around the world, it was striking how many have long-term strategies in place, with a clear vision for moving up that maturity curve. For instance, one US-headquartered food manufacturer said:

> "The time taken to deliver ROI is somewhere between weeks and months if we're talking about the benefit of capturing the data that we're tracking. **We're probably talking more into years to truly understand and figure out all the ways to find that data,** to come up with practical applications that can ultimately be commercialised."

At its greatest extent, the adoption of IoT has a broad impact even beyond the organisation. One premium car manufacturer based in Germany explained how IoT is transforming its whole business model, and how that ultimately disrupts the entire industry status quo:

> "The major aspect of IoT is that instead of just selling the car, you sell subscriptions to additional services to enable more features in the car. Your revenue stream is extended into the future — but you have to prove yourself on a monthly basis, because customers can cancel if they see no added value. **That is a new setup for the car industry."**

Machina Research

The analyst view: **From operation to transformation**

Over the last few years the most forward-thinking organisations have progressed from projects focused on efficiency to ones focused on transformation. These schemes often require a fundamental organisational shift, for example, from selling products to providing services ("servitisation"), with a rethink of business operations across almost all functional areas including sales, marketing and product development.

Such transformational IoT schemes require more coordinated effort, with buy-in from various business units, and determination on the part of senior management to push through these initiatives. As a result, they have inevitably been slower to materialise. However, they are a natural evolution of enterprise IoT, and naturally result in the greatest ROI. IoT has moved from being a cost saver to being the competitive differentiator of the 21st century.

Greater vision leads to broader benefits

Organisations that have already taken steps up the maturity curve, toward more ambitious and sophisticated uses of IoT, report a greater variety of benefits.

We asked adopters which of 13 different benefits they have experienced from IoT, from improved decision-making to greater compliance or reduced downtime.

On average, 39% of those at Level 1 — using IoT to trigger manual processes — say they have experienced each benefit.

By contrast, 52% of those that have reached Level 5 — using IoT to connect organisations and industries together — say they have experienced each benefit.

Figure 7 shows what percentage of adopters at each level of maturity report seeing each benefit — we've marked only levels 1, 3 and 5 so the increase in benefits stands out more clearly, but levels 2 and 4 follow the same pattern.

It's interesting to note how organisations that reach Level 5 report a more consistent spread of benefits, while those at lower levels of maturity are more likely to see benefits concentrated in a few areas, such as customer experience and reduced cost.

Percentage of businesses at each maturity level reporting each type of benefit

Level 5
Connect organisations

Level 3
Enable connected products

Level 1
Trigger manual processes

Delivery consistency
Staff productivity
Decision-making
Sustainability
Customer experience
Internal oversight
Supply-chain insight
Compliance
New revenue streams
Reduced cost
Safety and security
Reduced downtime
Asset utilisation

Fig 7. The more sophisticated an organisation's use of IoT, the more benefits it sees.

3 Leaders measure IoT within business processes

Organisations that have clear targets and build IoT into business processes see better results. Enterprises measure ROI in many ways; top performers involve outside providers.

Adopters quantify the business benefits they see

We looked in more detail at four benefits of IoT: revenue, asset utilisation, downtime and cost savings. We asked enterprises that had reported benefits in those areas what percentage improvement they'd measured. They reported an average improvement of 20% in each of the four, as Figure 8 shows.

The scale of benefits varies significantly by region. The Americas reports the strongest revenue growth, with 55% of adopters there measuring gains greater than 20%. APAC reports the greatest cost savings, with 50% seeing savings of more than 20%.

What percentage improvement did you measure in each area?

Average improvement measured

Generation of new revenue streams through new products and services
21%

Reduction in system downtime
20%

Optimised asset utilisation (e.g. vehicles)
20%

Reduced cost through automation
19%

10%   20%   30%   40%   50%
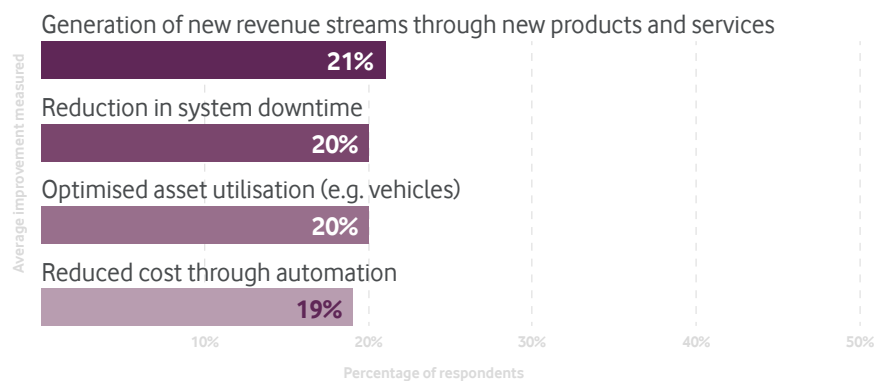
Percentage of respondents

Fig 8. Adopters quantify their benefits — the average improvement is around 20%.

One Germany-based consumer electronics company shared its experiences of generating new revenue through IoT:

> "We did have expectations, but did not expect them to be met so quickly. It was like an awakening, because the project was implemented so quickly. **A quick ROI appeared, both perceived but also in numbers. We were able to increase sales by 25%.** Exponentially, it started to increase. It was a huge benefit in our case."

Many of our interviewees told similar stories of ROI that's both quantitatively measurable and intuitively felt, as well as being both significant and rapid.

IoT can drive corporate revenue growth

We investigated whether IoT produces a noticeable effect on the business's overall corporate financials, particularly revenue. Businesses that reported a "significant" ROI from use of IoT saw a much more positive movement in their company revenue, as Figure 9 shows.

How has your company revenue changed in the past year?

Decreased	No change	Increased by 1–5%	Increased by 6–10%	Increased by >10%

Adopters reporting "significant" ROI

11%	7%	23%	38%	21%

Adopters reporting "some" or "little" ROI

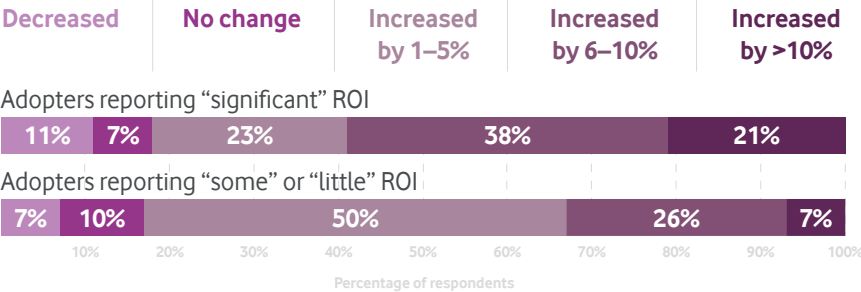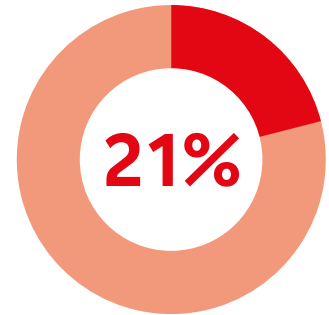| 7%	10%	50%	26%	7%

Percentage of respondents

Fig 9. Businesses that report "significant" ROI from IoT have stronger company performance.

Organisations reporting "significant" ROI from IoT are three times more likely to have increased their company revenue by more than 10% in the past 12 months than those reporting "some" or "little" ROI from IoT.

Setting clear targets is essential to steering projects

We asked businesses whether they went into their IoT projects with expectations: for example, if they had a general idea of what they wanted to achieve, or a clear target.

68% of businesses say they had a clear target, which is an extremely positive finding — IoT is so high-profile and the results so well publicised that you could forgive many businesses for trying it out simply to meet board expectations or to keep up with competitors. Only 5% say they initiated an IoT project with no expectations at all. The best performing businesses were even more likely to have set clear targets: 82% say they had a clear target in mind.
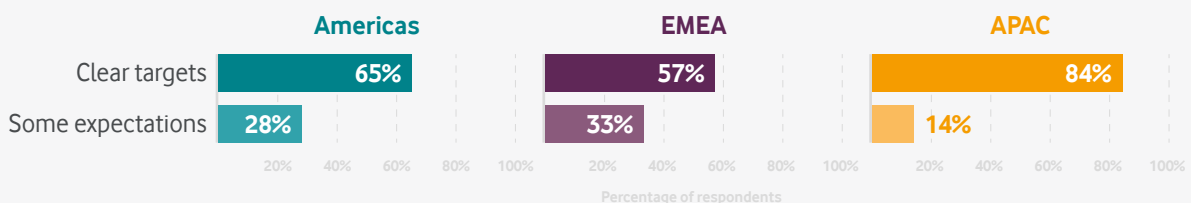
21%

21% of organisations seeing "significant" ROI from IoT say that their company's revenue has increased by more than 10% in the past year.

Consumer electronics companies were most likely to have clear targets in mind for their IoT initiatives — 88% did so, compared to the average of 68%.

Leaders measure IoT within business processes

Regional perspective: Respondents in all regions set clear targets for IoT projects

	Americas	EMEA	APAC
Clear targets	65%	57%	84%
Some expectations	28%	33%	14%

Percentage of respondents

Having a specific and well-communicated target encourages more focused application of effort during the project development and enables the business to periodically assess its progress and make adjustments. As one Spain-headquartered utility company explained:

> "We analyse and study what the project is going to cost us. From there we estimate the savings we expect to make from this new investment, we do our cost-benefit analysis, calculate the ROI and if it's favourable then we proceed to implementation. **After that there's constant monitoring to compare the real savings (or income) against forecast**."

The China-based aviation company we spoke to set its formal target for IoT after experiencing some positive initial results and deciding to increase its commitment. At this point the CEO and CFO set a company-wide goal:

> "**We set out to enhance our 2015 revenue by 15%.** The CEO knew that IoT would be a big part of hitting it, and the CFO calculated that all of the fixed and operating costs of the IoT project would be more than covered at that point."

Top performers use providers to measure results

Clear targets must be matched by clear performance metrics. We asked businesses how they track results, and we saw varied answers. Encouragingly, only 5% say they didn't actually measure results, but adopters use a mix of metrics: one-off and ongoing, qualitative and quantitative, existing and project-specific, conducted internally and by external providers.

Figure 10 shows what percentage of adopters used different approaches to measure their project ROI. What's noticeable is that the ranking of options is dramatically different between those seeing "significant" ROI and others.

How did you measure the ROI of implementing IoT?

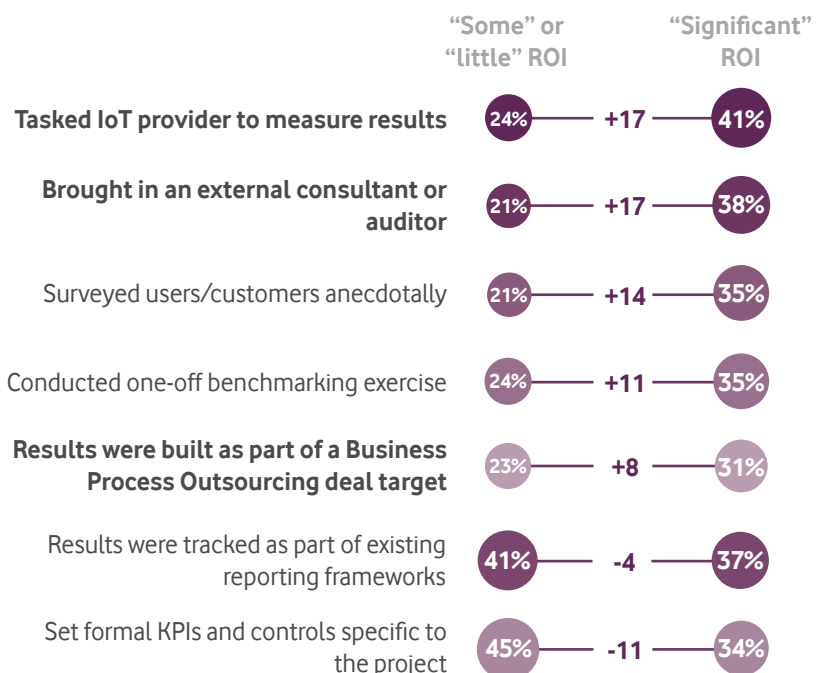|	"Some" or "little" ROI		"Significant" ROI
Tasked IoT provider to measure results	24%	+17	41%
Brought in an external consultant or auditor	21%	+17	38%
Surveyed users/customers anecdotally	21%	+14	35%
Conducted one-off benchmarking exercise	24%	+11	35%
Results were built as part of a Business Process Outsourcing deal target	23%	+8	31%
Results were tracked as part of existing reporting frameworks	41%	-4	37%
Set formal KPIs and controls specific to the project	45%	-11	34%

Fig 10. The best-performing IoT adopters call on outside providers to track their results.

In particular, the most successful users of IoT are much more likely to involve external providers in all three ways (highlighted in bold). 41% of organisations that report "significant" ROI tasked their IoT provider with measuring results — making it the most popular option among that group — compared to 24% of businesses that have seen only "some" or "little" ROI.
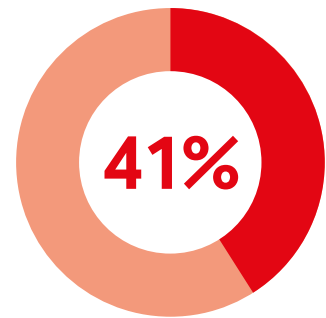
One China-based retailer we spoke to described providers as being critical to building the business case for investment in the first place:

> "The current issue is that many abstract concepts are flowing in the market. **If the IT industry can provide more sound and persuasive successful cases for our reference, I am sure that my boss would invest** more and more in this area without any hesitation."

Netherlands-headquartered electronics company Philips Lighting has seen this trend from the other side of the table, as a provider of IoT lighting solutions. It's seeing measurement as a key value proposition not only during the initial scoping of the project, but as a core feature of the solution itself:

> "We help customers of course during the offer phase to calculate the cost and returns. But **measurement and validation is a key aspect** of what the system does, so we measure the energy and compare it to the baseline we had before and validate the business case.

> "Customers are definitely coming round to the preference of having a trusted supplier that delivers an end-to-end system, as opposed to buying components and trying to deal with the issues inside their own organisation."

41% of organisations that report "significant" ROI tasked their IoT provider with measuring results.

The analyst view: **What does success look like?**

Enterprises rolling out IoT initiatives within their organisations must set tight parameters around what they want to achieve and what success looks like.

One of the recommendations that we generally make to our enterprise clients is this: decide what's next. It's all very well running trials and proofs-of-concept but there is a risk that the results are never acted upon. So when enterprises set up trials they need to set parameters for how to measure success and decide in advance what the next steps will be, depending on the possible outcomes.
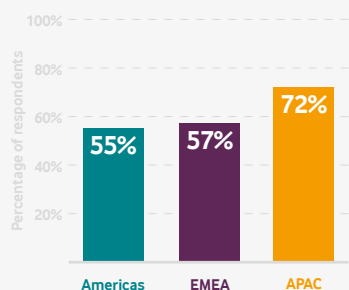
A particular emerging trend that we've noted is the role of the 'Trusted Third Party' to support enterprises as they navigate the choppy waters of IoT deployments. Philips touches on the concept in its comment about trusted suppliers. But we would go further. Deploying IoT is complex and enterprises would benefit from having a third party not only to pull together the various elements of the proposition — for example, devices, connectivity, data analytics, and application enablement — but also to act on their behalf in areas such as security, privacy and data management.

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67% of consumer electronics companies say they "consistently" make IoT an integral part of business process outsourcing arrangements, compared to **55%** across all sectors.

73% say that IoT is an integral part of wider initiatives, compared to **61%** across all sectors.

Regional perspective:
72% of adopters in APAC say that they see IoT as part of a wider initiative

Percentage of respondents

55%	**57%**	**72%**
Americas	EMEA	APAC

Leaders see IoT as a business process purchase

The use of external providers to measure ROI is part of a broader trend in how businesses are planning for, procuring and managing IoT solutions. Instead of seeing IoT as a pure technology purchase, they're putting IoT in a wider business process context. As one China-based retailer put it:

> "We consider IoT projects to be **business processes enabled by IT.**"

Importantly, enterprises that say they see IoT as part of business processes report stronger ROI, as Figure 11 shows.

How does your business see IoT?

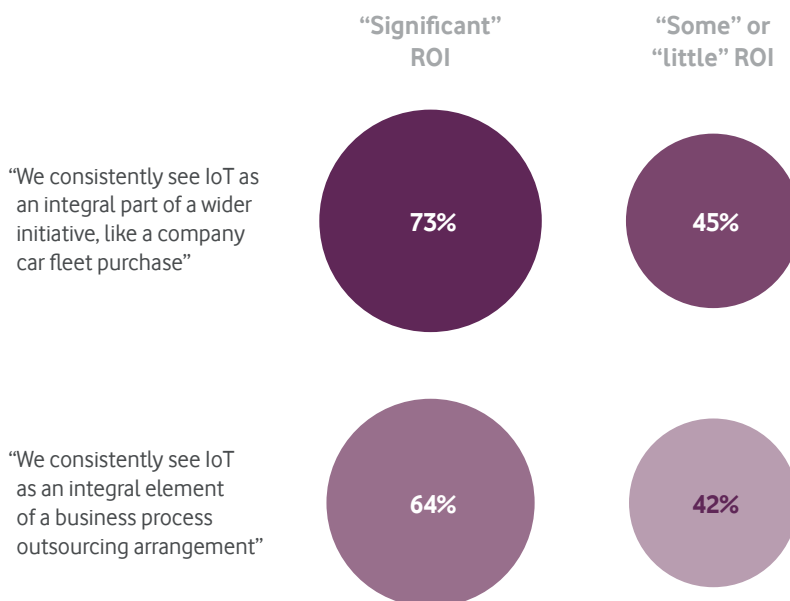|	"Significant" ROI	"Some" or "little" ROI
"We consistently see IoT as an integral part of a wider initiative, like a company car fleet purchase"	**73%**	**45%**
"We consistently see IoT as an integral element of a business process outsourcing arrangement"	**64%**	**42%**

Fig 11. The best-performing IoT users treat IoT as part of wider business process activities.

This is a clear recommendation for anyone adopting IoT: don't frame the initiative as simply an IT project, using traditional IT KPIs. Start by finding a business process that needs improving, and build IoT into the solution; draw on the strengths of external providers to help drive and measure results. One UK-based public transportation company has seen great success from doing so:

> "IoT started off three years ago purely as a tech purchase. We said, 'Let's just go and do some discovery' and we ended up going round in circles: we've got all this data, what do we use it for?
>
> "Then we started getting the organisation to think about the problems that we have, taking the ones that are hurting us the most, and then applying data to solve those problems.
>
> **"We managed to put across that this is more about how we operate as an organisation. As a result, IoT is moving to very much more of a business change, a business purchase, a business opportunity,** as opposed to a tech spend."

Project management is aligned to business processes

In pursuit of strong and consistent project leadership, it's easy to assume that centralising management of IoT projects would produce better results and avoid fragmentation. And for some businesses, that's true, as a Germany-based truck and car manufacturer explains:

> "IoT is not a trivial issue. **Our cars are developed centrally,** the costs are centralised, and the general strategy on what a car should contain is developed centrally."

But other management models deliver results too; in fact, we found that on average IoT projects are more likely than other IT projects to be managed at a local level, and as Figure 12 shows, enterprises reporting "significant" ROI tended to manage at a local level.

Which of the following best describes how you manage your IoT projects?

Adopters reporting "significant" ROI

37%	Locally
31%	Locally, but coordinated centrally
24%	Centrally

Adopters reporting "some" or "little" ROI

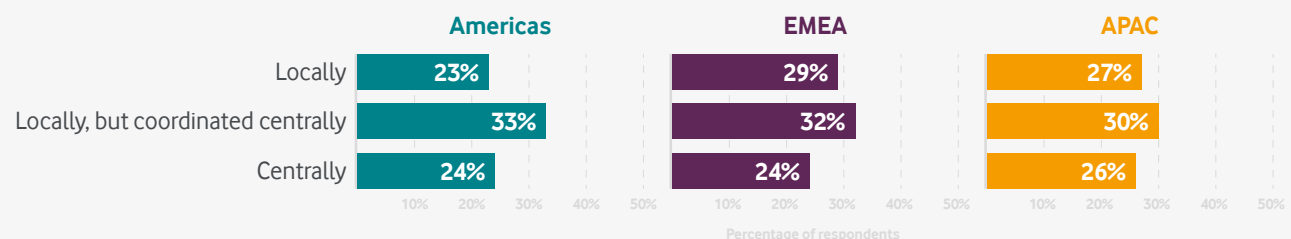|	
28%	Locally
39%	Locally, but coordinated centrally
21%	Centrally

Percentage of respondents

Fig 12.   Managing IoT projects at a local level tends to produce better ROI.

We believe the choice of management approach is driven by the need to align the IoT project more closely to the business process in question, and the needs of the local users and customers. For example, one premium car manufacturer based in Germany told us:

> "Connected car content is increasingly being managed locally — for example you cannot offer Google in China because it does not exist there. In the UK you need to offer different stolen vehicle checking systems than Germany because legislation is different. In the old world we were producing a global car, but **the new IoT world is extremely localised**."

As a result, the use of different management approaches varies by type of business and adoption profile. The very largest enterprises skew toward hybrid or centralised models, as you might expect. Those with the very largest IoT deployments in terms of number of devices, with more than 10,000 devices, also skew toward hybrid approaches. Some sectors, too, are more likely to use local management models than others: 32% of automotive and energy and utilities companies say they manage at a local level.
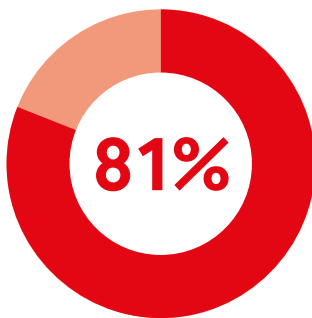
Regional perspective: EMEA organisations are most likely to manage projects at a local level

	Americas	EMEA	APAC
Locally	23%	29%	27%
Locally, but coordinated centrally	33%	32%	30%
Centrally	24%	24%	26%

Percentage of respondents

4

IT integration is key to using IoT data effectively

IoT data enables businesses to be more competitive. To use data effectively, it should be integrated with other enterprise systems. Most adopters already report extensive integration, with greater ROI as a result.

Organisations use IoT to gather data

Respondents were clear that IoT applications generate rich and varied data, and that IoT can only deliver real value if you effectively use that data. For example, one premium car manufacturer based in Germany told us about its experiences with the data gathered by connected cars:

> "All the data within the car and all the data the car gathers is valuable. We have just started to appreciate that if we could combine all that data **we'd have a complete understanding of the world at our fingertips**, would know all road conditions all over the world, where traffic jams are, where parking spaces are for instance. The question is, which of that data is the most valuable to us?"

The next question is what you do with that data. One UK-based transportation company told us how its collected data translates directly into business value:

> "In road transport, we're using data that comes from traffic lights, cars, sensors in the road, and people's devices. **We're using a combination of those data points to inform us what traffic looks like and therefore make real-time judgement calls on how we manage traffic.** That changes everything: travel demand management, the messaging we send out, and what we put on our real-time information website."

A large US-based electronics manufacturer notes particularly the wider value that analysing and applying data on a large scale can create:

> "It's not just about predicting the failure of a particular asset. You want to be able to say, if there's a part failure, show me a list of the millions of assets out there that share the same part. **Because of the data, you can use that information to prevent issues at a fleet-wide level.** People can make better decisions; you can start to change your whole strategy."

81%

81% of all respondents, and 90% of IoT adopters, say that IoT can only deliver real value if you effectively use the data it generates.

Integration with other IT enables better use of data

Gathering raw data from IoT sensors and devices is only the first step in a lifecycle in which data is stored, analysed and accessed by applications and by users. IoT applications need to be aligned and integrated with other systems in the IT landscape that perform these steps — from cloud hosting platforms to analytics tools and mobile applications, as well as conventional IT systems like enterprise resource planning (ERP).

We asked businesses about their experiences, and found that the majority are already well advanced with their integration. Figure 13 shows the results.

To what extent do you integrate your IoT solutions with other areas of IT?

We do this consistently   **We do this in selected instances**

Use big data and analytics platforms to support decision-making
64% | **30%** | **94%**

Integrate IoT data with core systems (e.g. ERP)
56% | **36%** | **92%**

Give employees access to IoT data from mobile devices
59% | **31%** | **90%**

Store IoT data and applications in the cloud
54% | **36%** | **90%**

Fig 13.   Most adopters already use IoT data widely across the organisation.

64%

64% of adopters "consistently" use big data and analytics platforms to support decision-making.
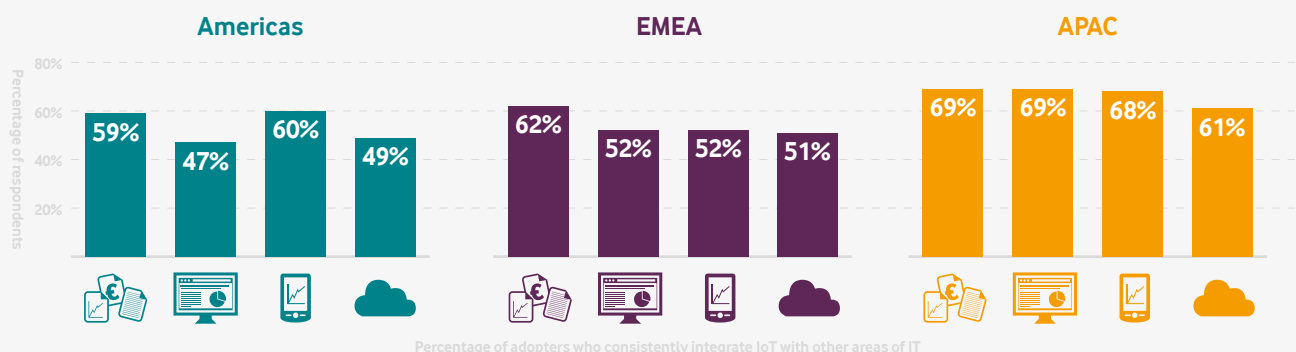
Integration varies by sector

The degree of integration varies by sector. For example, retail is one of the sectors most likely to integrate IoT data with core systems such as ERP. 61% of retailers say they do so "consistently". As distributed, supply-chain intensive organisations, retailers are generally some of the most advanced in their use of ERP systems.

Companies in the energy and utilities sector are most advanced in their use of mobile devices for accessing IoT data. 76% say they do so "consistently". Transport and logistics is only slightly behind, at 73%. Both of these sectors rely extensively on workers out in the field.

Automotive is perhaps the most advanced in the use of data overall. 94% say that IoT's value depends on effectively using the data it generates. 59% say they consistently store their IoT data in the cloud, and 68% say they consistently use big data platforms to support decision-making. When you consider the volume of data that the connected car produces, and the complexity of the automotive product lifecycle, this is easy to understand.

Regional perspective: Integration is consistently high across regions

Americas

Percentage of respondents

80%

59% | **47%** | **60%** | **49%**

EMEA

62% | **52%** | **52%** | **51%**

APAC

69% | **69%** | **68%** | **61%**

Percentage of adopters who consistently integrate IoT with other areas of IT

64% of organisations that report "significant" ROI from IoT say they "consistently" integrate data from IoT with core systems, compared to 35% of businesses reporting "little" ROI.

Similarly, 60% of businesses with "significant" ROI "consistently" store IoT applications in the cloud, compared to 47% of businesses that report "little" ROI.

Fully integrating IoT produces results, but takes time

We found a strong correlation between the integration of IoT with other IT systems and the business benefits that adopters are experiencing. Achieving effective integration between IoT and other enterprise IT systems is not always easy, and some of those we interviewed have made it part of their long-term vision for evolving their use of IoT. For example, one China-based retail and distribution company we spoke to pointed out that it may involve significant organisational change:

"I foresee that **there may be a new department formed** — something called 'Data Analytics' or 'Digital Analytics' — to help handle all the collected data.

"The data platform would be connected with our internal ERP system to ensure that the data and insights drawn would be shared [with] different business units."

A UK-based public transportation business noted that legacy systems in particular can be a stumbling block.

"When we're dealing with new technologies, there're loads and loads of data points that come off and enable us to create an application. In other areas where we'd like to have some data, **legacy means we're not quite there yet.** It's a bit of a mixed bag."

As a provider of IoT solutions, Netherlands-based Philips Lighting has made easy integration, particularly with ERP systems, a key part of its offer to customers.

"Easy access to analytics and insights is what creates value for customers. Our CityTouch smart lighting system gives customers energy reports and analysis, but **increasingly analytics needs to be flexible and broader.** That's why we build our systems with interfaces to enable more integration options.

"An example is a cooperation we have with SAP, which started in the city of Buenos Aires. We connected our CityTouch application to SAP HANA, so the customer can see the lighting status right on the HANA dashboard across different city services."

Machina Research

The analyst view: Start with data, not connections

If IoT is about anything it's about data. Businesses should ask "What business objectives do I want to achieve, and what data do I need to gather in order to do it?", rather than "What can I connect?"

Even the most basic of telematics solutions are based on data analytics. But as applications have become more sophisticated, the complexity of data analysis has escalated. Integration of IoT data into ERP systems is an inevitable step; indeed the starting point should be the ERP system: what does the enterprise need to operate more efficiently, and what IoT solution is required to meet it?

Integration of IoT with existing mobile enterprise platforms is also a growing trend. We expect this kind of convergence to facilitate the integration, for example, of field force technicians, fleet tracking and remote assets.

Sharing data is problematic only for organisations new to IoT

To deliver value, data must be shared around the business, with decision-makers and other users. But what about sharing it outside of the organisation, with partners, industry bodies, and other third parties?

Selling, exchanging and sharing data can be valuable, and we expect it to become a greater focus area in the coming years — indeed, nearly a third of adopters are already engaged in using IoT to build ecosystems in this way. But sharing does have its pitfalls, particularly if customer data is involved. Businesses must be aware of data protection regulation, potential tensions involving data ownership, and the complexities involved in developing the right commercial models to govern the exchange.

To examine these issues, we asked if enterprises felt safe sharing their data with others. There were striking differences between our whole base of respondents and those who already have live IoT projects, and specifically those that have reported "significant" ROI from their live projects. Figure 14 shows the results.

79%

79% of adopters seeing "significant" ROI feel safe sharing data.

To what extent do you agree that you feel safe sharing data with others?

Agree   **Strongly agree**

All respondents

35%   17%

Already adopted IoT

37%   31%

Significant ROI

38%   41%

10%   20%   30%   40%   50%   60%   70%   80%   90%   100%
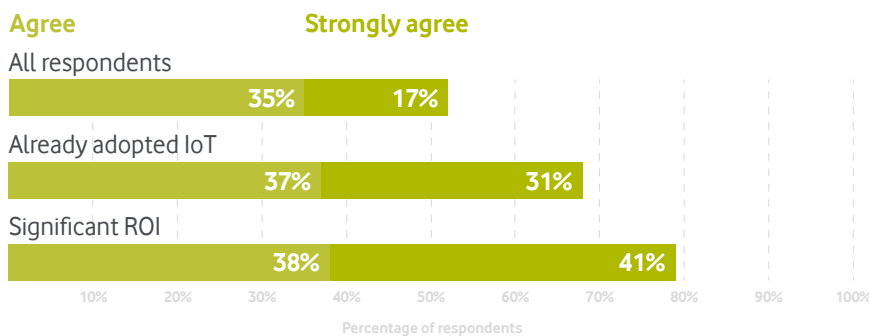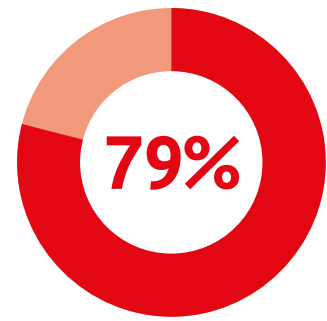
Percentage of respondents

Fig 14. Organisations with live IoT projects are more comfortable sharing data.

Businesses that use IoT are much more comfortable sharing data — whether that's because their experience with IoT has made them so, or whether the kinds of organisations that are more enthusiastic about sharing data are also the kinds that more enthusiastically adopt new technologies such as IoT.

The analyst view: **Agreeing the rules for sharing**

The biggest challenge with 'data' is inevitably related to its sharing with third parties. Our experience is that comfort around data sharing outside of the organisation is still limited, but will emerge gradually.

In multi-tenant systems such as that envisaged in the IoT, everyone needs to agree on a certain set of parameters, for example about who can use the data and for what purposes. At first, data sharing will emerge within what we term 'subnets of things', i.e. common interest groups with a shared understanding and trust on how data can be used.
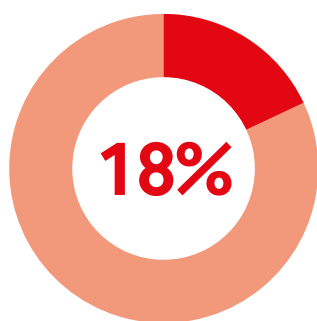
The earliest of these to materialise have been based on smart cities data, where diverse data sets are made available to third parties to build applications. Our expectation is that the next emerging areas will be healthcare and supply chain.

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5 Security needs end-to-end attention

Security risks are a fact of life in all areas of IT, and IoT is no exception. While concerns and confusion about security are affecting adoption, we see enterprises taking steps to manage the risks.

18%

18% of businesses say that concern about security breaches is a potential barrier to wider adoption of IoT in their organisation.

Caution about security risks is natural

There are barriers to adopting any new solution: some businesses are deterred by cost; others wait until the technology is proven to be mature. But security is often the biggest barrier, and IoT is no exception. 18% of businesses say that concern about security breaches is a potential barrier to wider adoption of IoT in their organisation.

Concern about security risks is natural: organisations should be cautious about how IoT will affect the integrity of their infrastructure and the privacy of the data they hold. And as IoT moves out of the lab and into the mainstream of business processes, security is rising up the agenda: more than half of businesses we talked to said they're more concerned about IoT security risks than they were in the past, and 30% said they were changing or restricting the scope of IoT projects to limit security risks.

This year we investigated those concerns in detail, exploring how they're shaping behaviour and what enterprises are doing to address the risks.

Fear of the unknown is the main concern

IoT solutions are made up of many parts, from the devices installed in connected assets, through network connections to back-end systems that are hosted in data centres. We found that enterprises are more concerned about data protection than about device or network security. Data protection covers all aspects of how companies manage the data they have gathered, including what happens in the hosting environment, applications and processing, data sharing, and access by employees and other users.

We asked organisations to rank their top three reasons why they're concerned about IoT security. Figure 15 shows the results. The top concern is that IoT security is an "unknown quantity" — the risks aren't yet well understood, and organisations haven't yet developed the skills and processes to feel that they can respond effectively.

What are your top concerns when it comes to IoT security and/or privacy?

Knowledge: IoT security is an unknown quantity

33%

Complexity: The increasing complexity of IoT connections is making it harder to manage risks

28%

Reputation: We're afraid of a customer or media backlash about the data we're gathering

14%

Management: IoT hardware devices are insecure and difficult to manage in the field

12%

Mobility: The increased mobility of employees increases the risk of data getting into the wrong hands

8%

Authenticity: We're concerned about the authentication of third-party data we're using

4%

Reliability: IoT applications are mission-critical so the effects of a security breach can be huge

1%

10%   20%   30%   40%   50%

Percentage of respondents

Fig 15. Enterprises' top concerns about IoT security highlight a fear of the unknown

Second is that the complexity of IoT deployments is making it harder to manage risks. There are many moving parts, particularly in large-scale IoT deployments.

Third is a concern about a reputational backlash from customers or the media about the data that businesses are gathering. This is not a concern about system security as such, but the related issue of privacy.
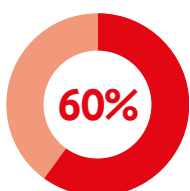
Businesses are taking a balanced view of risk

Enterprises are concerned about security, but that's not the whole story. In fact, many businesses are cautiously optimistic that the risks are manageable.
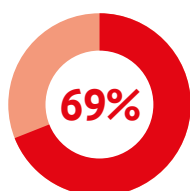
More than half said that IoT is no different fundamentally from any IT solution when it comes to security. Consequently, many of the same proven best practices and readily available solutions to conventional IT security challenges apply. For example, one US-based electronics manufacturer said:

> "**Security has not slowed down our adoption of IoT.** Unauthorised users will always try to hack into infrastructure — it's nothing to do with IoT."
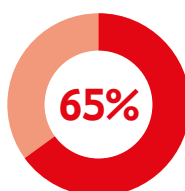
Furthermore, businesses are actually fairly comfortable that the actions they need to take are achievable, even with the resources they have available — and those that have already adopted IoT are even more confident.
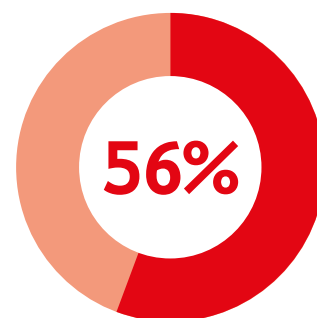
56%

56% of all businesses say that IoT is no different fundamentally from any IT solution when it comes to security.

60%

60% of businesses say their employees have the skills to manage IoT security — that's 84% for IoT adopters.
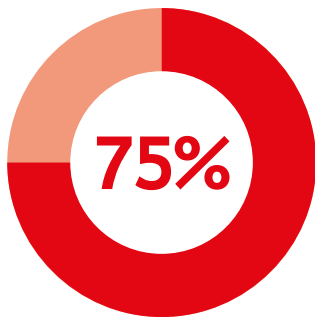
69%

69% of businesses say they have the processes in place to manage security — that's 89% for IoT adopters.

65%

65% of businesses say their technology is robust enough to safely process data — that's 84% for IoT adopters.

Security needs end-to-end attention

75%

75% of businesses we talked to consider security risks to be a "fact of life".

Perhaps most fundamentally, enterprises are acknowledging that security risks are a simple fact of life, an issue you have to get on and deal with.

A multinational automotive company based in Germany told us that it sees security and data privacy as things that drivers and regulators have concerns about, that simply must be addressed:

"Society has expectations and there are legal requirements you have to conform to. **It is just something you have to think about.**"

One way forward is to build security in as simply another project cost. As a Germany-based consumer electronics company described it:

"Security is simply a matter of costs. **If you want to make data accessible everywhere without any major issues, you have to be prepared to pay for it.**"

Also critical is a pragmatic and collaborative attitude across the project teams, as one UK-headquartered transportation company explained:

"IoT security is about balance: protecting information for the organisation, while allowing it to continue to operate. **It's a balancing act. But ultimately our security team is open-minded, it knows that it needs to enable the organisation, not stop it.** The relationship between project teams and security is far closer than ever before."

Many organisations are actively working on security

Perhaps most encouragingly, enterprises are actively engaged in addressing security in a variety of ways, from choosing to work with security specialists and establishing policies, to recruiting and training new staff. In fact, only one interviewee from our whole data set said they were doing "nothing". Figure 16 shows the full list.

What action is your business taking to improve the security of your IoT projects?

People
- 42% **Training staff**
- 41% **Recruiting security specialists**

Process
- 45% **Establishing clear security best practice and guidelines for staff**
- 38% **Establishing a clear breach contingency plan**

Providers
- 42% **Making security a major part of RFP requirements**
- 40% **Working with a specialist security provider**

10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Percentage of respondents

Fig 16. Adopters are taking a range of actions to secure their IoT projects.

Security-conscious sectors, such as energy and utilities, are ahead in committing to many of these activities — they know that, while it's essential, securing critical infrastructure and private data takes work. For example, 59% of energy and utility companies were working on security guidelines, while 52% say they're working with a specialist security provider.

One large US-based electronics manufacturer we interviewed has taken many steps to secure its IoT architecture, including acquiring specialist security companies. But it's not neglecting the human elements of achieving security:

> **"We have tried to address at each of the different layers in the stack how we can put in place practices around security —** it is a focal point of how we build solutions. Not only are we acquiring companies that have security technology, but we are training our people in mandatory classroom exercises. So not only are we bringing in the right technology, but making sure that as we build our software from the ground up it has the right processes and techniques."

Providers can play a greater role

At the heart of any robust security practice is effective governance, including clear division of responsibilities, consistent policy enforcement and regular monitoring. Today, this is not happening in many enterprises' IoT projects.

We asked enterprises to say who, ultimately, should be responsible for ensuring the end-to-end security of their IT projects. There was no consensus, with only one in ten saying it is ultimately the responsibility of their own business to secure their own IoT infrastructure. Responsibility was otherwise divided between the different vendors involved, from system integrators and network providers to device manufacturers, as Figure 17 shows.

Who should be ultimately responsible for ensuring the end-to-end security of your IoT projects?

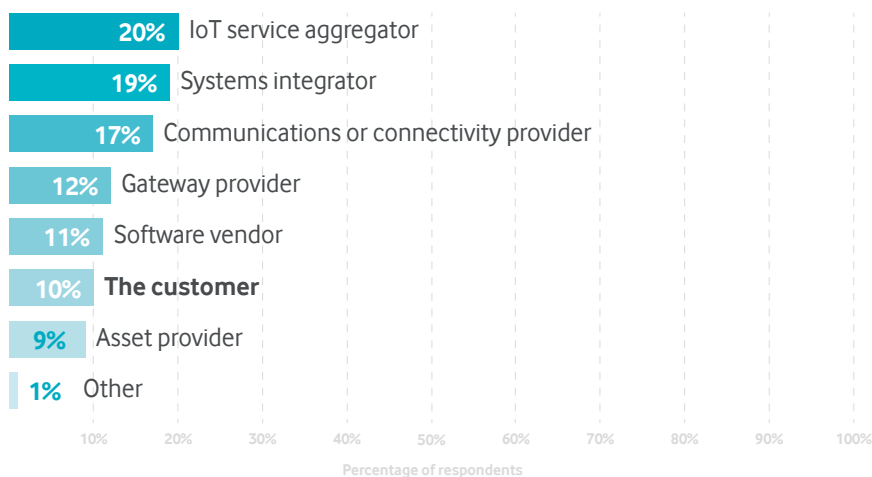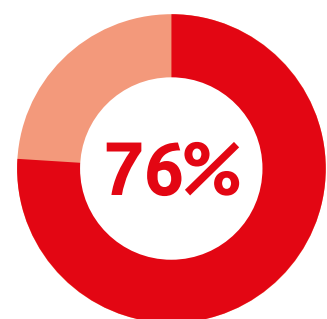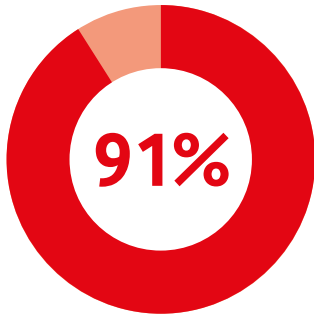|	
20%	IoT service aggregator
19%	Systems integrator
17%	Communications or connectivity provider
12%	Gateway provider
11%	Software vendor
10%	**The customer**
9%	Asset provider
1%	Other

Percentage of respondents

Fig 17. Few enterprises believe it's their responsibility to secure their IoT projects.

This is an issue, particularly for businesses that are using multiple providers to contribute to an overall IoT solution.

76% of businesses we spoke to said that IoT security should be treated as an end-to-end solution, yet very few outside providers will have the necessary visibility and control of the overall business process needed to effectively validate security as a whole.

76%

76% of businesses we spoke to say that IoT security should be treated as an end-to-end solution.

91% say it is important for them to work with an end-to-end solution provider for IoT.

For example, a device vendor can take responsibility for the security of its hardware and associated firmware, and perhaps installation and patching procedures, but it will struggle to take responsibility for how the customer handles data, or the security of the solution's communications channels.

If they're to address their concerns about end-to-end data protection, we expect more enterprises will start to take active ownership of their own security and privacy governance, at board level.

But we believe that enterprises will also choose to work more with end-to-end IoT providers that can take on greater responsibility and accountability for areas of IT security, as well as providing advice, specialist security services and access to people to support in-house IT teams. Security may be part of the reason why 91% say it is important for them to work with an end-to-end solution provider for IoT, as Figure 18 shows.

How important is it for your organisation to work with an end-to-end IoT solutions provider?

Very important   **Fairly important**

| 47% | 44% | **91%** |

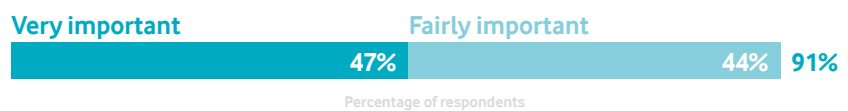Percentage of respondents

Fig 18. Almost all enterprises say it's important to work with an end-to-end provider for IoT.

For Netherlands-based Philips Lighting, as a provider of IoT, security is a topic that's taken very seriously at a business level. It too points out that security is not purely about technology, but about operational processes:

"A clear IoT security strategy is so important if you offer the solution we do. You need to have the skills and the structures — **security is much more than the right software code — it has to do with the processes you install and you have to ensure a holistic approach to security**.

"That's why we have a Head of Corporate Security who designs the policies that are deployed throughout the company, so we have processes defined at every level on what we do in terms both of product security and operational security … we regularly review and audit these policies and how they are executed."

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The analyst view: Security is not an excuse

One of our predictions for 2016 was that "enterprises would stop using security as an excuse for not delivering". The Barometer seems to bear us out: enterprises are taking on board that these are solvable issues.

There is nothing fundamentally different about IoT security, and while there is no silver bullet, there are a number of things that enterprises should be doing. The first is to identify threats to your specific situation and act proportionately to the risk, focusing effort and resource on the most threatened and sensitive data. Second is to pick your partners carefully as the chain is only as strong as the weakest link, and identify security challenges both within each element and end-to-end. Finally, the enterprise should accept that there will be a security breach and ensure that the impact of any such breach is mitigated.

Above all, businesses must learn from others' errors — or put their confidence in a third party that can handle all issues around security and privacy, including ensuring that other suppliers meet their obligations.

The future

IoT is an incredibly varied and complex market, and generalisations are difficult. But our research reveals a number of broad trends that we expect to shape how enterprises use IoT in the years ahead.

1 From "if" to "how"

Within the next two years, the majority of businesses will be using IoT. Just adopting IoT will no longer be a differentiator — it's part of the IT landscape and digital strategy of every business. The decision to take is how best to use it. That may be as a highly visible technology that's driving service quality, revenue or process efficiency. Or it may be invisible to most employees, as an intrinsic part of the business environment: quietly and autonomously monitoring the health of vehicles, updating digital signage, optimising building systems.

2 From "technology" to "business outcome"

IoT will increasingly be treated as indistinguishable from business processes; it will be part of the fabric of the organisation. IoT will be seen as an intrinsic feature of a modern warehouse system, company car fleet or security solution, for example. We expect business-led approaches to procuring and managing IoT — including end-to-end outsourcing — will dominate, in order to drive measurable business results and more effective governance. At the same time, we expect IoT, cloud, mobile and analytics will increasingly be conceived of and purchased together as elements of an integrated solution.

3 From "caution" to "action"

IoT may be managed as part of the business, but just like cloud or mobile, it's still a technology, and cybersecurity will remain a major consideration. Today, IoT security is dominated by fear of the unknown; we expect that this will shift as businesses recognise the value of data and the need to manage it. IoT will be absorbed into overall IT security practices and businesses will invest in actively protecting it as a mission-critical asset.

4 From "optimise" to "engage"

We're already seeing that IoT applications of all kinds are not only driving operational and process improvements, but having a noticeable impact on the employee and customer experience. As businesses increasingly look at building IoT into their products and services, certain sectors will naturally take the lead in revolutionising how they engage with their customers, among them automotive (through the connected car) and healthcare (through mhealth).

Contributors

Machina Research

Machina Research is the world's leading provider of market intelligence and strategic insight on the newly emerging Internet of Things, Machine-to-Machine (M2M) and Big Data opportunities.

We provide market intelligence and strategic insight to help our clients maximise opportunities from these rapidly emerging markets. If your company is a mobile network operator, device vendor, infrastructure vendor, service provider or potential end user in the IoT, M2M, or Big Data space, we can help. Within Machina Research's rapidly growing team are 14 analysts focused exclusively on IoT, including world-renowned industry veterans.

A member of the Industrial Internet Consortium and the Continental Automated Buildings Association, Machina Research is headquartered in London with offices in San Francisco, Toronto, Boston and Hong Kong.

Matt Hatton is a widely respected wireless industry expert with 20 years' experience at the cutting edge of technology research. He is considered one of the foremost industry experts on the Internet of Things, and is Founder and CEO of Machina Research where he manages a rapidly expanding team of analysts focused exclusively on the IoT. Matt holds an MSc in Telecommunications (Distinction) from University College London.

Learn more at **machinaresearch.com**

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Find out more at **philips.com/smartcities**

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Contributors

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