

# THE INTERNET OF THINGS BUSINESS INDEX

## A QUIET REVOLUTION GATHERS PACE

A report from The Economist Intelligence Unit

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## About the report

*The Internet of Things business index: A quiet revolution gathers pace* is an Economist Intelligence Unit report, sponsored by ARM. It is intended to gauge the current and future use of the Internet of Things by the global business community.

This report draws on two main sources for its research and findings:

- In June 2013 The Economist Intelligence Unit surveyed 779 senior business leaders, nearly half (49%) of whom are C-level executives or board members. Respondents come from across the world, with 29% based in Europe, 29% in North America, 30% in Asia-Pacific, and the remaining 12% from Latin America, the Middle East and Africa. A total of 19 industries are represented in the survey. Around 10% of respondents come from each of the following industries: financial services; manufacturing; healthcare, pharmaceuticals and biotechnology; IT and technology; energy and natural resources; and construction and real estate. The sample is evenly split between large firms, with an annual revenue of more than US\$500m, and small and mid-sized firms. Some of the results from this survey have been used to create the inaugural Internet of Things business index featured in this report.
- Alongside the survey the EIU conducted a series of in-depth interviews with the following senior executives and experts (listed alphabetically by organisation):

- Kevin Ashton, general manager, cleantech division, Belkin
- Stefan Ferber, director for communities and partner networks for the Internet of Things and services, Bosch Software Innovations
- John Davies, chief researcher, corporate ICT research practice, BT
- Liz Brandt, CEO, Ctrl-Shift
- Elgar Fleisch, deputy dean, ETH Zürich
- William Ruh, vice-president and corporate officer, global software headquarters, GE
- Filip Sergeys, head of ITS government relations and regulations, Honda Motor Europe
- Honbo Zhou, board director, Qingdao Haier
- David Bott, director of innovation programmes, Technology Strategy Board

The report was written by Clint Witchalls and edited by James Chambers. We would like to thank all interviewees and survey respondents for their time and insight.

## Executive summary

The Internet of Things (IoT) is an idea whose time has finally come. Falling technology costs, developments in complementary fields like mobile and cloud, together with support from governments have all contributed to the dawning of an IoT “quiet revolution”. Now, after more than a decade of slow progress, the business community is beginning to look seriously at the IoT—to the extent that a mere 6% of business leaders believe that the idea of IoT is simply hype, according to a global survey conducted by The Economist Intelligence Unit.

The IoT business index, which is featured in this report, has been specifically created to measure the level of IoT uptake by businesses globally, regionally and by industry. These initial findings will form a benchmark to be tracked over time. At present, businesses worldwide are mainly in the research stage (at point 4 on a scale of 1 to 10), and they are slightly more likely to be using the IoT for internal operations and processes than in external products or services. By region, European businesses are fractionally out in front. Meanwhile, manufacturing leads the way among industries, with financial services bringing up the rear.

Key findings from the research include the following:

- **The IoT is on the agenda at most organisations—even if they disagree about its scope.** At present, over three-quarters of companies are either actively exploring or using the IoT. The vast majority of business leaders believe that it will have a meaningful impact on how their companies conduct business, yet there is some divergence about the wider effect it will have. The largest group of respondents (40%) sees the impact limited to certain markets or industries, whereas a similar-sized group of respondents (38%) believe that the IoT will have a major impact in most markets and industries. A smaller group (15%) see the IoT as having a major impact but only for a few big global players.
- **Optimism about the IoT is not yet matched by investment.** Three years from now, almost all respondents (96%) expect their business to be using the IoT in some respect. For now, however, investment in the IoT is relatively low. Since 2012 only around 30% of organisations have seen double-digit growth in IoT investment, from what would have been



a low base to begin with. Investment is likely to increase as organisations move from the research stage to the planning stage. Although uncertainty remains about what successful business models will look like, the majority opinion (61%) is that companies that are slow to integrate the IoT into their business will fall behind the competition.

- **More IoT-specific skills are needed for the next stage of development.** A lack of IoT skills and knowledge among employees and management is viewed as the biggest obstacle to using the IoT more extensively. To address these gaps, organisations are training staff and recruiting IoT talent, raising the potential for IoT talent wars. Others are hiring consultants and third-party experts, seeking to build knowledge and identify successful IoT business models. Moving executives and employees up the IoT learning curve should also help to ease the difficulty many firms experience in identifying IoT applications for existing products and services.
- **Companies must learn to co-operate with players across industries, including competitors.** National and supranational governments are taking an active interest in the commercial development of the IoT, encouraging common standards and sponsoring IoT projects that promote interoperability between organisations. For their part, businesses must be willing to adopt a different mindset. Successful IoT rollouts require interconnected networks of products and services, but few senior executives currently expect their business to become more co-operative with competitors as a result of the IoT. With

30-50bn so-called smart objects projected to exist by 2020, the IoT risks becoming heavy on “things” and light on interconnectivity.

- **Consumers could soon be awash with IoT-based products and services—even if they may not realise it.** Over the next few years the IoT is expected to have the biggest impact on customer service and products and services. Current activity should mean that a strong pipeline of IoT-based products and services will soon begin reaching the market. This should raise consumer awareness; the majority of respondents believe that low awareness levels are depressing demand for IoT products and services. Still, this should not prove a major hindrance for businesses because many consumers will use IoT-related products and services without knowing it.
- **Businesses should be prepared for an explosion of IoT-generated data.** Fitting sensors and tags to products will generate even more data than are currently being created and captured. Companies feel confident in their ability to handle this explosion of information, but prior experience of storing and analysing large amounts of “big data” may lead them to underestimate the additional talent and skills needed to spot new uses and revenue streams emerging from it. Data security and privacy are also likely to grow in significance as more consumers engage with IoT-based products. Beyond storing, securing and analysing these data, companies should also consider how they manage the commercial sharing of the data as the IoT becomes a platform for trading information.

## Five things businesses should know about the Internet of Things

**There is more going on than you might think:** 75% of companies from across industries are already exploring the IoT

**The IoT is not just for manufacturers of “things”:** Service providers are already offering new IoT products (e.g. insurance companies pricing premiums based on driver behaviour)

**Skills development should not be an afterthought:** A lack of IoT-related talent is considered the top obstacle to businesses using the IoT

**The IoT will not flourish without genuine co-operation:** Turning 50bn so-called smart things into a global network requires business to agree standards for interconnectivity and data sharing

**Unknowns should not be feared:** Few know today what successful business models will look like, but exploration now will pay benefits later

# MAKING BUSINESS SENSE OF THE INTERNET OF THINGS

## 1 Most companies are exploring the IoT...

Percentage of companies exploring or using IoT in the business in some respects (% of respondents)

**Internally** (operations or processes)

**YES 76%**

**NO 24%**

**Externally** (products or services)

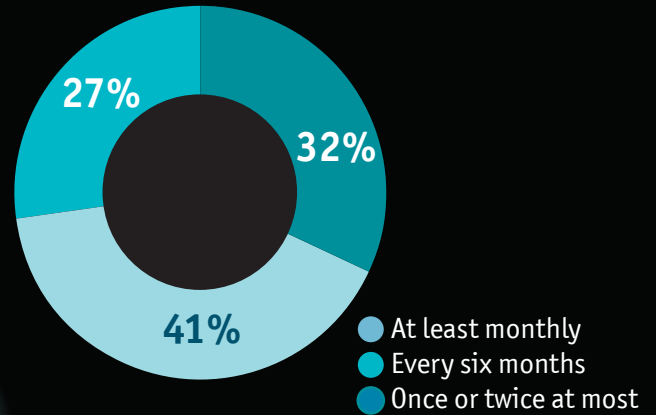
**YES 74%**

**NO 26%**

Three years from now only 4% of companies do not expect to be using the IoT in the business at all

## 2 Two in five members of the C-suite are talking about it at least once a month...

Frequency of IoT meetings (% of respondents)

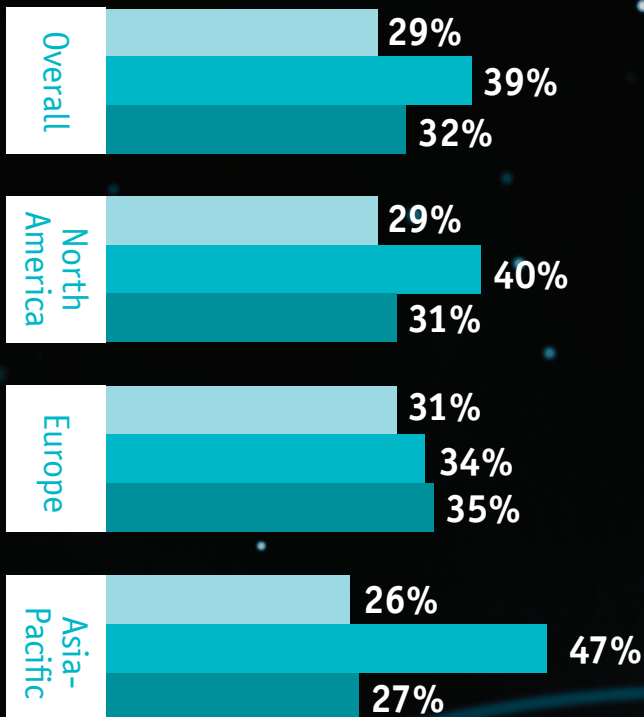


10% of business leaders have not discussed the IoT at their organisation

## 3 Investment in the IoT is more mixed... for now

Year-on-year increase in IoT investment (% of respondents)

● Over 10% ● Under 10% ● No investment to date (or don't know)



3% of companies have more than doubled year-on-year investment in the IoT

## What C-suite executives are saying about the IoT

**95%** Expect their company to be using the IoT in three years' time

**63%** Believe that companies slow to integrate the IoT will fall behind the competition

**58%** Would like to see government doing more to promote development and adoption of the IoT

**45%** Believe adopting the IoT will make their company more environmentally friendly

## 1

## The Internet of Things business index

Kevin Ashton coined the term the “Internet of Things” (IoT) in 1999 while working at Procter & Gamble. At that time, the idea of everyday objects with embedded sensors or chips that communicate with each other had been around for over a decade, going by terms such as “ubiquitous computing” and “pervasive computing”. What was new was the idea that everyday objects—such as a refrigerator, a car or a pallet—could connect to the Internet, enabling autonomous communication with each other and the environment.

Mr Ashton is currently a general manager at Belkin, a US manufacturer of consumer electronics. Looking back, he says: “I was incredibly excited and optimistic about the Internet of Things, but compared to my optimism,

progress seemed incredibly slow. It was quite frustrating. We were dealing with a lot of senior executives who had grown up long before the age of email, and it just wasn’t clicking with them.”

The interim period has yielded a new generation of technologists who have grown up in the wireless world. “Most of the people I see driving the Internet of Things forward in interesting ways now were probably undergraduates in 1999,” says Mr Ashton. As a result, he maintains that the IoT is no longer the future—it is the here and now. Proof of this is in the numbers, he says. A manufacturer of sensors recently told him that it sold 2bn units last year and expects to sell 3bn in 2013. “Where are they going?” he asks. “Clearly somebody is buying [sensors] and using them.”

## Introducing the Internet of Things business index: scores, bands and stages

The inaugural IoT business index is based on a survey of 779 executives from around the world, conducted by The Economist Intelligence Unit in June 2013. Survey respondents were asked to indicate the extent to which their companies currently make use of the IoT in their external products and services, and separately in their internal operations and processes (see Appendix 1 for a full explanation of the methodology).

The index is on a scale of 1 to 10. The scale represents five “stages” of IoT use: the highest or most advanced stage (a score of 9 or 10) equates to extensive use of

Score/band	Stage of IoT use
9 to 10	Extensive
7 to 8	Early implementation
5 to 6	In planning
3 to 4	In research
1 to 2	Non-existent

the IoT, whereas the lowest stage (a score of 1 or 2) equates to non-existent (or virtually non-existent) use of the IoT. A score that lies between these stages indicates that businesses are transitioning from one stage to another. ■

The purpose of this report, and of the Internet of Things business index, is to measure periodically the stage at which the IoT is being used by businesses on a global, regional and industry level. The initial index scores below will form the baseline for future versions of the index, tracking the business uptake of the IoT over time and giving an indication of how quickly businesses are progressing with the IoT. The remainder of the report explores some of the main issues and challenges that businesses will have to consider if the IoT is to become more pervasive.

Likewise, the three major regions of the world are at roughly similar levels in both external and internal categories; Europe is fractionally ahead in both. "In terms of global market position, the UK is in the leading 20% of developers of these technologies," says David Bott, director of innovation programmes at the Technology Strategy Board, the UK's government-funded innovation agency. "But, like the rest of the world, we are only about a quarter of the way along the road to fully implementing them."

### Global momentum

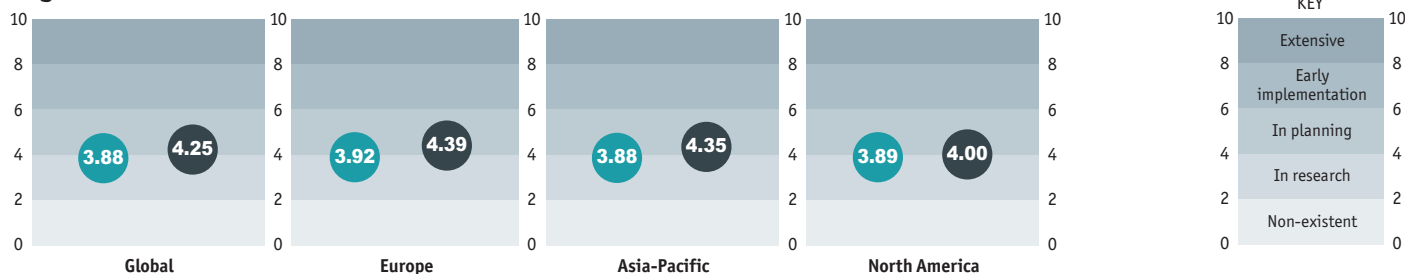
The inaugural IoT business index indicates that the business world is embracing the IoT on a global level. An overall score of 3.88 for products and services places businesses at the top end of the "in research" stage. Meanwhile, businesses score higher for operations and processes, meaning that they are slightly further ahead in using the IoT internally rather than externally. A score of 4.25 in internal operations places them in transition between the "in research" stage and the "in planning" stage.

The support of the EU in Europe and the Chinese government in Asia (where the previous premier used the term in his speeches) has a role to play in encouraging business uptake of the IoT, says Mr Ashton. He was surprised when the IoT did not play an important role in the legislation passed by the US government in 2008 to stimulate the economy and avoid recession (the Economic Stimulus Act of 2008). Nonetheless, the US is playing a leading role in developing the underlying technology, and its firms should not be expected to lag behind those of other regions when it comes to putting the IoT to business use.

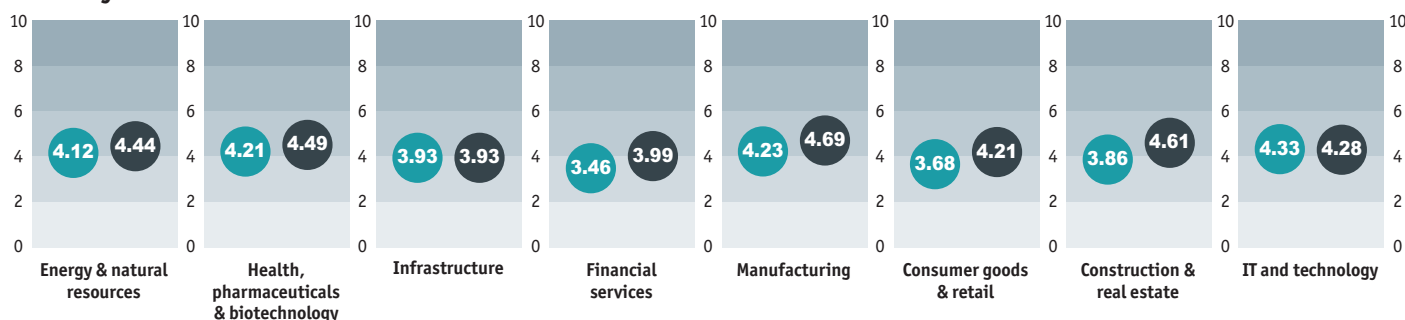
## The Internet of things business index

● External products & services ● Internal operations & processes

### Region



### Industry





As outlined below, there is greater variation in IoT use between industries than between regions.

### Sensors on the shop floor

In the early part of the 21st century, retailers such as Wal-Mart in the US and Tesco in the UK pioneered the tagging of products to optimise warehousing and the supply chain. Logistics companies have been using similar methods to track packages along the delivery route. These examples of passive communication between humans and objects are considered an entry-level stage for the IoT. Other early uses for the IoT have tended to focus on the internal workings of a business and efficiency measures, such as reducing energy consumption, building management or monitoring the status of plant and equipment.

Consequently, it is not surprising to see all but one industry score higher in the internal operations part of the index than in products and services. The manufacturing sector currently leads the way in using the IoT internally (with a score of 4.69), followed by construction and real estate and healthcare, pharmaceuticals and biotechnology. One in four manufacturing companies already has a live IoT system in place, moving beyond passive tagging of objects to autonomous machine-to-machine communication with limited human involvement.

Bosch, a German services and technology company, both sells IoT manufacturing systems (hardware and software) and uses them in the company's 200-plus factories. "In Germany, we call this 'Industry 4.0'," says Stefan Ferber, director for business development of the IoT and services at Bosch Software Innovations. "Industry 1.0 was the invention of mechanical help, Industry 2.0 was mass production, pioneered by Henry Ford, Industry 3.0 brought electronics and control systems to the shop floor, and Industry 4.0 is peer-to-peer communication between products, systems and machines."

In Industry 4.0, an initiative led by the German government, sensor data are used to control the flow of materials, products and information, with minimum human intervention. (The US has a similar initiative led by the Smart Manufacturing Leadership Coalition, in which manufacturers are working towards a shared infrastructure, known as the Smart Manufacturing Platform.)

Although centralised factory control systems exist today, Industry 4.0 will offer decentralised intelligence, believes Mr Ferber, and the reach will be much farther than the factory floor. "Today, you have optimised production for one factory," he says, "but Industry 4.0 will make possible optimised production across multiple factories or even multiple companies."

### From pipedream to productisation

When it comes to developing IoT-based products or services, IT and technology firms lead the way (with an index score of 4.33), followed by manufacturing and healthcare, pharmaceuticals and biotechnology. At least one in five survey respondents in each of these industries says that their organisation already has an IoT-based product or service in the market.

Belkin straddles both the technology and consumer goods industries. It celebrated the one-year anniversary of its first IoT product, WeMo, in June 2013. WeMo is a combination of WiFi-enabled plug sockets and smartphone apps, which allow users to control their home electronics from anywhere. This represents an initial step towards home automation, epitomised by the popular prophesy about a smart fridge that autonomously replenishes its contents.

More traditional consumer goods and retail companies are not as far along: nearly one in three (31%) companies in the industry has yet to even experiment with IoT products or services. There are prominent exceptions to this, such as the Nike+ Fuelband, a wearable computing device

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The amount of patent applications is steadily growing and this should be an indicator of the importance of the topic to Honda.

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*Filip Sergeys, head of ITS government relations and regulations, Honda Motor Europe*

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These [IoT] products become platforms for new business services, and with these additional services you can also generate new revenue streams. Either you do this yourself or somebody else will do it.

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*Stefan Ferber, director for communities and partner networks for the Internet of Things and services, Bosch Software Innovations*

that measures daily exercise and activities. But low consumer IoT awareness may be hindering faster development in the sector. Talking about Belkin's own trickle of IoT products, Mr Ashton says, "We are very deliberately conducting an experiment, so we brought out a few products to learn about the market, develop our technical know-how and start to understand what customers want."

There is, nonetheless, a hive of research activity and piloting under way across industries. The single largest group (40%) of businesses are researching the IoT while 17% are planning to roll out an IoT-based product. During the next few years, this pipeline of IoT products or services has the potential to turn the current trickle of IoT products and services on the market into a flood (subject to the potential hurdles explored in chapters 2 and 3).

Companies in infrastructure (e.g. airports, power transmission and sewage) and energy and natural resources appear particularly busy. Around two-thirds of organisations in each industry have IoT-related products and services at the research or planning phase. The automotive sector also has a large range of IoT products and services in development.

Filip Sergeys, head of intelligent transport systems (ITS) government relations and regulations at Honda Motor Europe, says that his firm is furiously working on IoT products and services. This is mostly in the area of ITS, which aim to make driving safer, greener and more convenient by connecting vehicles (with embedded sensors) through wireless networks.

Vehicles will be able to communicate with other vehicles, with sensors embedded in road infrastructure and with back-end computers. "The amount of patent applications is steadily growing and this should be an indicator of the importance of the topic to Honda," says Mr Sergeys.

### A virtuous circle

As organisations continue to integrate the IoT across multiple levels of the business, the divide between internal operations and processes and external products and services will become blurred. GE uses the IoT internally and externally in a similar way to Bosch. Data from sensors are used to monitor machines (such as wind turbines) remotely, and to spot potential problems before they occur. This predictive maintenance is a customer service, but the boundary between internal processes and external (customer-facing) processes starts to fade when GE's engineers use the data on how a machine is performing in the field to design the next generation of products.

Mr Ferber of Bosch underlines the commercial importance of this virtuous circle: "These [IoT] products become platforms for new business services, and with these additional services you can also generate new revenue streams. Either you do this yourself or somebody else will do it. If somebody else does it you've been pushed back in the value chain from tier 1 to tier 2 or from tier 2 to tier 3. The further away you are from the customer, the lower your margins are, and so it's good to stay connected to the customer."

## Why now?

A number of developments have contributed to business adoption of the IoT. One important factor is the falling cost of the underlying technology. In other words, the sensors and actuators fitted to “things” to connect them to the Internet and their environment, such as radio-frequency identification (RFID) and micro-electromechanical systems (MEMS). The cost of a RFID identification tag, which is commonly used to track assets and manage inventory, fell by 40% in the 18 months to April 2013.<sup>1</sup> One tag now costs about 10 US cents.<sup>2</sup> Meanwhile, the price of MEMS, such as accelerometers, gyroscopes and pressure sensors, has fallen by 80-90% in the past 5 years.<sup>3</sup>

Alongside the falling cost of sensors, Honbo Zhou, a director of China’s Haier, the world’s largest manufacturer of white goods, would also add the cost of WiFi routers. Haier is developing a WiFi-based “smart home” platform, known as Networked Home Appliance Platform. The platform would not have been feasible a few years ago, when WiFi routers used to cost around US\$200. Now they are US\$10. “We can consume that cost and still do this,” says Mr Zhou.

As this suggests, uptake of the IoT is benefiting from the convergence of a number of other technology developments. The introduction in

2012 of Internet Protocol Version 6 (IPv6), for instance, massively extended the number of unique Internet addresses available, making it possible to connect trillions of physical objects to the Internet. To this should be added cloud computing and so-called big data. Sensors generate an enormous amount of data, but without the technology to store them and the analytic software to make sense of it the data are not worth much. “Five years ago, those technologies didn’t exist,” says William Ruh, vice-president of GE’s global software headquarters.

For practitioners such as Mr Zhou and Mr Ruh, however, a main reason the IoT has finally come of age is the mobile Internet, epitomised by ubiquitous smartphones and tablet devices. The IoT involves devices communicating with each other (machine-to-machine communications, or M2M), but it also involves devices communicating with people and people communicating with devices. For example, a healthcare professional may be alerted via a smartphone that a patient’s blood pressure has risen above a critical threshold, or a smartphone may allow a consumer to switch the airconditioning on at home, even though they are at work.

<sup>1</sup> “Low tag costs and high benefits drive interest in RFID for loss prevention”, Truecount, April 4th 2013.

<sup>2</sup> Ibid.

<sup>3</sup> *Disruptive technologies: Advances that will transform life, business, and the global economy*. McKinsey Global Institute, May 2013.

# 2 Taking the IoT to the next level

The IoT is reaching a tipping point. Although the idea, the terminology and the technology have been around for at least a decade, the IoT is beginning to become an important action point for the global business community. More than three-quarters of global companies are exploring

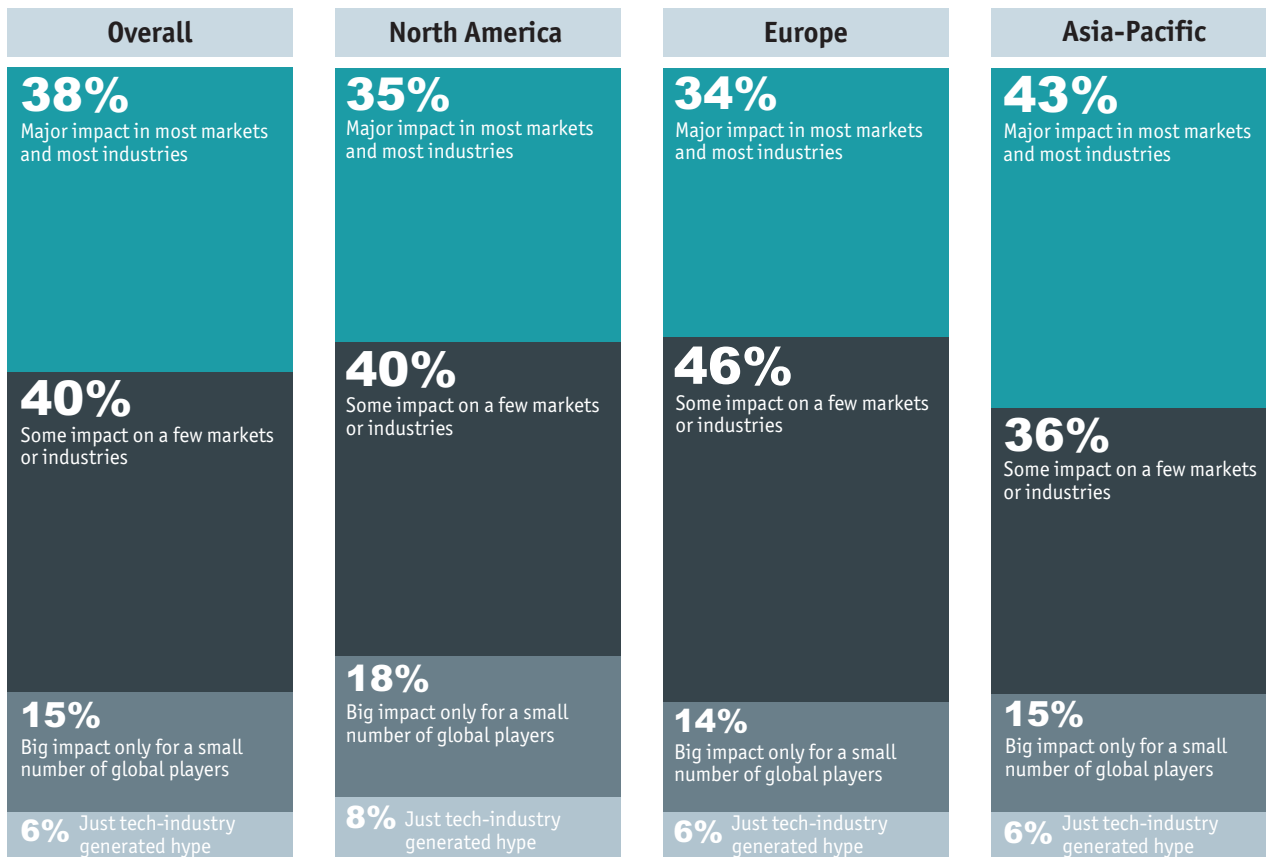
or using the IoT in their business to some extent, and around two in five CEOs, CFOs and other C-suite-level respondents have a formal meeting or conversation about the IoT at least once a month.

Chart 1: Future impact of the IoT - industry level



What impact is the IoT likely to have on business in general over the next three years?

(% of respondents)



Source: The Economist Intelligence Unit.

Looking forward, the overwhelming majority of business leaders (94%) believe that the IoT will have some impact on markets and industries over the next three years, even though there is a split in the majority opinion around the precise impact that the IoT is expected to have. More than one-third (38%) of survey respondents believe that the IoT will have a major impact in most markets and most industries. A similar number of respondents (40%) believe that the IoT's impact will be limited to a few markets or industries.

One reason for this split in the macro-level outlook could be because many executives have yet to realise the potential applications for the IoT at their companies: one of the biggest obstacles to using the IoT is the perception that products or services do not have any obvious IoT application (see chart 3). Other uncertainties remain, such as the nature of consumer demand (see *A different kind of revolution* on page 15).

Nonetheless, as the IoT business index confirms, there is no doubt that the technology is already having a broad impact across the world. The precise effect is likely to vary by country and by company, but it is hard to imagine that any sector will be left untouched by the IoT.

### Green shoots of growth

One-quarter of businesses (25%) surveyed are currently not doing anything around the IoT. If the survey is a judge, that number will fall to under 5% within three years. By that time, the majority of these executives (63%) expect their

organisations to be using the IoT across at least one-half of the business, which suggests that the IoT will impact core and ancillary operations alike.

Up until now, asset management or energy management have been key areas of IoT use, but over the next three years the IoT is expected to have the biggest positive impact on customer service and products or services themselves. In particular, the IoT is forecast to unlock new revenue opportunities from existing products and services, inspire new working practices or business processes and change existing business models or strategies. Only 9% of senior managers believe that the IoT will not change the way their company conducts its business in a meaningful way.

Liz Brandt is the CEO of Ctrl-Shift, a London-based consultancy that focuses on business opportunities made available by the information economy. Even during recessionary conditions her discussions with businesses about the IoT revolve around the search for growth opportunities, rather than creating efficiencies. Senior executives always perk up at meetings whenever the IoT is mentioned, Ms Brandt observes.

### Developing skills

If organisations are going to make the most of the IoT they will need a workforce with the proper skills. According to survey respondents, a shortage of employees with IoT-related skills and knowledge is the biggest hurdle to greater

Chart 2: Future impact of the IoT - company level

#### Where in the business will the IoT have the biggest impact?

(Top responses)

- 1** Customer service/support
- 2** Products or services (B2B or B2C)
- 3** Data management & analysis

#### How will the IoT change how the business currently operates?

(Top responses)

- 1** Unlock new revenue from existing products/services
- 2** Inspire new working practices or processes
- 3** Change existing business model or strategy

Source: The Economist Intelligence Unit.

### Chart 3: Help or a hindrance

#### Top 5 actions companies are taking to increase IoT usage

(Top responses)

- 1** Learning from the successes or failures of early movers
- 2** Seeking advice from third party experts/consultants
- 3** Training existing staff to work with the IoT
- 4** Hiring talent with IoT capabilities
- 5** Conducting or sponsoring research to establish market size/demand

#### Top 5 obstacles to companies increasing use of IoT

(Top responses)

- 1** Lack of employee skills/knowledge
- 2** Lack of senior management knowledge/commitment
- 3** Products or services do not have an obvious IoT element to them
- 4** Immaturity of industry standards around the IoT
- 5** High costs of required investment in IoT infrastructure

Source: The Economist Intelligence Unit.

vary from company to company. As a telecoms company and Internet service provider (ISP), with core competencies in networking and connectivity, BT is growing, developing and augmenting these skills internally, according to John Davies, chief researcher in the firm's corporate ICT research practice.

Most of the other steps that are being undertaken reflect the research stage that the majority of organisations are in. Companies are sponsoring market research and hiring consultants to make up for the lack of internal expertise and to obtain market-sizing information. This is especially true of construction and real-estate firms, as well as those in the consumer goods and retail industry. That said, the most popular "action" being undertaken by businesses, more so than any of the steps listed above, is to learn from the successes or failures of early movers.

### Cautiously optimistic

Together with cultivating or attracting the necessary talent, the next steps for companies that are beginning to make the transition to the planning stage will be to decide on the level of investment they wish to make in the IoT and where company resources should be allocated. For now, about one in four firms represented in the survey have yet to invest in the IoT, and around the same number have increased their investment by under 5% compared with 2012. The high cost of investment in IoT infrastructure is considered to be one of the top five obstacles to making use of the IoT.

This cautious approach to investment is equally true of companies that already have IoT products on the market, such as Belkin. A deliberate trickle of product releases is part of a plan to test market appetite. "We are trying to understand before we get in too deep, because once you are financially invested and committed you cease to become agile," says Mr Ashton. "Then you really have to start building on the thing you've already invested in."

use of the technology. A lack of knowledge and commitment among senior management is seen as another important obstacle.

Companies moving from research to the planning stage need employees who understand the technology underlying the IoT, such as wireless systems, networks and sensors. Once products are in development, sales and marketing employees will need to be able to sell the benefits of the IoT in terms that consumers can understand, and companies will require armies of "data scientists" to analyse all the sensor-generated information (explored below).

When it comes to filling these knowledge gaps, businesses are not sitting idly by. Some of the most common steps being undertaken by organisations to increase their use of the IoT are training existing staff in IoT-related skills and seeking to recruit talent with these aptitudes. This could lead to greater competition for IoT talent, although the extent of these skills gaps

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Only 9% of senior managers believe that the IoT will not change the way their company conducts its business in a meaningful way.

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*Economist Intelligence Unit survey, June 2013*

“You don’t need a lot of R&D, it’s more about integration. Everyone can build it [into their products]. It’s just a matter of finding a business model that works.”

”

*Honbo Zhou, board director, Qingdao Haier*

Generally speaking, the majority of senior executives (61%) feel that their governments should be doing more to support the development of the IoT. This is the majority view in all regions, although support is strongest in the Asia-Pacific region (67%) and weakest in North America (55%). “In the early stages of technology deployment it’s a charitable act really to explore a new technology because the return on investment isn’t there, it’s too expensive and it’s too unknown. That’s where government has a role,” says Mr Ashton.

Looking ahead, investment in the IoT should continue to increase as more and more senior executives move up the IoT learning curve. The survey results suggest that the more frequently executives meet to discuss the IoT, the more

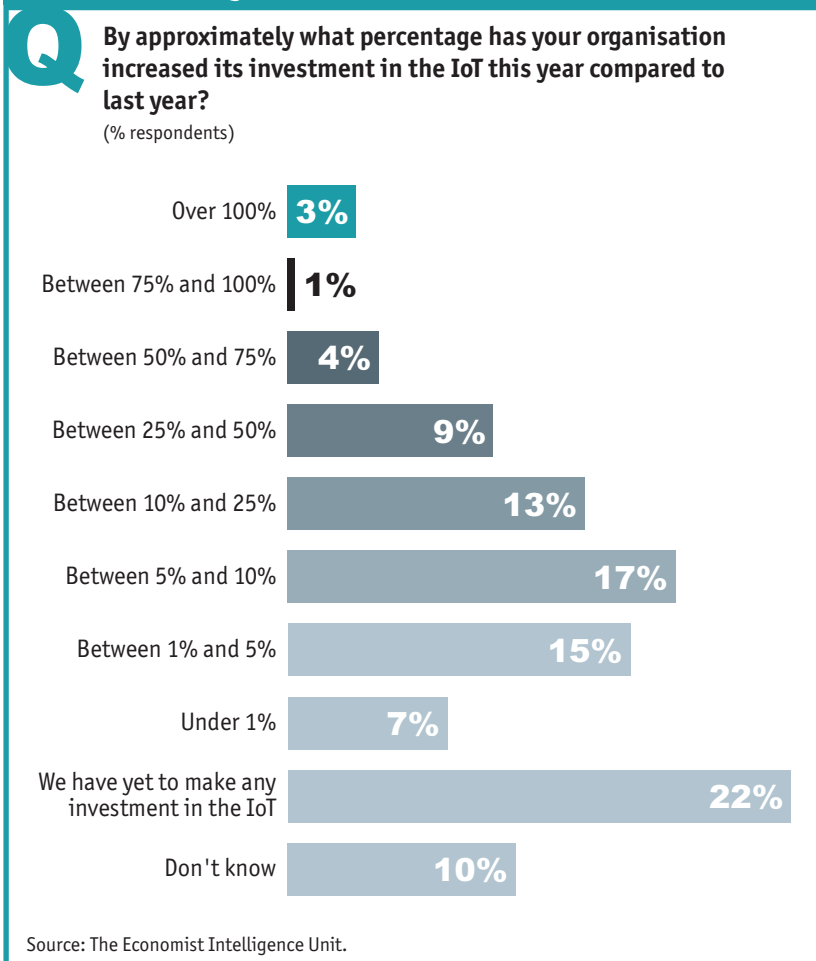
likely they are to see its potential impact on their business and the more optimistic their outlook for the IoT.

In addition, the costs associated with the IoT should continue to fall just like any nascent technology. Even now, some early adopters believe that the technology is already mature enough and cheap enough to make IoT products and services viable without the need for a big upfront investment, at least for initial trials. “You don’t need a lot of R&D, it’s more about integration,” says Honbo Zhou, a director of China’s Haier, the world’s largest manufacturer of white goods. “Everyone can build it [into their products]. It’s just a matter of finding a business model that works.”

Some companies will, of course, require more IoT investment than others. Likewise, every business will have unique opportunities and appetite for risk. The one consistency among these variables is that underinvestment in the IoT carries its own risks with it, too. More than three in five (61%) executives agree that companies that are slow to integrate the IoT will fall behind the competition—a position shared by William Ruh, vice-president of GE’s global software headquarters.

Nobody knew which business models would work during the first phase of the Internet, recalls Mr Ruh. If it was obvious, he says, everyone would have become an Amazon or Google. They did not because there were differing views about in which directions the technology was going to develop and what would be the most attractive business models. Mr Ruh contends that the situation is the same today, and it could take ten years before we know which business models work and which do not. “Of course, by then it will be too late [for late starters],” he says. “You can’t catch up.”

**Chart 4: Investing in the IoT**



“

You don't go to the end user and talk about the Internet of Things. You go to the end user to talk about benefits.

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*Kevin Ashton, general manager, Belkin*

## A different kind of revolution

Elgar Fleisch, the deputy dean of ETH Zürich, a science and technology university, believes that IoT adoption will be quite different from what he calls the “Internet of people revolution”. During the first phase of the Internet, he maintains, anyone with a good idea and a computer could start an organisation with global reach.

However, Mr Fleisch sees the initial advantage in the “IoT revolution” going mainly to bricks-and-mortar organisations, especially large firms with many assets to track and monitor. This means that we are unlikely to see another Facebook, Yahoo or eBay. “There will be winners and losers, but we are unlikely to see entirely new big players entering the market,” says Mr Fleisch.

Notwithstanding the significant involvement of the physical world of assets and products, the IoT is still expected to be a less visible revolution than the traditional Internet. PayPal, Groupon and YouTube are well-known Internet companies, yet few people are probably aware that the smart meter in their cellar means that their home is a part of the IoT.

The low level of consumer awareness of the IoT is of some concern to businesses: around two-thirds (65%) of survey respondents believe that it is depressing demand for IoT-related products and services. Still, as organisations move towards the “productisation” of the IoT, there are signs that business leaders recognise that this need not be a major hindrance: undeveloped consumer awareness is not seen as one of the top obstacles to organisations using the IoT.

After all, consumers will always want products and services that are better, cheaper, greener and more convenient. “Consumers are not going to demand the Internet of Things. Nobody is going to demand the underlying infrastructure,” says Kevin Ashton of Belkin. “They're going to demand some value and some benefit. They're going to demand a security system that they can control from their smartphone. You don't go to the end user and talk about the Internet of Things. You go to the end user to talk about benefits.”



## 3

## Connecting a cast of billions

<sup>4</sup> Evans, Dave. *The Internet of things: How the next evolution of the Internet is changing everything*. Cisco, April 2011.

Based on current estimates, the number of “things” predicted to be connected to the Internet by the end of this decade range from 30bn to 50bn.<sup>4</sup> But having connected things is the easy part. More difficult will be getting these things to communicate with each other—where human involvement is still necessary.

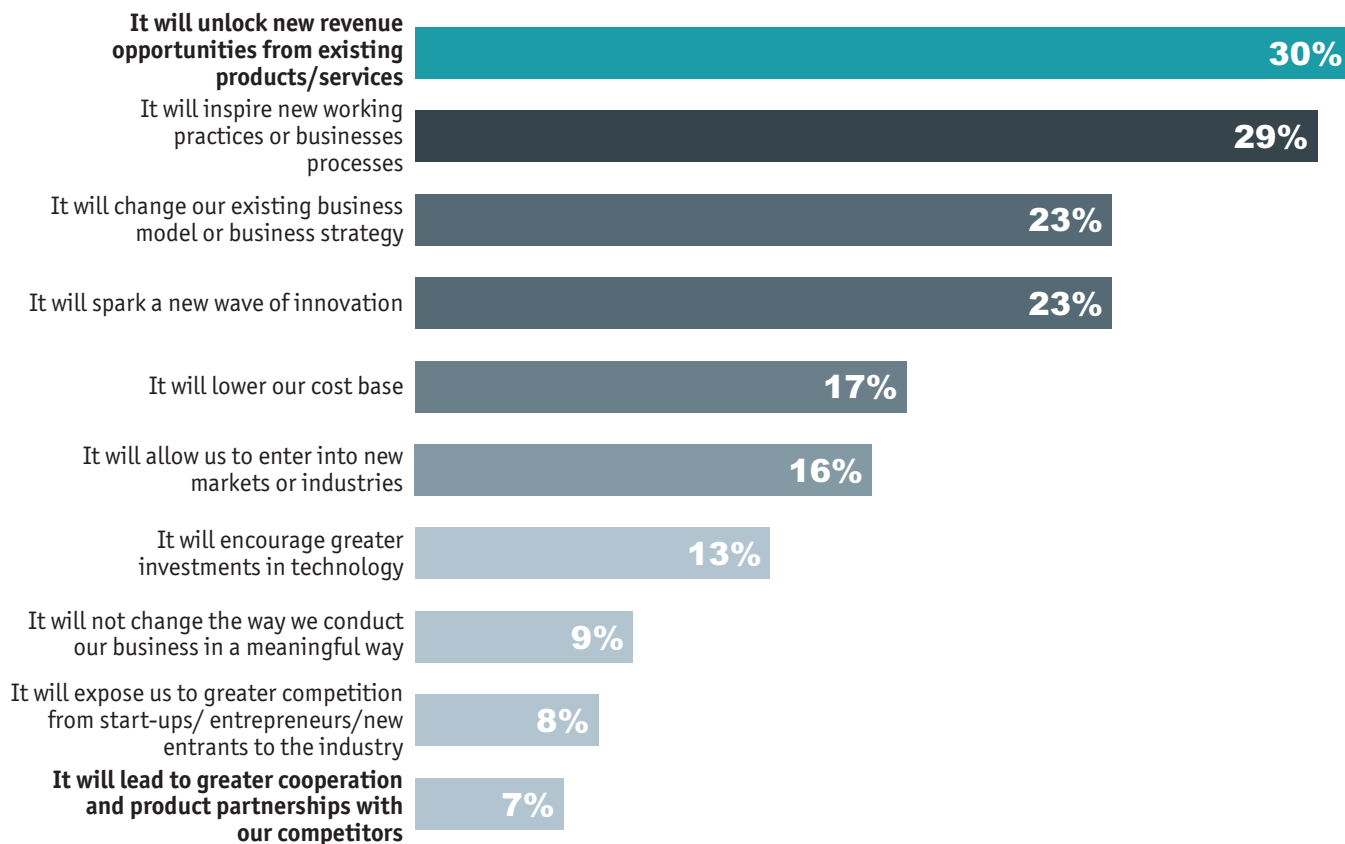
With the traditional Internet it was easy to “go it alone”. Voice over Internet protocol (VoIP) start-ups did not first sit down with telecommunications operators and work out how they would fit together in the ecosystem. By contrast, the IoT tends to follow Metcalfe’s Law, which says that the value of a network is

Chart 5: New toys over new friends



**How will the IoT change the way your company operates?**

(% of respondents)



Source: The Economist Intelligence Unit.

proportional to the square of the number of its users. Thus, a more co-operative approach than that shown in the past by telecoms and Internet companies will be required. Many users are needed to achieve the “network effects”.

To achieve these network effects, individual organisations have to show willingness. For the time being few executives believe that the IoT is likely to change the way that their organisation co-operates and partners with competitors, and so clearly a change in mindset is required. In outlining the challenge of getting different organisations to co-operate, Mr Ashton makes another distinction between the Internet and the IoT.

The rollout of the traditional Internet happened relatively quickly, he says. Companies were provided with a system that could interoperate

before they had invested too heavily in systems that could not. Since then companies have built up their own networks, with considerable investment, and so the challenge is to convince them to see the benefits in a common network.

A simple example of one of these “walled gardens”, according to Mr Ashton, is employee office passes or ID badges, many of which are fitted with radio-frequency identification (RFID) tags. Swiping an ID card will get an employee into his or her workplace, but he will still have to fill out a form or wear an identity sticker when visiting a different office building. A common network between landlords could eliminate this inefficiency as well as create a much richer data set on employee whereabouts. “What we have right now is a lot of IoT-type technology that is heavy on things and light on Internet. That’s the bit that needs to change,” he says.

## Case study: Driving towards common standards

Vehicle standards for safety and emissions differ widely from one region to another. “Car manufacturers cannot develop one car and sell it across the world,” says Filip Sergeys, head of intelligent transport systems (ITS) government relations and regulations at Honda Motor Europe. “We have to develop a specific vehicle type for each region.” Now, the IoT is offering the automotive industry and government transport departments the opportunity to create global standards for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, with the aim of reducing accidents and traffic congestion. It is still early days, but the progress so far looks promising.

In 2002 car manufacturers established the Car 2 Car Communication Consortium with the aim of creating open European standards for V2V and V2I communication. The consortium with its 60 members, consisting of car manufacturers, suppliers and research institutes, is now close to finalising the messaging standard, named the Co operative Awareness Message (CAM), which allows vehicles to speak the same ‘language’.

Efforts to harmonise standards are also

proceeding in other regions of the world. For example, the European Commission’s Directorate-General for Communications Networks, Content & Technology (“DG Connect”) is working with the US Department of Transport to bring the European CAM standard closer to the US Basic Safety Message (BSM) standard. Although the standards will not be identical, they will be close enough to make it feasible to use a single hardware platform for both. Honda has also been actively pushing to use the European standards in Japan. “It won’t be a global standard, but it will at least cover the three major automotive markets,” says Mr Sergeys.

Although the automotive industry is leading the effort to create harmonised IoT standards, government departments—including DG Connect, the US transport department and the Japanese Ministry of Land, Infrastructure, Transport and Tourism—are also playing a crucial role. “The efforts by the authorities to push this have been very instrumental and very helpful,” says Mr Sergeys.

“  
We cannot afford to end up with lots of different systems that can't communicate with each other.

”

*David Bott, director of innovation programmes, Technology Strategy Board*

The automotive industry, for one, is working closely to make intelligent transport systems a reality (see case study). If you have just a few cars equipped with WiFi, talking to other cars—to avoid collisions, for example—then it is not much benefit if the cars around you do not have the same technology. “We are trying to get a very quick market penetration so that a lot of vehicles are rapidly equipped,” says Mr Sergeys of Honda. “It means we need to work closely with other car manufacturers. We need to quickly achieve a minimum critical mass so that the [intelligent transport] system performs properly.”

Much of the collaboration under way within industry verticals is around standards, such as information-exchange protocols. According to Elgar Fleisch, the deputy dean of ETH Zürich, there is an extensive standardisation effort going on. “The main impact of standardisation is that every computer can talk to every other computer, and every thing can talk to every other thing,” he says. “That dramatically reduces the cost of making things smart. The IoT will not fly if we don't have these standards.” As confirmation of this, survey respondents list the immaturity of IoT industry standards as one of the top five obstacles that are currently holding back greater adoption of the IoT.

### Interoperability across industries

The full potential of the IoT will be unlocked when small networks of connected things, from cars to employee IDs, become one big network of connected things extending across industries and organisations. Since many of the business models to emerge from the IoT will involve the sale of data, an important element of this will be the free flow of information across the network. Ms Brandt of Ctrl-Shift envisages the IoT becoming one big trading system for data. The question, she says, is how those data can be traded across the whole ecosystem.

Governments are playing a facilitating role here. Earlier this year, for example, the UK government's innovation agency, the Technology Strategy Board (TSB), began funding a year-

long pilot project whereby eight groups or clusters work in different areas of the IoT. The constituents of each cluster bring together businesses, so-called smart cities, universities, business schools, consultants and local governments. BT, the University of Cambridge and Ctrl-Shift, among others, make up one of these clusters working on a project called STRIDE.

The aim of STRIDE is to create a smart transport and logistics ecosystem in the east of England, linking drivers who are having traffic difficulties to developers looking to turn those traffic data into new applications to predict journey time, traffic incidents and driver behaviour. At the heart of the cluster, BT is acting as an information broker. It has set up a hub that acts as a trusted and commercial framework for data gathering and sharing.

This kind of interoperability is at the heart of the TSB's vision. Each of the eight clusters is expected to participate in this mass exchange of data. “As a society, we cannot afford to end up with lots of different systems that can't communicate with each other,” says David Bott, a director at the TSB. But the purpose of projects such as STRIDE is not just to develop the technology capabilities for interoperability; an equally important part is to explore the commercial opportunities emerging out of the IoT.

This is where the role of Ctrl-Shift comes in: to develop a business case for data sharing, redefine business models and create new ways of generating money. “We're looking at how standard commercial terms and conditions for the controlled sharing and use of data could be devised to support a sustainable future market for the Internet of Things,” says Ms Brandt. “If we start to get to the point where every single bit of data has a different set of terms and conditions, that's going to be very slow and possibly unsustainable in the market where every single app developer has to negotiate their own terms and conditions.”

“

There is this very simple equation that we've learnt. People will use a technology if the perceived benefit is larger than the perceived risk.

”

*Elgar Fleisch, deputy dean,  
ETH Zürich*

### Big data, big privacy issues

Data are thus a fundamental component of the IoT's future. Fitting sensors to a potentially infinite number of “things” will generate untold amounts of new information. For now, however, most business leaders are confident that their organisations will be able to manage and analyse the data flowing from the predicted rapid expansion in IoT networks.

“Honda handles terabytes of data stored in databases for 1.4m users from our floating car data system on the Japanese market,” says Mr Sergeys. “With the further growth of the Internet of things—linked to Honda vehicles—we do not see any major challenge given our ten years of experience with managing big data.”

The development of cloud storage is an important resource in this respect, owing to its wide availability and scalability. Today, many third parties, including Amazon and GE, provide cloud services for managing big data. Honda, like many companies, stores its data in the cloud. Yet storage is only one data challenge. Being able to analyse and make use of those data is ultimately more critical. Mr Fleisch believes that most companies underestimate the skills they need to deal properly with even structured big data.

“It is not so much about big data infrastructure; it's more about having data scientists that have a clue about computer science, statistics and business,” he says.

The challenge of ensuring data protection and privacy also looms large. Although the survey respondents are fairly sanguine about their ability to manage big data, they are more alert to concerns about data privacy: three in five respondents (60%) agree that lack of trust and concerns about data privacy are hampering consumer uptake of the IoT. Mr Sergeys says that privacy is a “very big issue” when it comes to ITS, but finding or developing the perfect concepts for absolute data protection, privacy and security is probably not feasible.

The solution will be finding an acceptable balance that does not slow the system down to the extent that it becomes unworkable. This is a challenge for organisations, but one that is surmountable. “There is this very simple equation that we've learnt,” says Mr Fleisch. “People will use a technology if the perceived benefit is larger than the perceived risk. As long as the perceived benefit is bigger, people don't worry as much about the risks.”

# Conclusion

The quiet revolution is taking shape. Businesses across the world are piloting the use of the IoT to improve their internal operations and are preparing a stream of IoT-related products and services. Consumers might not recognise them as such, but that will not stop them from being launched, as few end users need to know that user-based car insurance, for example, is an IoT-based application.

Yet some important unknowns remain. Nobody knows what the winning business models are going to be. Even seasoned management consultants will struggle to provide definitive answers. It is a matter of experimenting with different models to see which ones work. The main message for latecomers and doubters is to consider the opportunities offered by the IoT—if nothing else for improving internal operations: the vast majority of survey respondents agree that companies that are slow to integrate the IoT risk falling behind the competition.

The indications of this survey are that companies are preparing for the IoT, conducting research, identifying knowledge gaps and taking steps to fill skills shortfalls through training and hiring. Governments are being urged to do more to promote IoT development and adoption. The next step for business leaders is to decide what IoT commitments and investments they are ready to make, and where.

This is not a race that organisations need enter alone: the “business as an ecosystem” analogy has never been more apt. The value of IoT products and services will grow as more people use them (according to Metcalfe’s Law). Expect, therefore, to see several firms banding together for “big bang” launches of IoT products and services; an example is the automotive sector, where the launch of ITS is imminent.

Looking ahead, the potential financial returns from its “productisation” are arguably the biggest incentive for businesses to move ahead with the IoT. Fitting sensors to existing products can result in new revenue streams and feedback into a virtuous circle of better client service and enhanced product development. Innovation will follow from new IoT-based products that are yet to be conceived. The most exciting possibilities, perhaps, will emerge from the insight provided by the amount of new data being generated, captured and analysed and the value that is generated from such information. Connecting 50bn smart things together is going to make the business of “big data” a whole lot bigger.

# Appendix 1

## Index methodology

The Internet of Things business index is based on an online survey conducted by The Economist Intelligence Unit in June 2013. (See Appendix 2 for survey details.) The index scores are generated from the responses to two questions in the survey:

- To what extent is your organisation using, or planning to use, the IoT in its products or services (e.g. embedding sensors in products, developing services utilising data generated by IoT technology)?
- To what extent is your organisation using, or planning to use, the IoT in its internal operations (e.g. to reduce energy consumption, monitor status of plant and equipment)?

The response options to each question are: non-existent; in research; in planning; early implementation; and extensive. Each response

option is assigned a score ranging from 1 (non-existent) to 5 (extensive). The responses to the questions are fed into a model which converts the scores—for the entire sample and for each regional and industry sub-sample—to a 1-10 scale, where:

1-2 = non-existent (or virtually non-existent)

3-4 = in research

5-6 = in planning

7-8 = early implementation

9-10 = extensive

Scores lying between these levels (for example, 2.5) indicate that businesses in the relevant sample or sub-sample are transitioning from one stage to another. ■

# Appendix 2

## Survey results

In June 2013 The Economist Intelligence Unit conducted a global survey of 779 executives. Our sincere thanks go to all those who took part in the survey.

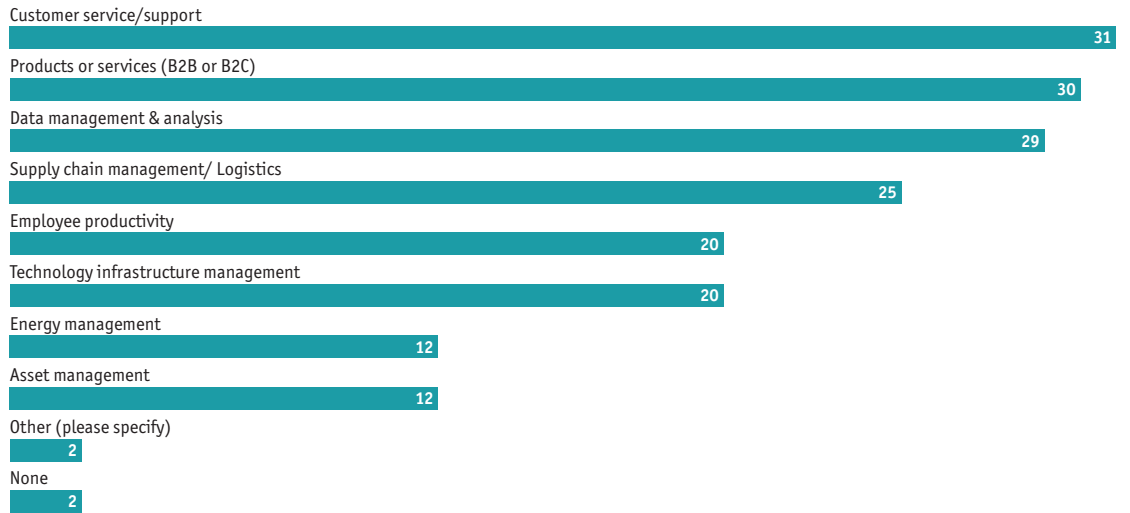
Please note that not all answers add up to 100%, either because of rounding or because respondents were able to provide multiple answers to some questions.

**What impact is the IoT likely to have on business in general over the next three years?** Select one of the following statements, which best characterises your view  
(% respondents)



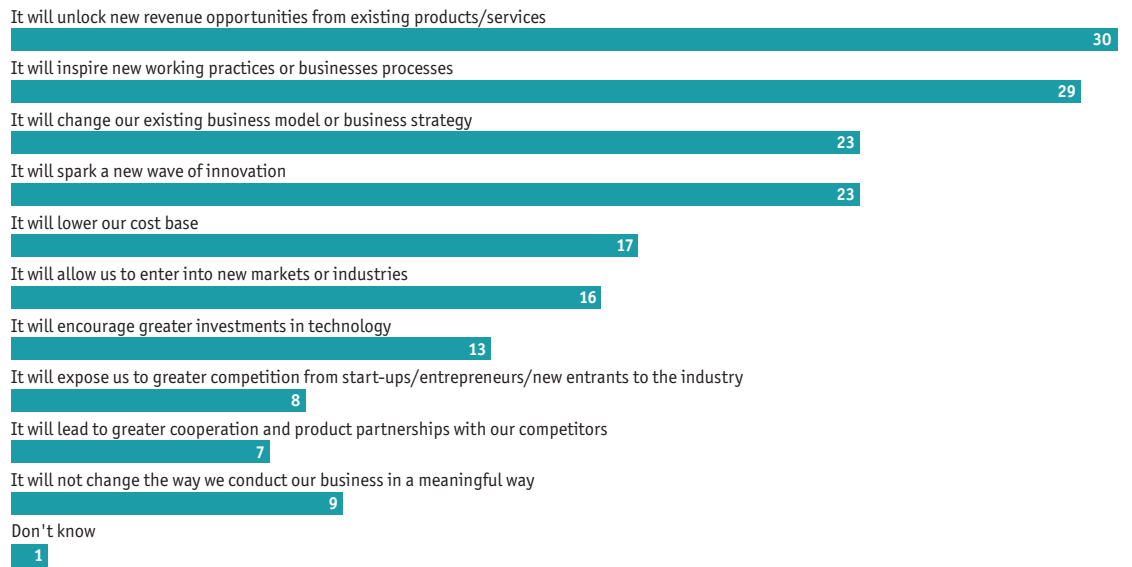
**Which parts of your business are likely to see the biggest positive change from the IoT over the next three years?**

Select up to two  
(% respondents)



**In what ways do you think the IoT is most likely to change how your organisation conducts its business over the next three years?**

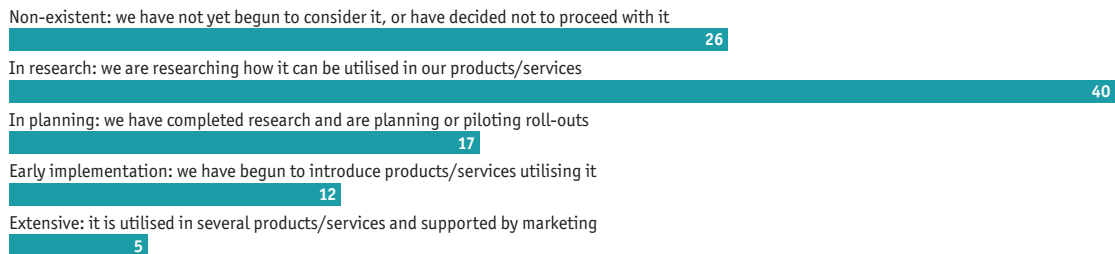
Select up to two  
(% respondents)





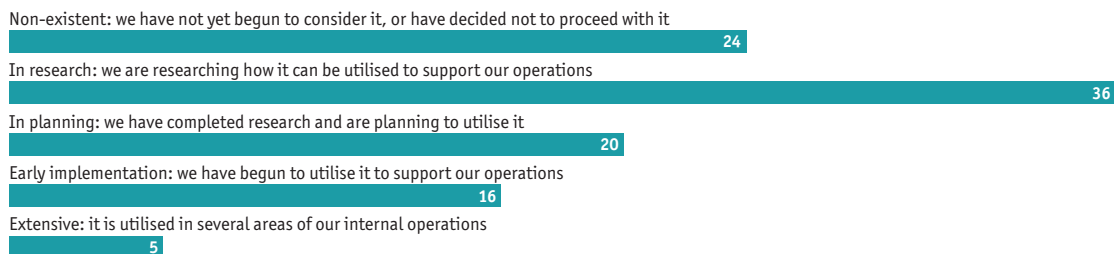
**To what extent is your organisation using, or planning to use, the IoT in its products or services (eg, embedding sensors in products, developing services utilising data generated by IoT technology)?**

(% respondents)



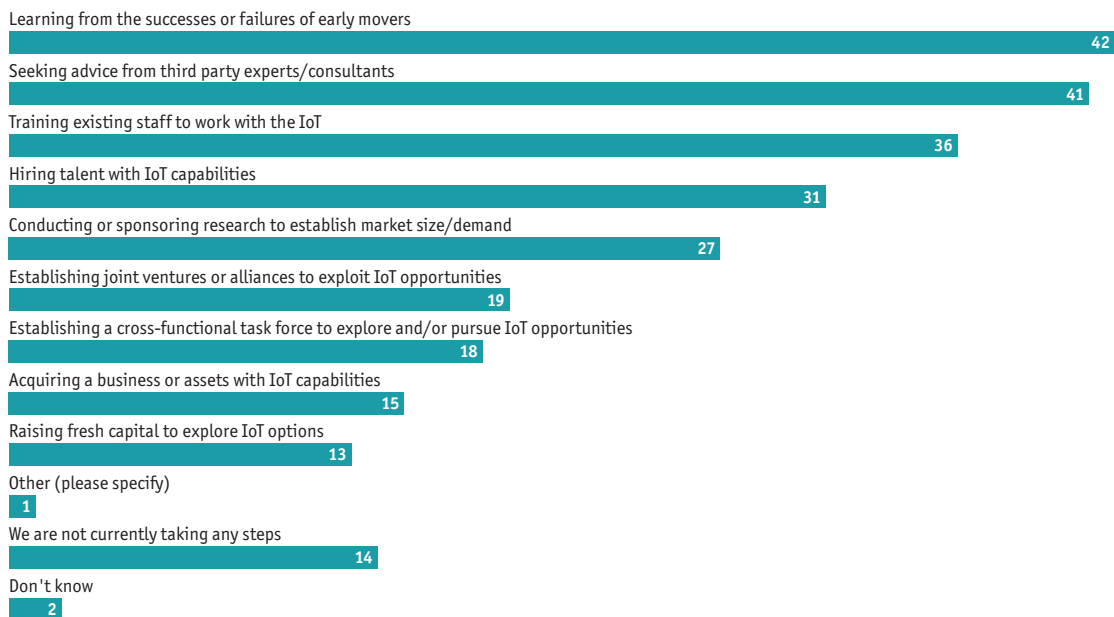
**To what extent is your organisation using, or planning to use, the IoT in its internal operations (eg, to reduce energy consumption, monitor status of plant and equipment)?**

(% respondents)

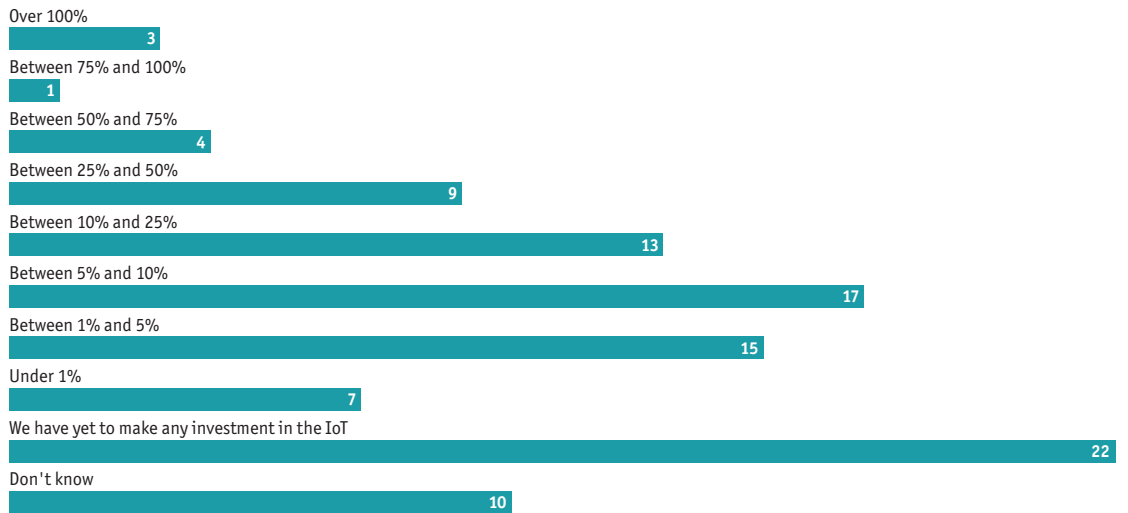


**What steps is your organisation taking, or planning to take, to use the IoT more extensively in the business (either in products/services or internal operations)? Select all that apply**

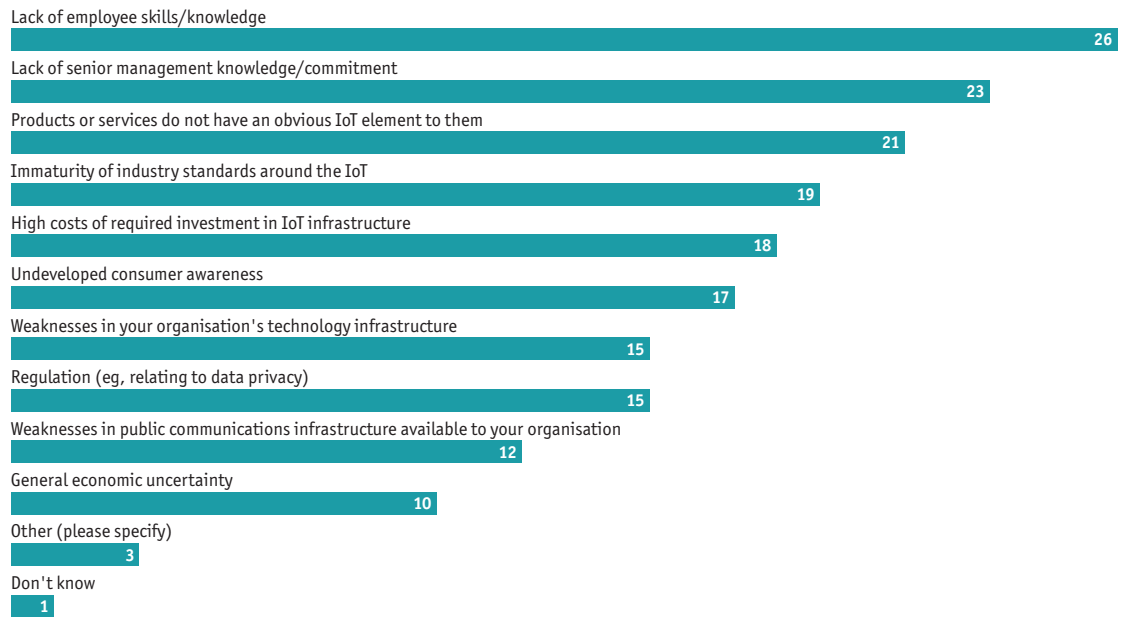
(% respondents)



**By approximately what percentage has your organisation increased its investment in the IoT this year compared to last year?**  
(% respondents)



**What are the chief obstacles to your organisation using the IoT? Select up to two**  
(% respondents)



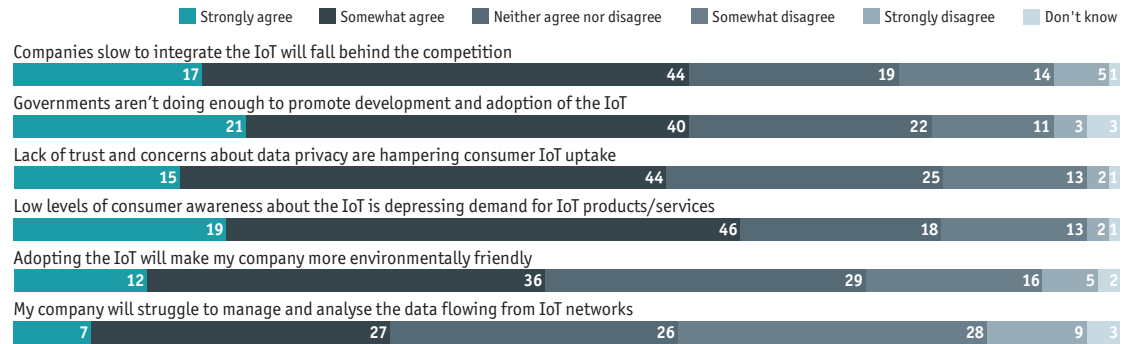
**Three years from now, how relevant do you expect the IoT to be to your overall organisation?**

(% respondents)



**To what extent do you agree or disagree with the following?**

(% respondents)



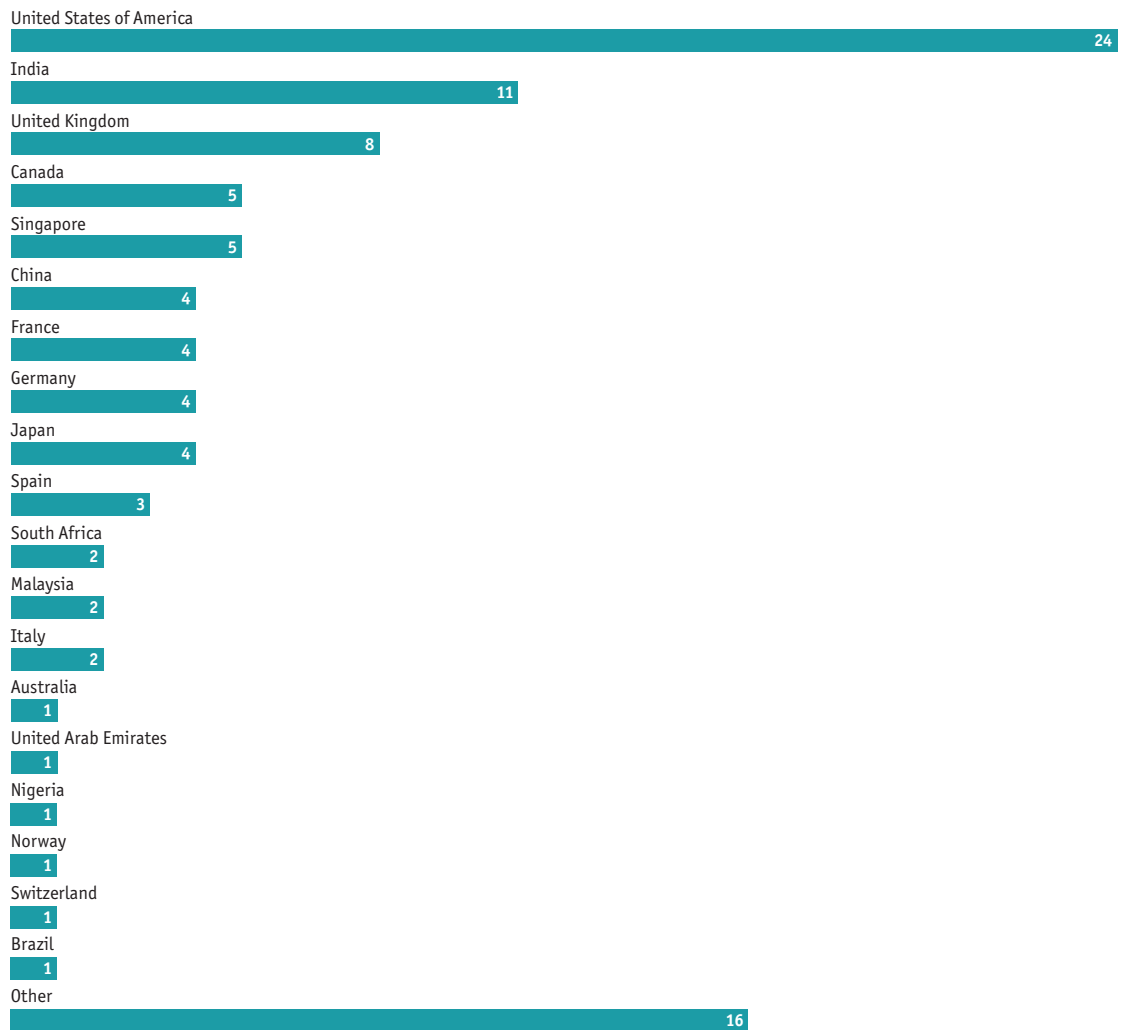
**Roughly how often are you involved in a formal conversation or structured meeting about the IoT at your organisation?**

(% respondents)



**Where are you personally located?**

(% respondents)

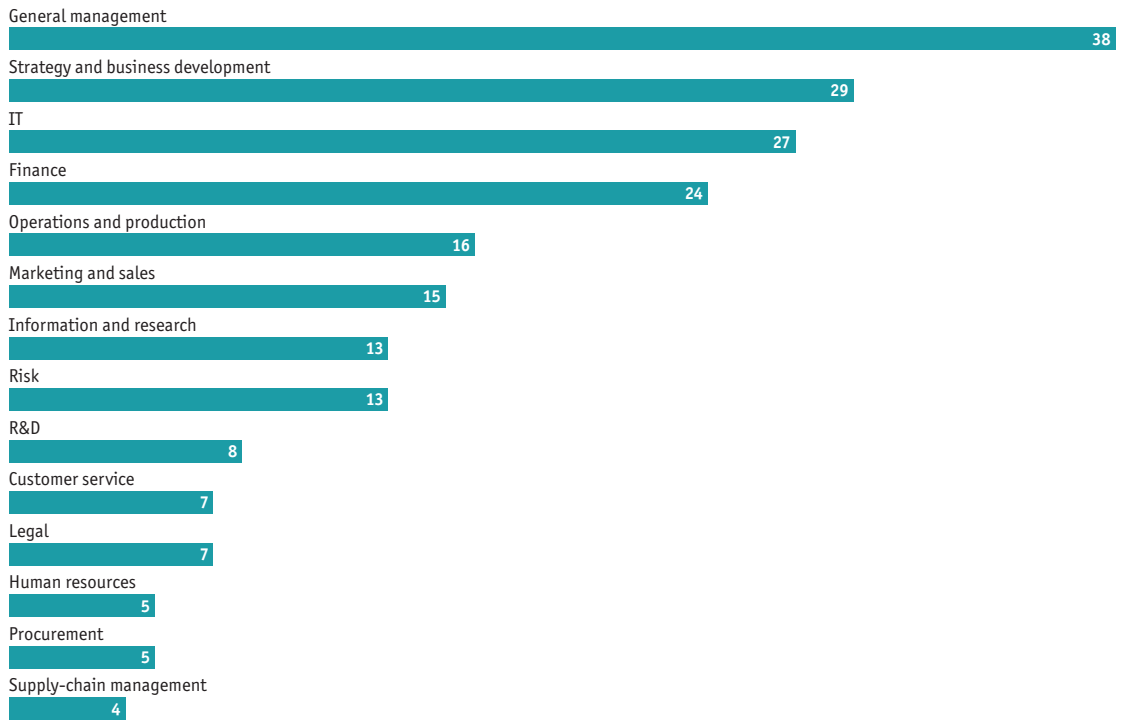


**In which region are you personally located?**

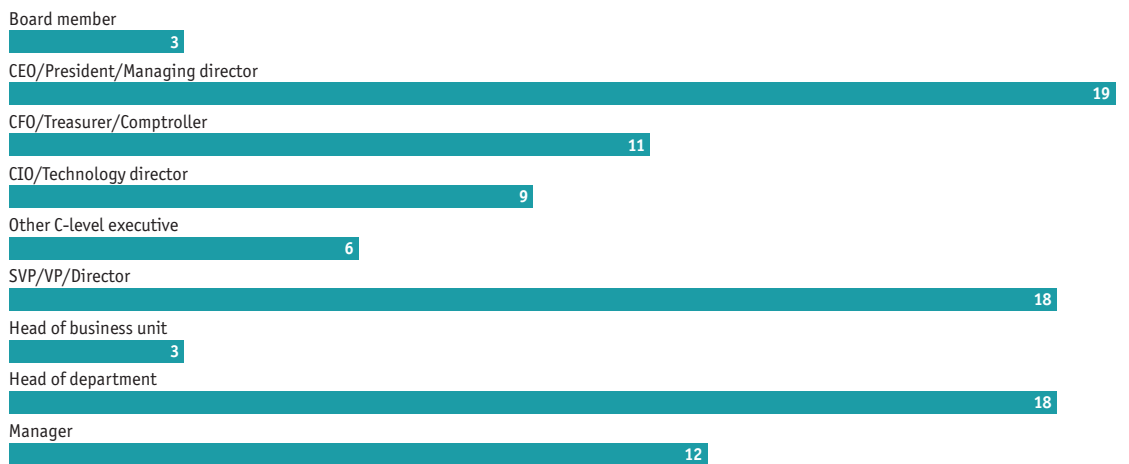
(% respondents)



**What are your main functional roles?** Select all that apply  
(% respondents)

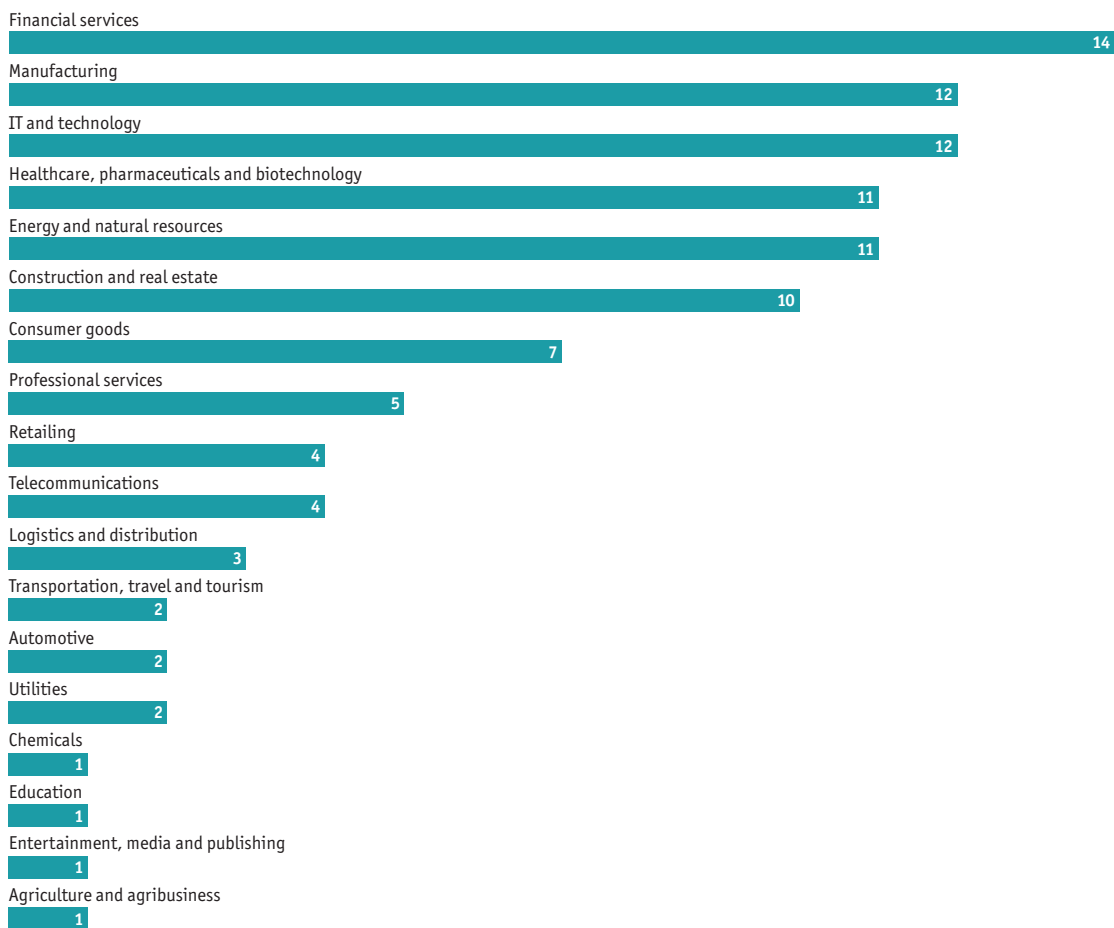


**Which of the following best describes your title?**  
(% respondents)



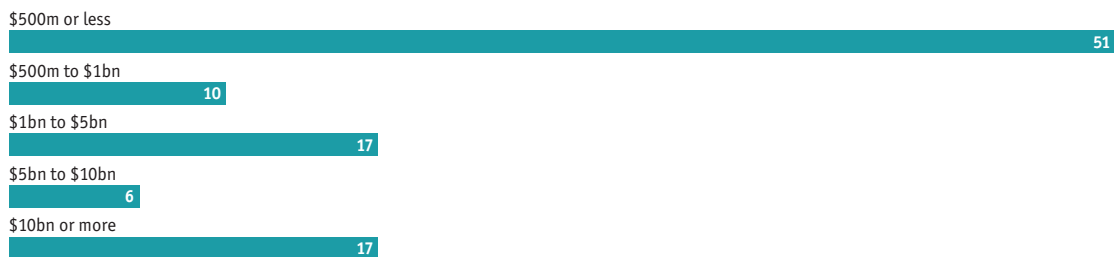
**What is the primary industry your organisation is in?**

(% respondents)



**What is your organisation's annual global revenue in US dollars?** Please select the most appropriate option if your company does not report revenue in US dollars.

(% respondents)



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