Internet of Things World Asia

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IoT VIEWPOINTS

Ovum explores the IoT opportunity in 2018 and beyond

Welcome to the future of the Internet of Things. IoT Viewpoints 2018 is a collection of Ovum's newest thought leadership on emerging IoT trends, technologies and opportunities.

From smart cities to autonomous vehicles, from precision agriculture to usage-based insurance, the IoT has the potential to drive improved efficiency, deliver new revenue streams, support sustainability and enhance customer experience.

Enabling technologies - including low-power wide area networks, 5G, blockchain and AI -are accelerating momentum and increasing the opportunities to leverage IoT data for business and social benefit.

At the same time, providers and enterprises must tread carefully as they build sustainable positions in the IoT value chain. Security and data privacy concerns are becoming more pressing, as the reach of the IoT extends. Identifying the right IoT technologies, verticals and partners is critical, but not always straightforward. Transformational IoT business models offer great promise, but also the possibility of significant disruption.

Ovum's research and consulting services provide a wealth of IoT market and technology knowledge to support our clients. Our 30-year history at the center of the ICT market gives us a unique perspective on IoT developments. Our core data and objective analysis are key ingredients in building market-leading strategies. Ovum's experienced analysts and consultants work in partnership with our clients to chart the road to IoT success, supported by insights from across Ovum and the wider Informa Group.

We hope the insights presented here will inform your decisions, challenge your thinking, and inspire you to look at market opportunities in a new light. As always, we welcome your feedback, questions, and ideas on how Ovum can further support your success in the IoT world, and beyond.

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Exploring Enterprise IoT Drivers, Challenges, and Spend

Ovum's IoT Survey

To understand what is driving take-up of IoT solutions and applications, it is critical to understand the attitude and intentions of enterprise end users. To this end, Ovum recently conducted a 14-country survey of enterprises that are already deploying or in the process of rolling out IoT solutions. The objective was to examine IoT deployment trends, drivers and challenges, use cases, investment, and technology and provider choices.

Ovum view

Our survey findings clearly show that IoT adoption is still in the early stages for most enterprises. Fragmentation and immaturity characterize the market. Given the current state of the market, providers must consider who to approach within the organization and be ready to engage in education about IoT solutions, use cases, and benefits – it is not just about introducing new technologies to the IT department.

Regional differences are significant in some cases, from technology choices to organizational goals and challenges. But many drivers for IoT are universal – organizations are looking for cost savings, greater efficiency, and improved competitiveness in the first instance, with sustainability or new revenue growth goals further away for most.

Top IoT challenges cover a wide range of issues, from integration with existing IT and security concerns, to worries over in-house skillsets to support sustainable and scalable IoT deployments. These are not minor concerns, and providers should work to help their customers meet these challenges head-on if they wish to see successful and growing IoT deployments.

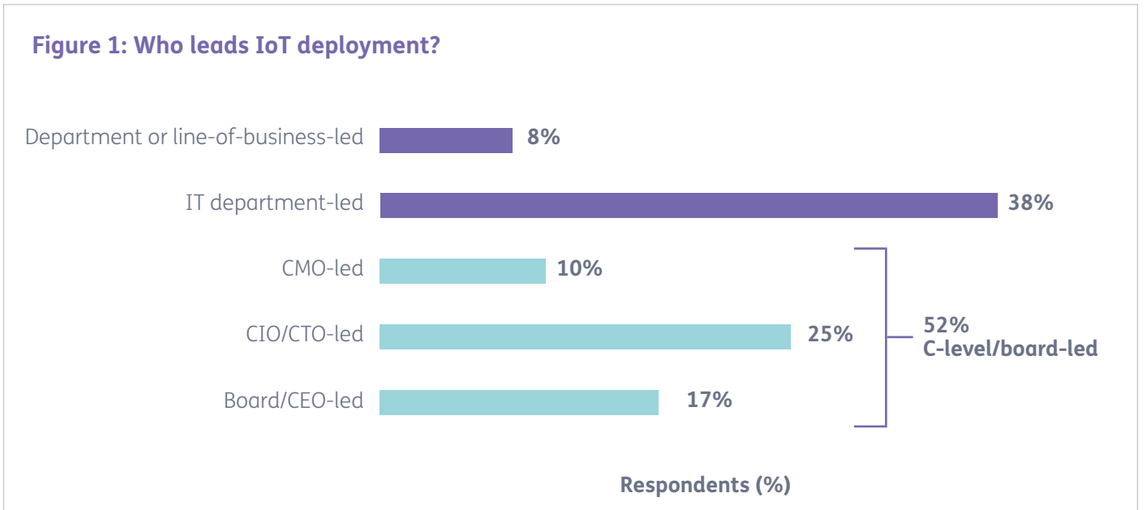
Providers should be ready to start small and to meet customers where they are. A quick deployment and targeted 'just do it' approach to IoT will work better than trying to promote broader strategic approaches, though these can be a useful framework for a longer-term vision.

Most respondents report seeing measurable benefits from IoT deployments in fewer than 12 months; helping customers understand the best KPIs to measure and demonstrate IoT success can help drive further investment. Entering into IoT project discussions armed with this information can maximize the chances of a successful outcome for all parties.

IoT leadership starts at the top

A decision to deploy IoT typically involves multiple stakeholders. Our survey results show that while the IT department is an important stakeholder, enterprise board/C-level leaders are the driving force behind 52% of IoT deployments. IoT suppliers must ensure their pitch is understood by senior leaders, which may require more focus on business benefits and less on the IoT technology. To further boost chances of winning a deal, IoT suppliers must also secure buy-in from the head of IT.

Figure 1: Who leads IoT deployment?



Source: Ovum IoT Enterprise Survey, 2017-18

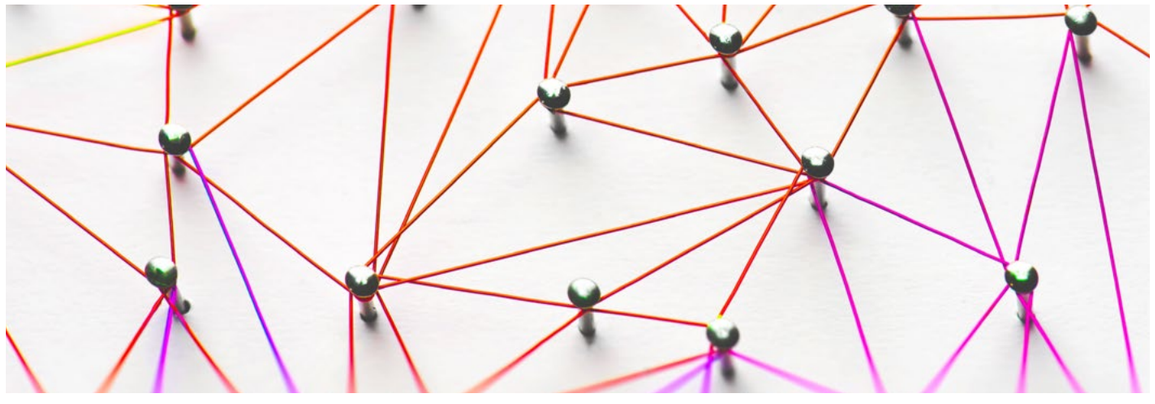
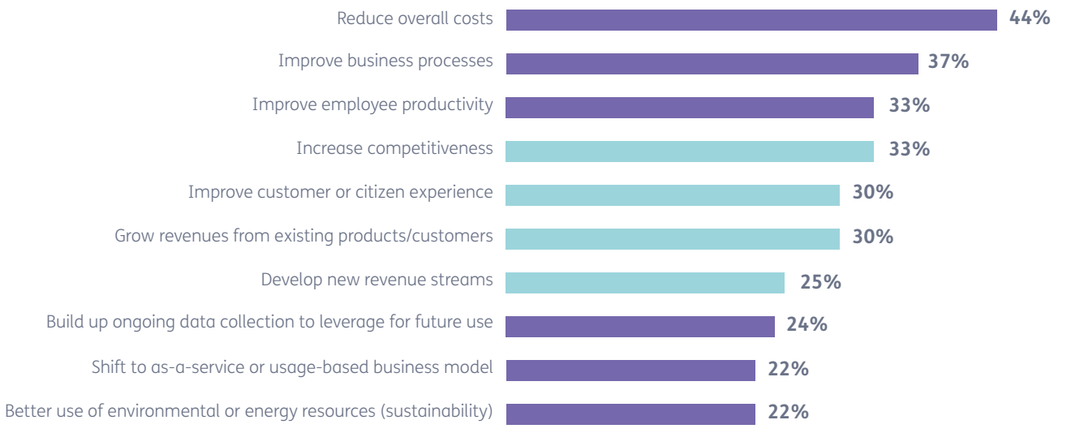


Figure 2: Main goals of enterprise IoT projects



n=1,343

Percentages indicate % of enterprise respondents selecting goal as one of their top 3. Multiple response question.

Source: Ovum IoT Enterprise Survey, 2017-18

Key drivers link to cost reduction, efficiency, and competitiveness

Reducing costs and improving business processes are the top IoT drivers, but a solid one-third of respondents also placed high priority on using IoT to improve competitiveness or customer experience.

As one manufacturer told us:

"The biggest thing for us, to be honest, is customer satisfaction, which is really driving us as a differentiator. We think deploying this technology can move us up the value chain with customers."

In this particular case, the manufacturer is using sensor-enabled technology to track the progress and performance of a cleaning device moving through an oil pipeline – a purely B2B application and not what one would think of as a typical use case for improving customer satisfaction. But the IoT data generated by the connected device is being used to understand many other elements besides simply its speed of progress and location. These are then analyzed and fed back to both customer service and sales teams to enable greater insight, more effective service, and a stickier customer relationship.

Building new revenue streams from IoT was important to a minority of enterprise deployers, along with longer-term goals such as sustainability. These goals are still further out for most enterprises, though they play a role in strategic decision-making on IoT deployment.

The key drivers are reflected in the KPIs used by enterprises to measure successful IoT deployments; almost half of enterprises surveyed use productivity and cost savings data as their top KPIs. Enterprises were likeliest to report measurable benefits linked to efficiency or productivity gains, greater asset/performance insights, cost savings, and improved customer satisfaction.

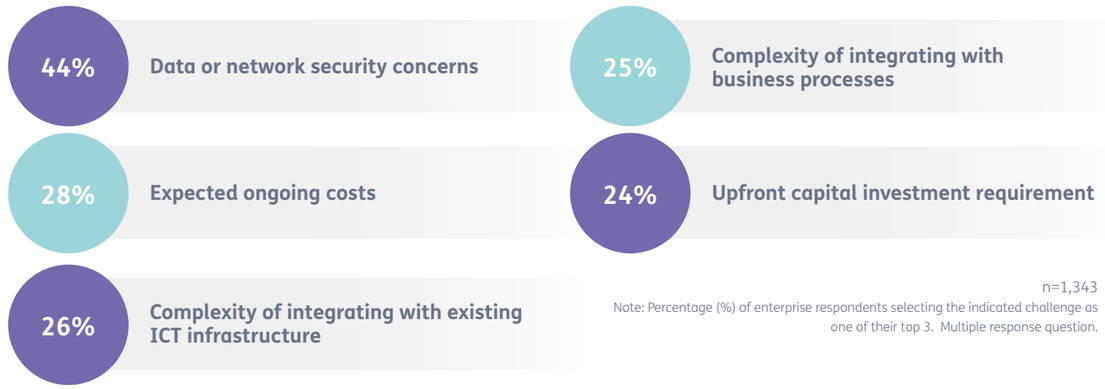
Challenges center on security, costs, and integration

It was not a big surprise to see data and network security concerns topping the list of IoT challenges that enterprises face (see Figure 3). The ongoing cost of sustaining IoT projects is also a key concern for enterprises. Organizations also face headaches over the complexity of integrating IoT with their existing ICT infrastructure and existing business processes.

Project size and spend start small, but will increase rapidly

We asked respondents about the number of connections/devices they were deploying for their IoT projects at the time of the survey, and how that will change in the future, in order to get a better picture of IoT project scale. Figure 4 shows that as of 2H17, 56% of enterprise IoT projects involve deployment of fewer than 500 connections/devices. At the other end of the scale, just 7% of

Figure 3: What are the biggest specific challenges to successful IoT adoption?



n=1,343

Note: Percentage (%) of enterprise respondents selecting the indicated challenge as one of their top 3. Multiple response question.

Source: Ovum IoT Enterprise Survey, 2017-18

enterprises surveyed had IoT deployments with 10,000+ connections/devices.In the next 12 months, the size of enterprise IoT projects will shift up; 60% of enterprises surveyed expect their projects to support 500–9,999 connections/devices in 2018. China will lead on larger IoT deployments with 38% of Chinese enterprises planning 1,000-9,999 connections/devices, followed by 26% of enterprises in France and in South Korea.

IoT spend is still low. In 2017, 71% of the enterprises surveyed invested less than $500,000 in IoT. In nearly all countries, the largest percentage were investing in the sub-$250,000 range. The clear exception was China, where 53% of enterprises fell into the higher $250,000–$500,000 investment band. Germany led in the $5m+ investment category, with 5% of German enterprise respondents investing at this level.

In tandem with the planned increase in the number of IoT connections/devices that enterprises plan to deploy, enterprises also intend to grow their IoT investments in 2018. A total of 29% of enterprise IoT adopters will spend $1m+ on IoT in 2018, up from 12% in 2017. German enterprises are the most optimistic with 38% of those surveyed planning for $1m+ spend on IoT in 2018, followed by South African enterprises with 35%.

To help enterprises make the most of their planned increased spending on IoT, providers will need a full understanding of the most relevant IoT use cases, technologies, and business models.

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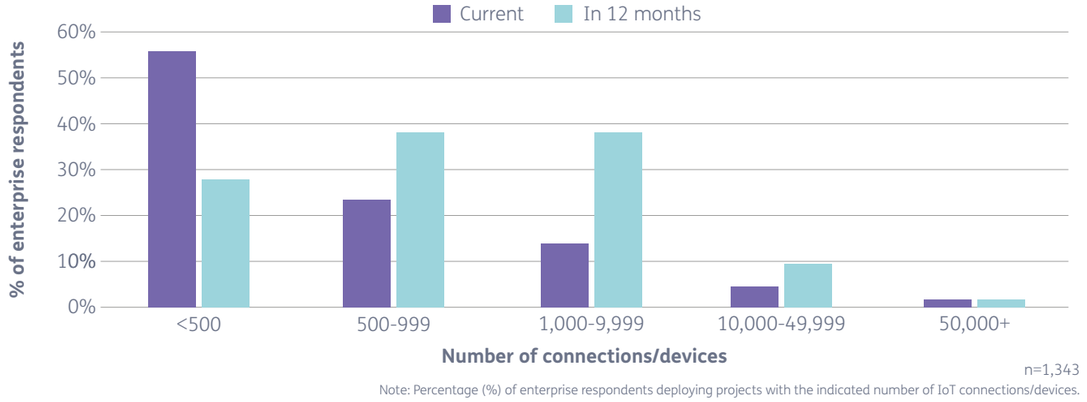
Figure 4: Number of devices or connections in IoT deployments, current and planned



n=1,343

Note: Percentage (%) of enterprise respondents deploying projects with the indicated number of IoT connections/devices.

Source: Ovum IoT Enterprise Survey, 2017-18

SCALE AND VERTICAL SPECIALIZATION ARE KEY TO CSP IOT SUCCESS

Together, the top 10 communication service providers (CSPs) accounted for 500 million IoT (cellular M2M and licensed spectrum LPWAN) connections at the end of 2017. This select group of CSPs has been successful in part due to their scale, with most offering a global, robust, and reliable horizontal platform and connectivity play that provides volume-based success.

A second key factor is their ability to pick the right IoT verticals to target with end-to-end solutions. While the automotive sector remains important for CSPs, in 2017, the verticals which yielded the most CSP IoT contracts were smart cities, fleet and logistics, and asset tracking. Going forward, we also expect to see an increased interest in industrial IoT, both because of the clear cost-benefit case and also due to its potential to drive forward 5G use cases.

A handful of CSPs dominate the IoT connectivity market

The IoT/M2M connectivity market is dominated by 10 key connectivity players who have been consistent market leaders over recent years, as shown in Figure 1. Scale matters, and the leaders are operators in large geographic markets such as China and the US (operators from these markets account for five of the world's top 10), as well as operator groups covering multiple territories (who make up the other half of the top 10). The three Chinese operators (China Mobile, China Unicom, and China Telecom), together with Vodafone and AT&T, lead the pack.

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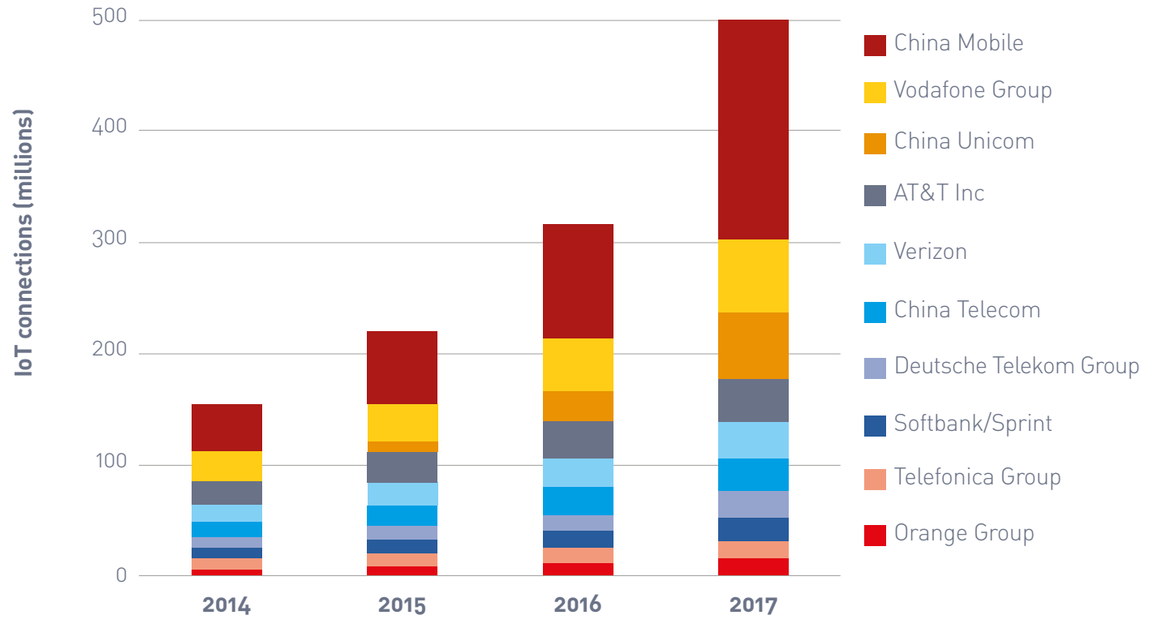
Figure 1: IoT connections for the top 10 CSPs, 2014–17



Note: Connections include both cellular M2M and licensed spectrum LPWAN

Source: Ovum estimates, company reports

LPWAN begins to impact CSP IoT metrics

Most telcos are using still cellular M2M technology to connect the majority of their IoT devices. However, as more and more CSPs roll out licensed spectrum LPWA networks (NB-IoT and LTE-M), we are increasingly seeing operators move to reporting combined 'IoT connections' as a metric, which generally includes both cellular M2M and LPWAN technologies.

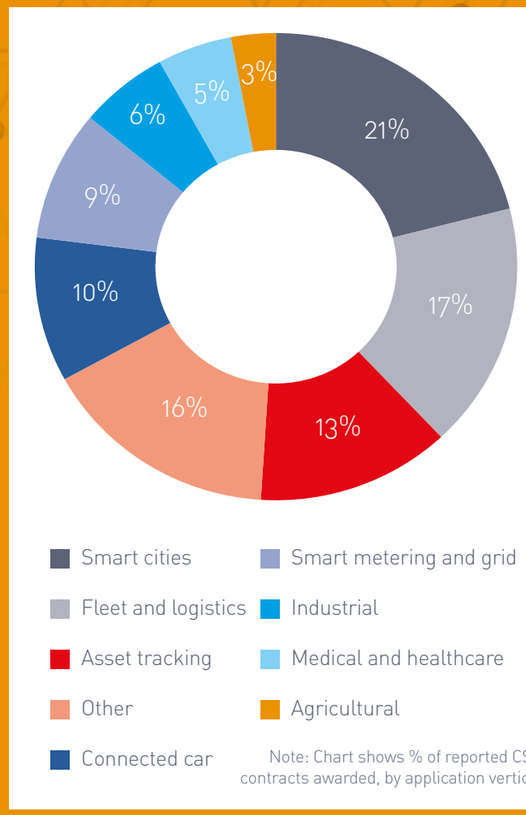
For most operators, LPWAN still does not have a significant impact on reported totals, as commercial rollouts are still in these early stages. The exception to this is China, which has seen rapid growth of NB-IoT network deployments over the past 12 months. While NB-IoT take-up in China is still small compared to the overall M2M connections base, we estimate that it reached around 10 million connections by the end of 2017, helping to fuel a 120% year-on-year IoT connection growth in China. The Chinese government has thrown its weight behind the technology and is targeting 600 million NB-IoT connections by 2020.

Going forward, as more and more service providers deploy NB-IoT and LTE-M networks, definitions will become increasingly important in being able to provide 'apples-to-apples' comparisons of CSPs' key IoT metrics. Ovum's LPWAN Deployment Tracker, which tracks both licensed spectrum and unlicensed spectrum public network announcements, has identified more than 70 new LPWA network launches across the globe in the last year alone, and take-up is expected to be rapid over the coming five-year period.

Smart cities, fleet and logistics, and asset tracking provided the greatest CSP IoT opportunities in 2017

Certain industry verticals are driving growth in telco IoT contracts. Ovum's IoT Service Provider Contracts Tracker shows that the greatest number of publicly-announced IoT contracts for CSPs during 2017 came from a handful of verticals: Smart cities, fleet and logistics, and asset tracking together made up more than 50% of announced contracts, as seen in Figure 2.

Figure 2: Telco IoT reported contracts segmented by vertical/application, 2017



Source: Ovum IoT Service Provider Contracts Tracker

This is a change to the previous year where connected car and smart metering were the second and third largest category, respectively, after fleet and logistics. It is a reflection of the (relative) maturity of the automotive and metering verticals that the number of contracts announced has slowed down in the last 12 months. The rise of smart cities from fifth position in 2016 to the number one vertical for announced service provider contracts last year reflects the increasing interest and investment in this area. Smart cities are providing CSPs with opportunities to move up the value chain and deliver value beyond connectivity (see Ovum's upcoming research report, Service Provider IoT Strategies for Smart Cities, which explores this in greater detail).

The industrial, medical and healthcare, and agricultural verticals together made up 14% of announced CSP IoT contracts in 2017. The relatively low ranking of these verticals is in part due to telcos coming up against strong vertical-specific players (particularly the case for industrial IoT), and in part due to slower progress in market take-up. The number of telcos who are offering end-to-end solutions for these verticals is relatively small compared to the larger vertical categories; although there is growing interest in supporting industrial IoT, which is expected to drive a number of 5G use cases.

The strongest CSPs combine horizontal scale with end-to-end IoT solutions

Those service providers that have achieved the greatest IoT success thus far have utilized their scale for horizontal connectivity (and in many cases, platform) plays, alongside of co-creating IoT solutions for specific enterprise use cases in specific verticals. The further a service provider moves away from a pure connectivity and platform offer, the more vertically-specific each service layer becomes, and therefore one solution most definitely does not fit all.

Most leading CSPs are now narrowing down the number of verticals for which they are developing end-to-end solutions, recognizing the challenges of gaining a deep enough understanding of both buyers and business processes in multiple industries. Vodafone, for instance, has selected a handful of verticals to specialize in (automotive and insurance, and going forward potentially retail and healthcare), while other providers choose to focus more on smart cities, on retail, or on healthcare. Typically, CSPs are supporting the development of these vertical specializations through a combination of acquisitions, partnerships, and in-house innovation.

Even those operators who have the opportunity to provide IoT connectivity at massive scale (e.g., those in China), are still delivering some key end-to-end solutions to maximize their opportunities to drive IoT

take-up in specific verticals. For China as well as many other markets, smart metering has been an important focus, particularly so given it is a strong use case for the costs and capabilities of LPWAN/NB-IoT. Water metering projects in Shenzhen and Fuzhou alone have deployed more than 700,000 NB-IoT connections, while a gas metering project in Shenzhen has created a further 100,000 connections. These types of projects are being rolled out across multiple cities.

Smart cities have been another key focus for the Chinese operators, and here again the opportunity to deploy at scale makes China an interesting testbed for many smart cities use cases – smart lighting, smart parking, and smart waste being the key smart city applications Ovum is seeing deployed, while a number of private providers are deploying connected bicycles for shared use (e.g., Ofo, Mobike). Many of the government-led smart city projects are only just moving into the pilot phase, but take-up is expected to dramatically increase once the value and viability of proof-of-concept initiatives are more widely accepted.

CONTACT US

BLOCKCHAIN: HOW DISTRIBUTED LEDGER TECHNOLOGY WILL SUPPORT THE IOT

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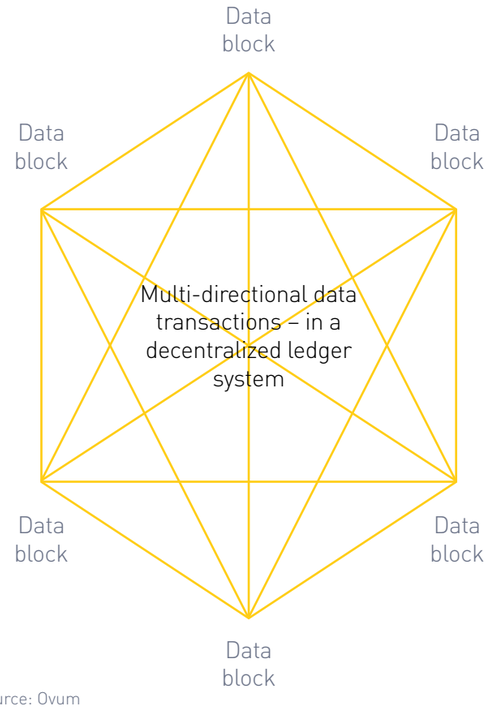
Blockchain technology (also called distributed ledger) is commonly associated with Bitcoin, Ethereum, and other digital currencies. These digital currencies established the viability of distributed ledger as a means of conducting, verifying, and permanently recording transactions without the need for a trusted third party. Beyond digital currencies, blockchain has many other potential applications. Many players are now starting to explore opportunities to apply blockchain in IoT scenarios.

What is blockchain?

Ovum defines blockchain technology as "a database technology that allows data to be shared among users without the need for a centralized authority by using a consensus mechanism." Essentially, it works through a peer-to-peer network of computers that share and record information in a distributed ledger (see Figure 1).

Figure 1: Decentralization and consensus are key criteria for blockchain technology



Source: Ovum

Blockchain consists of data structure blocks, with each block containing batches of individual transactions and the results of any blockchain executables. Each block holds a timestamp and information linking it to a previous block, forming a chain of blocks. A transaction represents a unit of value between two (or more) people. This unit of value will go from owner X to owner Y by broadcasting to the network the changes in amount, status, or activity. Network nodes timestamp and keep track of changes after transactions are made, and changes are verified through links to previous transactions, which are called inputs.

Blockchain use in IoT

Blockchain is fundamentally a horizontal technology. It can potentially benefit any transaction-centered business activity where the integrity of data records is essential, offering lower cost and increased efficiency. Wider applications for the core timestamping technology that underpins Bitcoin and other cryptocurrencies include financial services, supply chain management, healthcare, and government. In addition, blockchain's distributed ledger capability could prove useful wherever the inviolable nature of anything inserted into a chain could provide data with evidential weight about who did what and when.

In the IoT context, Ovum sees strong potential for the use of blockchain for security, identification/authentication, verification, and record-keeping. Early use cases are likely to include IoT applications in transport and logistics, and agriculture. We have seen particular interest in using blockchain to enable 'smart contracts' (also called self-executing contracts) created between machines as IoT-enabled machine-to-machine transactions take place. Smart contracts are a series of if-then statements defining a set of conditions that must be met to authorize payment for a transaction. This contract is written into the blockchain, and when the conditions are met – verified by the blockchain itself – payment is issued automatically.

Transport and logistics

In international trade, moving physical assets or goods across countries involves customs declaration and clearance. This process requires authenticating the identities of the shipper and receiver, and verifying the declared quantity and type of physical assets or goods, and the source and authenticity of these when they are shipped. It is a paperwork-heavy process. Many trade and legal documents must be submitted and processed, and many intermediaries are involved, such as freight forwarders, and customs brokers. The process requires timely submission of accurate documents and timely payments among parties. Errors in documentation or delay in payments can result in delayed customs clearance, which then cascades down the line and often results in operational loss.

Shipping and logistics activities are a natural fit for IoT applications, with asset tracking being one of the fastest-growing areas of the IoT thanks to the clear value of being able to track the location and status of goods in near-real time. Incorporating blockchain technology into this process enables ongoing, highly

reliable recording of the status and location of goods, of receipt of goods and the timing of receipt, and of other key elements of transactions as goods make their way from producer to buyer.

With blockchain's shared distributed ledger and smart contract functionality, business terms embedded in the blockchain database can be executed among multiple parties – shippers, customs officers, and receivers. IoT data about the goods as they move through the shipping process feeds into smart contracts, which can then automatically transfer payment when goods are received and all necessary conditions have been met (as verified via the distributed ledger). This can speed up the trade process, improve operational efficiency, and reduce the need for intermediaries. Moreover, blockchain provides shipping companies with tamper-proof records of the movement of the physical assets or goods from source to destination, thereby assuring their clients of the authenticity of those assets or goods.

Shippers such as Maersk Line, and logistics company UPS are among those applying blockchain to their shipping and logistics operations, alongside of IoT-enabling containers, packages, and means of transport.

Agriculture

Agricultural produce and livestock goes through a complex production and distribution process. It involves the producer (typically the farm), the processor, the distributor, and the retailer before ending up in consumers' hands. The end goal is to deliver quality food to consumers. IoT sensors are used by some parties in the supply chain to monitor the quality of produce and livestock. But no one has visibility of the entire supply chain as produce and livestock moves through it.

This is where blockchain comes in. By using a distributed ledger involving all parties in the food distribution supply chain, blockchain offers a traceable trail of tamper-proof records to all parties. Data transmitted by IoT sensors from the produce or livestock at the farm, processor, distributor, and retailer levels are permanently recorded and verified through blockchain. This gives all parties visibility and assurance of the authenticity of these records. Claims such as country of origin and quality can thus be easily verified. All parties in the supply chain benefit from increased trust, accountability, and transparency. Costs previously associated with the need for third-party verification services can be reduced or eliminated. Any quality issues with the food can now be traced back at each level, because the records are permanent and cannot be tampered with. Interest is high in this area. Leading retailers and food companies (Nestle, Walmart, Costco, Golden State Foods, McCormick and Co., and Tyson Foods) in August 2017 announced a major blockchain collaboration with IBM to "strengthen consumer confidence" in the foods they purchase.

Blockchain use caveats

While adding blockchain can assist identification and secure recordkeeping in IoT transactions, it is not an appropriate solution for all IoT transactions. The question is whether eliminating the friction point for a particular workflow in IoT is worth the investment in implementing a new technology and in dealing with new complexities.

Blockchain deployments are currently limited, mostly in proof-of-concepts, or small-scale experimentation. Service providers and vendors should not expect net new revenue from implementing blockchain in their IoT transactions. If they were to acquire or develop their own blockchain technology and know-how and become blockchain technology providers, they could potentially monetize blockchain by licensing or providing professional services to implement and apply blockchain in IoT transactions. Realistically, few communications service providers are likely to do this on their own. It is quite complex and, for most, well outside of their core business and capabilities.

For more widespread adoption of blockchain as part of IoT deployments, the technology needs to overcome two main technical challenges. The first is scalability. The longer a specific blockchain is in use, the longer its chain gets. This means a need to increase storage infrastructure across all nodes that store a copy of the chain. The costs of sustaining a blockchain can rapidly escalate, both in terms of storage required and the energy required to run the blockchain. The transactions supported must be of high enough value to make it worth the storage and energy costs, or there must be other factors involved that mean blockchain is the best choice. This is going to be an important barrier to wider adoption of blockchain as a general record-keeping technology.

Interoperability is a second major challenge for blockchain use in IoT. Though there are some technical and business standards for specific use cases such as international trade transactions and smart contracts, at present different versions or variants of blockchain are fundamentally incompatible with each other. Barring regulatory intervention, there is little likelihood that blockchain consortiums such as Enterprise Ethereum Alliance, Hyperledger Project, R3, Digital Asset Holdings, and others will make their blockchain technologies work with one another.

There is no doubt that service providers and vendors should keep an eye on blockchain, and consider investment and development of sensible use cases. But a new technology is not in itself a business strategy. While blockchain-based systems and applications could potentially provide more security and trustworthiness to IoT transactions, there must be concrete proof of the value of this over a significant period, and in multiple instances, to drive forward the use of blockchain as a competitive advantage in providing IoT solutions.

CONTACT US

Autonomous transport progress depends on AI and ecosystem evolution

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An important application for artificial intelligence (AI) is autonomous transport. All areas of transport are being investigated for autonomous control, with AI playing a large part in driving/piloting control and providing intelligent decision-making in real time based on data from an array of sensors. These include light spectrum (cameras), radio (radar), laser (lidar), positioning (global navigation satellite system, GNSS, such as GPS), inertia using inertial measurement unit, and IOT (vehicle-to-everything) communications. Ovum is seeing progress in autonomous vehicles, trucks, aviation, trains, and nautical vessels.

The December 2017 Ovum AI Reality (AIR) chart provides a qualitative view of progress in autonomous transport. 2017 saw many milestones achieved as ventures from start-ups, technology companies, and transport industry incumbents staked their position in trials and pilots. The scope of the topic is potentially huge, including regulations, legal issues, security, safety, geographical differences, smart cities, and more, but this report is strictly concerned with the advance of AI in autonomous technology. The AIR chart is based on current state-of-the-art progress. In addition, we offer a view on when autonomous vehicles will become a common sight on our roads.

Autonomous transport is driving toward reality

Progress in autonomous transport is already seeing road, rail, and air examples

The impact of autonomous transport on society will be huge, and will affect urban architecture, road building and parking spaces, patterns of transport use, driving/piloting skills and de-skilling, and more. In light of the role of cars in our culture, there will be a deep impact on how we live. Technology is incrementally pushing forward and the motivation exists, with recognition all round that this technology will save many lives (in the US there is a traffic accident fatality every 15 minutes). There will also be job changes, and while demand for drivers/pilots will undoubtedly decrease, new jobs will be created to design, build, maintain, and monitor autonomous systems.

The Society of Automotive Engineers (SAE) International defines five levels of autonomous driving (see Figure 1). In our analysis, we stretch the use of SAE levels to generic modes of transport with similar autonomous system capabilities at the corresponding levels. One provision should be noted in extending SAE this way. While mass-market vehicles will be truly autonomous with no centralized control, we expect commercial operations, at least in the first wave of this technology, to have a degree of remote monitoring, with the capability for humans to take over if necessary. This is not reflected in the SAE level.

Major road transport manufacturers (Tesla, for example) envisage level 4 capability in a few years, or over 10 years, and are striving to achieve this goal. Creating an autonomous driving industry has become a nation state race. For example, the Obama administration kick-started billion-dollar investments in the US, and in recent weeks the UK government pledged investment and relaxed regulations to encourage research in the UK, following on from its UK Autodrive initiative, which is currently running autonomous driving trials in Milton Keynes and Coventry.

In the assessment below, we refer to "level 3-4 pilots", which should be interpreted as a system being developed for level 4, but having a test driver on board who can take over makes it in effect a level 3 system during testing. Some of the milestones in autonomous transport that helped define the December 2017 AIR chart are as follows.

- **Air taxi and drone:** Volocopter demonstrated an eight-minute level 5 autonomous flight without passengers on September 25, 2017 in Dubai, UAE. Amazon Prime Air is trialing a pilotless drone delivery service, with the first delivery to a real customer accomplished in December 2016 in Cambridge, UK. Unmanned aerial vehicles (UAVs) are already common in the military.
- **Airplane:** Aircraft are already highly automated, and fully autonomous flying is likely in the next decade. For airlines, passenger sentiment not the technology may be the main barrier. Unlike air taxis, where airplanes fly and take off and land is highly controlled.
- **Car:** Waymo (owned by Google owner Alphabet) has been trialing level 4 autonomous vehicles in Phoenix, Arizona without drivers on board since November 7, 2017. The level of activity was kick-started by Google and Tesla, but established motor manufacturers are very much in the race, including BMW, Daimler, Ford, Honda, GM, Nissan, and Toyota, as well as start-ups.
- **Ship:** Level 5 autonomous ships and ferries are being developed, including by Rolls Royce, which predicts the first examples to be short-distance ships such as car ferries, and ocean-going robot cargo ships in 10 to 15 years. Norway's Yara and Kongsberg are jointly working on building the first crewless ship, the Yara Birkeland, for cargo shipping in Norwegian waters. Autonomy will be added in stages with level 4-5 expected to be achieved by 2020.
- **Submarines:** There is a history of autonomous underwater vehicles but there is activity in creation of a new generation. Boeing and the US Navy are, for example, working on autonomous submarine drones.
- **Taxi, bus, shared-ride services:** The first level 4 autonomous taxis were trialed in Singapore by nuTonomy in 2016. Navya offers Autonom Cab, a robot taxi designed for level 4 autonomous driving with no cockpit, steering wheel, or other manual controls. A Navya bus has been in operation in Lyon, France, since 2016. Tesla has delivered 50 vehicles to city of Dubai, UAE, for an autonomous taxi service. Waymo plans to open its autonomous taxis to passengers in Phoenix in early 2018. Zoox is planning to have customers by 2020. Uber and others are researching driverless taxis. An autonomous bus system is being trialed in Las Vegas. In December 2017, Lyft, in partnership with nuTonomy, is matching passengers in select areas of Boston with autonomous rides. The UK Transport Research Laboratory's Harry shuttle has been trialed with the public in Greenwich, London.
- **Train:** Driverless train systems have been in operation since 1967, either with a driver monitoring the automated system, or driverless but with staff on board. The first freight train using an autonomous system without a human on board ran on October 2, 2017 and was operated by Rio Tinto in its iron ore network in Western Australia and monitored from an operations center in Perth.
- **Trucks:** Rio Tinto has been operating level 4 autonomous trucks in its iron ore mining in Western Australia for some years. Embark and other truck operators have been piloting level 3-4 autonomous trucks on public interstate highways in the USA in 2017, with drivers taking full control over the first and last miles.

December 2017 AIR chart on autonomous transport

The December 2017 AIR chart is shown in Figure 2. It is notable that road transport level 5 is still

Figure 1: SAE driving automation levels defined

	SAE level	Name	Execution of steering and Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment	0	No Automation	Human driver	Human driver	Human driver	n/a
	01	Driver Assistance	Human driver and system	Human driver	Human driver	Some driving modes
	02	Partial Automation	**System**	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment	03	Conditional Automation	System	**System**	Human driver	Some driving modes
	04	High Automation	System	System	**System**	Some driving modes
	05	Full Automation	System	System	System	**All driving modes**

Source: Ali Maleki, Ricardo

some years (perhaps a decade) away from being realized. This, however, does not take account of further improvements in the core technology, particularly AI, which is improving incrementally. Algorithms are being refined (for example, deep level architectures), computing power is increasing annually, and new AI hardware accelerators expected to reach the market in 2018 will add to this rate of improvement. These improvements in the technology will bring SAE level 4 and ultimately level 5 autonomous driving to fruition earlier than expected.

Some modes of transport are ahead of road transport. Aircraft, due to the highly regulated control of their paths, are at levels 4 and 5. Similarly, nautical vessels have less complexity in their environment and are at advanced levels.

The sheer size of the car industry makes it a particularly important area of focus. Many contenders will bring level 4 and eventually level 5 vehicles to our roads. In the US, there are more than 25 companies currently registered in California to trial autonomous cars. Other states attracting research include Arizona and Pennsylvania.

A metric of proficiency used by the Department of Motor Vehicles in the state of California is the number of autonomous miles achieved per disengagement. The most recent figures released relate to 2016. Ahead of the pack is Waymo (owned by Alphabet) at 5,128, followed by BMW at 638, Nissan at 246.7, and Ford at 196.7. Waymo has received the most funding of the contenders, at over $1bn, and has been longest established (2009), accruing the most miles of actual road testing (3.5 million) and simulation (3 billion).

By comparison, Tesla has a metric of 3 miles per disengagement.

However, this metric should be read as a general assessment of progress and is not scientifically meaningful. Disengagements can occur for many reasons and are not distinguished in the logging. A disengagement of a test run in Pittsburgh under snow conditions cannot be compared with a disengagement on a grid road in a desert climate city such as Phoenix.

Autonomous driving technology is powering next-generation vehicles

Because of the array of sensors needed, building autonomous vehicles is not cheap. All manufacturers use a range of different sensors, including lidar. The exception is Tesla that so far relies solely on cameras and radar. The cost of the sensors per vehicle suggests the most economical model would be for autonomous technology to be used for shared-ride and taxi services, with expensive models available in the top end of the private car market. However, the cost of the sensors continues to fall. Cruise (the GM acquisition made in 2016 to establish itself in the race), acquired lidar manufacturer Strobe in October 2017 and expects a 100% reduction in lidar costs.

A key provider of technology for AI-based autonomous transport is Nvidia, whose GPUs are an essential ingredient for training and inferencing AI systems. Nvidia Drive PX is an AI car computer appliance, housing Nvidia's high-end GPUs and other advanced microprocessors and sensors, and built to support ASIL-D, the highest level of automotive functional safety. Nvidia says it has partnerships with most of the leading car manufacturers in the race to bring autonomous vehicles to the roads. Another provider of GPUs into this market is AMD. Intel announced in 2017 a partnership with AMD to deliver a joint CPU and GPU solution, and acquired Mobileye, a start-up developing autonomous driving technology. Baidu is making its Apollo autonomous driving platform part open source, and its partners include Daimler, Ford, and Nvidia.

New AI hardware accelerators are expected to reach the market in 2018 and it remains to be seen if they can outperform the best GPUs, and raise the computing capability to run ever larger AI architectures that yield higher performance and accuracy. Even if these novel AI accelerators disappoint, the year-on-year improvements in GPU performance are expected to continue. We therefore see a continuing upward trend in AI system performance over the next decade.

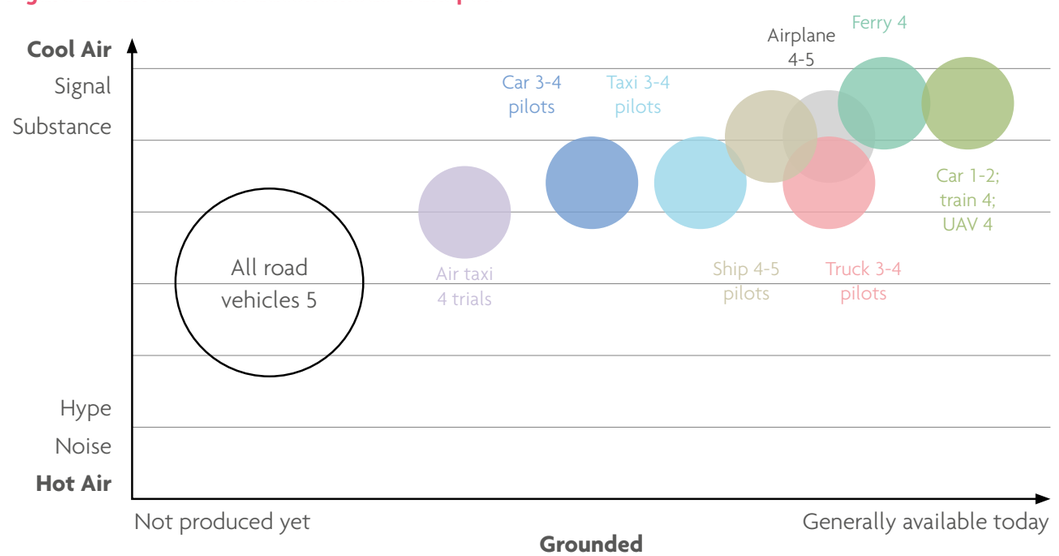
Autonomous transport will comprise of connected machines and will therefore be part of the Internet of Things (IoT). Much IoT technology will therefore also be relevant to autonomous transport, as will smart cities, 5G, and telemetry, which will also play an important role in future autonomous transport, and create opportunities for IoT and telco vendors.

Ovum expects autonomous driving capability at SAE level 4 to appear in the next few years in trucks and passenger services such as shared rides, taxis, and buses. Examples already exist. Cars at level 4 will not be good enough for people that, for example, need to rely on their car and not being able to use it when it snows is not satisfactory.

An autonomous car at level 5 is yet further away because the AI technology needs to improve. However, the current incremental pace of AI evolution means it is not a question of if but when. In the near future there will be an identical overlap between an Uber/Lyft style service, a taxi ride, and a car rental that comes with a (virtual) robot chauffer and arrives at your door. Such car usage will reduce the number of cars needed in society, and the impact of this scenario on the car industry will be far-reaching.

CONTACT US

Figure 2: AIR Chart on autonomous transport



Note: numbers represent SAE levels

Source: Ovum

Connected Car Consumer Services: Winning at Data Monetization

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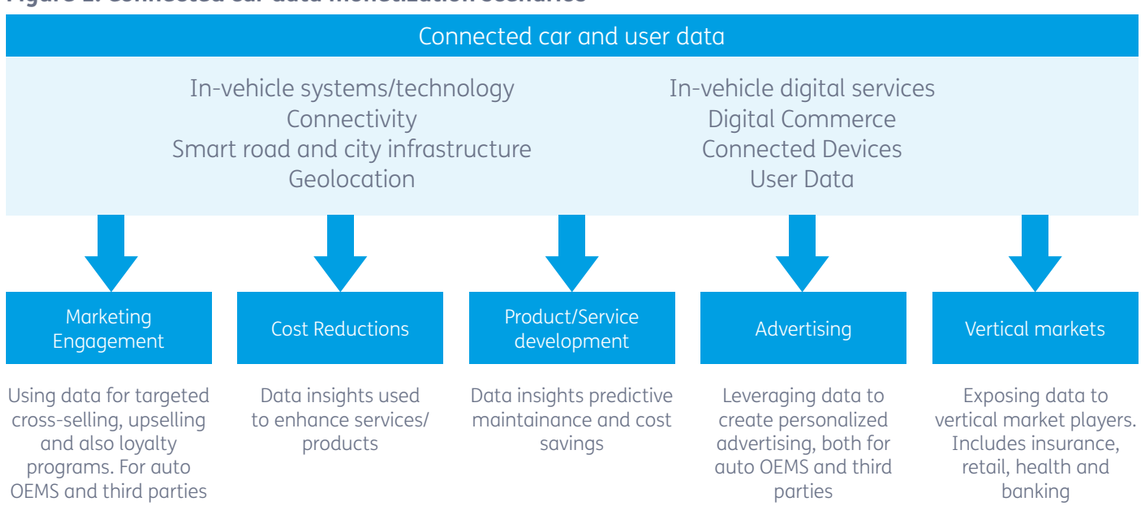
As the number of connected passenger vehicles continues to grow, the connected car ecosystem is starting to generate data from a wide variety of complementary sources. This includes data from embedded SIMs and sensors, and from connected external devices in vehicles, as well as from digital services, payments, geolocation systems, in-vehicle diagnostics, and smart road and city infrastructure.

What is less certain is how best to monetize this data, and who will be in pole position to do so. There are multiple scenarios to explore, for both direct and indirect revenues. But before the benefits of monetizing connected car user data can be fully realized, significant issues need to be addressed, including the need for data privacy safeguards, greater collaboration between players, and integration challenges.

Figure 1: Connected car data monetization scenarios



Source: Ovum

Data monetization scenarios

At Ovum, we've identified multiple scenarios that could create new revenue opportunities from connected car data, as highlighted in Figure 1.

Some are clear near-term opportunities for automotive OEMs and other players in the ecosystem, such as using connected car data to enhance customer engagement, or to feed back into improved service or product development. Other scenarios will take more time to develop – for example those using in-car data to support richer, more interactive advertising formats and experiences, or as an input to decision-making in the healthcare sector.

Marketing engagement, service development, and R&D

Connected car data will enhance a range of customer relationship marketing activities and engagement, such as loyalty programs and targeted promotions, creating upselling and cross-selling opportunities. This is particularly valuable for automotive OEMs, giving them new insight into customer and car behavior.

Sensor-based systems that monitor vehicle functions (e.g., fuel efficiency, brakes, and tires) produce data that can be used to support not only marketing engagement, but cost reduction and product development.

Telematics platforms produce data that shows how well a particular function or part of the car is performing. This can be used to push marketing messages or reminders about vehicle maintenance (e.g., flagging when a car needs a service) or to trigger specific actions (e.g., flagging the urgent need for more fuel or new tires). AT&T recently announced a partnership with CarForce to deliver such predictive maintenance-led services for dealerships, fleet management providers, and repair shops.

Similarly, a vehicle's performance-related data can feed back into automotive R&D to improve and enhance future vehicle functionality, with a view to reducing costs or improving performance.

In-car data can also feed into better service development – and improved customer experience – for providers of infotainment and communications services. For example, passenger consumption of in-vehicle entertainment produces insights into usage patterns and preferences, that can in turn be used for more effective infotainment and data package recommendations, personalization, and bundling.

Consumer vertical markets

Connected car data can be used to enhance services offered by industry verticals that already target the automotive market, and to create opportunities for new vertical services.

A natural fit for vehicle rescue services and insurance

Vehicle performance data is useful for breakdown assistance providers and road infrastructure operators. For example, a roadside breakdown assistance provider could receive an automatic alert from a member's vehicle when something has gone wrong, and could then use vehicle location and status data to optimize the arrival time of a recovery vehicle, or discover what has gone wrong and predict the best course of action.

In-vehicle data is already being leveraged for usage-based insurance (UBI), which rewards safer, more efficient drivers with lower insurance premiums. UBI draws heavily on data from in-vehicle telematics and allows insurers to monitor a range of driving parameters including speed, miles driven, location and fuel consumption.

UBI appeals to consumers because it more accurately reflects how they drive, offering an alternative to a one-size-fits-all approach to car insurance. It has enabled a range of innovative business models such as pay-as-you-drive (PAYD) and pay-how-you-drive (PHYD). Smartphone apps from insurers provide "try before you buy" models, whereby drivers can use the app to assess how safe they are on the road and even share scores with friends and family, adding a gamification element.

Health monitoring is a promising longer-term opportunity

Connected car data in the health domain is attracting considerable interest, but is still a work in progress. Drivers can spend many hours in a vehicle, and connected car sensors and cameras can monitor various parameters related to health and stress. However, health-related data is sensitive and people may be unwilling to share physiological data.

There are also broader wellbeing scenarios that can be supported by connected car data. Auto OEM Audi's Fit Driver service uses data from connected cars and associated wearable devices to monitor a driver's wellbeing. Smartwatches can monitor a driver's temperature and heart rate, while the connected car tracks their driving style and external conditions (e.g., weather, congestion). Combining these two data inputs allows the car to actively improve a driver's wellbeing and safety: Giving them a seat massage if they are stressed, ramping up the cold air-conditioning if they are drowsy, suggesting a stop for a rest, and so on.

Retail

Vehicle and user data will be valuable to retailers for location-based, personalized in-car advertising. But car data can also help the retail sector in other ways, such as revealing traffic patterns, journey routes, and popular stopping places, so that retailers can better plan store locations. Demographic information associated with car users, along with their preferences and service consumption habits, could help retailers better plan store inventory for drivers.

Digital advertising

Digital advertising has been available in vehicles via radio for decades, but it has typically been tied to the coverage area of the radio broadcaster and time periods/slots.

Richer forms of in-vehicle digital advertising such as video are not widespread. The main barrier – and it is a considerable one – is that digital advertising in vehicles runs the risk of distracting drivers and compromising safety. This is particularly the case with advertising designed to stimulate an interactive response, where an action is needed to receive a discount offered by an advertising message, for example. Early in-car advertising may be more focused on passengers (e.g., when consuming infotainment) rather than the driver, for safety reasons.

Conversational interface, digital assistants, and augmented reality (AR)

The provision of an AI-powered voice interface makes interacting with advertising in vehicles more viable – and safe – while driving. Advances in AI-powered speech recognition and natural language processing (NLP) are making voice interactions more accurate and nuanced, enabling the voice interface to take on more sophisticated roles.

Digital assistants with a conversational interface have the potential to curate advertising in connected vehicles. They could tap into and create detailed consumer data sets around search history, content of emails/conversations, and journeys completed. Combined with vehicle-related data, this will enable advertising and marketing to be targeted with greater precision and contextual relevance.

AR has the potential to transform the windshield itself into an advertising screen. However, advertising on AR-powered HUDs must be presented in a way that is not distracting to drivers and therefore dangerous. This will be difficult to achieve and is likely to be more viable (and of more interest) in shared or public transport autonomous vehicles than in passenger cars, in the medium term.

Digital payments

The arrival of digital payments in connected vehicles makes the in-car advertising proposition more compelling, both for consumers and brands. Until relatively recently, it was not possible to make digital purchases directly from in-vehicle platforms. Connectivity and the use of tokenization in digital payments has changed this, enabling connected cars to support the whole shopping journey from an initial targeted advert through to payments for the product or service advertised. Early initiatives in the in-car payments space have come from Visa, Mastercard, and payments processing firm Worldline.

The impact of autonomy

Autonomous driving will have a profound impact on in-vehicle digital services and advertising.

Self-driving cars will give passengers more free time and a safe environment to engage with media-rich advertising such as video and VR in. This is a longer-term scenario, as fully autonomous vehicles will not be a widespread commercial proposition in the consumer segment in the next 10 years, although shared autonomous vehicles may appear sooner.

Success factors and challenges

Success in monetizing connected car data requires a range of skills and assets. Those best-positioned will have the ability to generate or access connected car data, access to advanced analytics capabilities, experience with data monetization, and access to, or control over, key enabling technologies (e.g., AI) and services (e.g., digital assistants).

Consumer tech OTT and e-commerce players such as Google, Amazon, Apple, Baidu, and Alibaba are in a robust position when it comes to the capabilities and assets needed to generate and monetize connected car data. Some are already advanced in developing connected car technologies, and provide popular digital services via smartphone-mirroring solutions, content, apps, communications, mapping, navigation, and digital commerce. These players are also experienced when it comes to consumer identity management. Alongside this, they have cutting-edge data analytics and AI technology, plus existing business models based on monetizing consumer data.

The CSP challenge: Moving beyond connectivity revenues

While wireless connectivity is the foundation of the connected car ecosystem, the challenge for communications service providers (CSPs) is how to move beyond connectivity revenue and win a significant share of the value of connected car services. This is a key reason why CSPs are looking at wider, end-to-end service opportunities for connected cars. Digital Wi-Fi hotspot and infotainment services are logical for tier-one CSPs that are already committed to connected cars, especially if they have also invested substantially in media and content properties. But the problem for CSPs is that they are not the only ones eyeing this opportunity: Major OTT and consumer tech players are chasing the same prize.

New complexity, new skills for digital advertising players and OEMs

Connected vehicles are also an opportunity for brands, but for advertisers and agencies this means getting to grips with a new platform that has unique requirements and challenges, including ensuring advertising formats and timing do not compromise safety. Digital advertising in connected cars requires skills and expertise that most advertisers and agencies currently lack, which will take time to develop. The rise of car sharing also has far-reaching implications for personalization, not only for digital services but also for successful delivery of targeted advertising messages. Automotive OEMs, for their part, are looking to move beyond simply providing cars, to establishing ongoing service-based relationships with their customers. All major OEMs are exploring opportunities around in-car services, and hoping to monetize these as part of a fundamental business model shift. But – as with agencies – they do not necessarily have the right in-house skill sets or relationships to develop and leverage the large amounts of data their vehicles will be producing. Partnerships will be critical for success.

Collaboration and data sharing are key, but privacy and regulation are challenges

A host of different parties are involved in providing connected car services and generating data. This raises issues of ownership and makes data sharing and standardization a challenge. Auto manufacturers may manage sensor and system data; mapping and navigation vendors have access to location data; OTT players collect media consumption and usage information; retailers or payments providers may collect purchasing data; while CSPs manage cellular network–related data. Integration will be an ongoing challenge, creating significant opportunities for platform and analytics providers, particularly as demand grows for data to feed AI engines.

Data privacy in the connected vehicle domain is coming under increasing regulatory scrutiny, and most existing data protection frameworks have not been designed with connected vehicles in mind. Different connected car data use cases will have different requirements in terms of the type, depth and breadth of data collected. Regulatory initiatives such as European GDPR regulation make it imperative to provide transparency on who owns, has access to, and has rights over data generated by the car itself, and by drivers and passengers. Ensuring appropriate consent mechanisms are in place for data sharing and privacy will also be critical for compliance.

CONTACT US

The battle for your smart home is intensifying

The smart home represents one of the biggest potential growth areas in the consumer technology market, and global players such as Amazon, Apple, and Google, as well as security, utility, and telecommunication service providers, continue to jostle for position. However, proving the everyday value of smart home technology remains a significant challenge to mass-market adoption for all players. Ovum expects a significant increase in marketing efforts in 2018, and that retailers and service providers alike will focus heavily on the benefits and various use cases, rather than just the technology, of smart home solutions.

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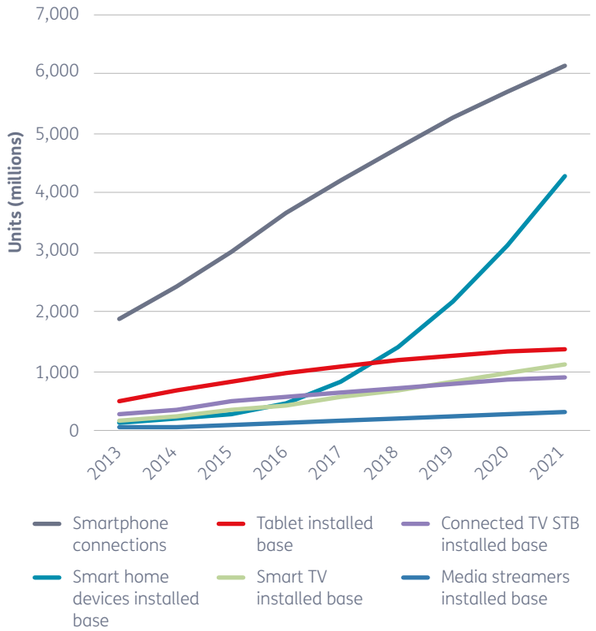
2018 will be an inflection point for smart home technology

For many years, smart home technology languished at less than 5% household penetration, failing to attract consumers beyond early technology adopters. In 2016–17, the market saw the first real signs of growth as telcos, utilities, and security companies, as well as heavyweight technology companies including Samsung, Google, Amazon, and Apple all ramped up their investments. 2018 will continue to see rapid growth, and by the end of the year there will be more smart home devices installed than there are tablet PCs. Over the next four years, the market will continue to grow to an installed base of more than 4 billion devices by the end of 2021, representing one of the biggest growth opportunities in the consumer technology industry.

Figure 1: Global installed base of connected consumer devices, 2013–21



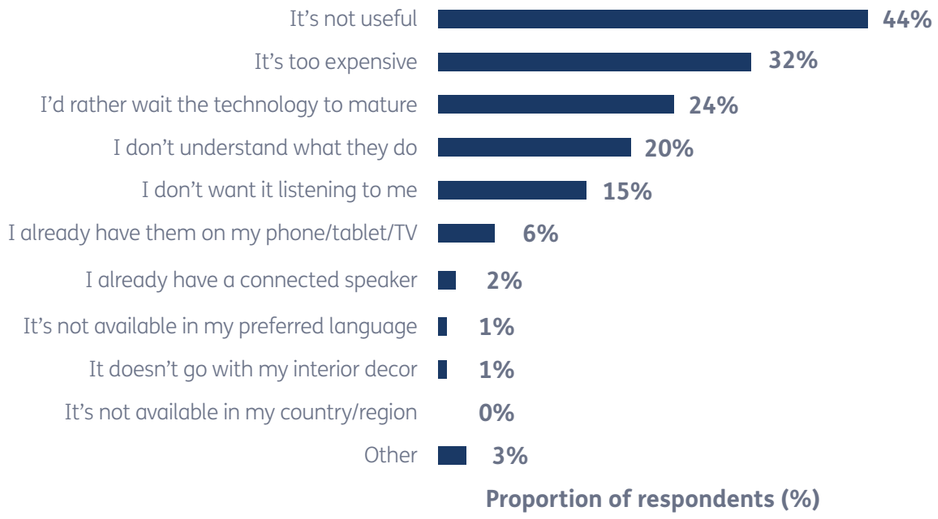
Source: Ovum

Marketing focus will shift toward use cases

Before the industry can truly reach the mass market, several barriers need to be overcome – the biggest of which is the lack of understanding among consumers about the value smart home technology can bring.

Drawing on Ovum's *Digital Consumer Insights 2017* survey data, Figure 2 shows why consumers may choose not to purchase a smart home assistant device such as the Amazon Echo. By far the most popular answer (given by 44% of respondents) was that they believed the device would not be useful, but 20% of respondents did not even know what such a device did. A further 32% of respondents thought smart home assistant devices were too expensive, which again may have reflected a lack of understanding about the technology's value.

Figure 2: Reasons people give for not purchasing a smart home assistant device*



Source: Ovum's Digital Consumer Insights 2017: Smart Living; *UK, US, China, and South Korea

Although Figure 2 shows opinions on home assistant devices, consumers often express similar feelings for other forms of smart home tech, which all tend to come at a premium price over non-smart, unconnected products. A single Philips Hue lightbulb can cost as much as $50. In order to show the value of such products, in 2018 there will be a significant increase in marketing for consumer-facing smart home technology, particularly around introducing different use cases and greater functionality for smart devices in the home. That $50 lightbulb, for example, could be used as part of a burglary deterrent system, which for some customers may actually be a small price to pay for greater peace of mind. Getting these messages across to the right consumer segment is key.

To increase the marketing complexity, the potential uses of a single device can be varied, and there is an element of personal taste or circumstances involved – what is considered valuable to one customer could be completely different for another. Therefore, Ovum expects social media to play a big part in capturing, and then promoting, real-life stories of how smart home technology has changed the lives of ordinary people. The inclusion of more smart home technology in retail store demonstration areas (such as those in Ikea, for example) will also help to educate consumers on how new technology can be used in their own homes.

All players need to take a long-term view

Consumers do not just go out and buy a 'smart home.' Rather, the home environment will evolve gradually over time as consumers gradually add more and more connected devices to their home. Therefore, the performance of those initial devices is important. A good early experience will encourage consumers to quickly invest further in smart home technology, while a bad experience will deter them.

Consumer apathy is dangerous; and as much so for smart home device vendors as for service providers. Vendors may rely more heavily on retail sales of their smart home devices to drive revenue, but if consumers do not remain engaged beyond the initial "honeymoon period" after purchasing their first product, vendors will struggle to find further upsell opportunities and will be less likely to benefit from word-of-mouth marketing. The latter is badly needed in the smart home industry, because it enforces the value marketing message with consumers.

Therefore, vendors need to continue to innovate and evolve their technology, as well as quickly fixing defects. This will ensure better customer engagement with their products. Service providers may be more experienced with supporting an ongoing relationship with the consumer, but are not necessarily agile enough to continue developing their smart home propositions at the speed that consumers expect; some may find an enabling role a more comfortable fit.

Recommendations

- A detailed understanding of the smart home device market is essential. This way players can not only segment the market properly, but also change marketing messages according to segment, to make sure the right values are being highlighted. Many smart home providers have launched products without fully understanding the market. This means they risk wasting investment on product development and integration on top of sales and marketing costs. Different consumer segments have different demands and interests. Understanding such nuances is vital to a successful campaign.

- Providers must focus on demonstrating the value of smart home technology in real-life situations. Often, it is only when consumers experience smart home technology first-hand that they truly understand its value. The more a supplier can demonstrate smart technology adding value in real-life situations, the easier it will be for consumers to understand the benefits of the smart home (especially if consumers are allowed to experiment themselves).

- Work closely with key retailers to educate the end user. For equipment vendors (especially those with no direct-sales capabilities), trying to convey the message to consumers about the value of new smart home technology is particularly difficult. Having a good relationship with retailers that can help solve this issue – through in-store showcases, for example – will be a significant advantage.

- Where possible, partner with retailers or service providers that have a dedicated team of engineers in the field. As discussed in Ovum's 2017 report, Driving Greater Customer Satisfaction from Smart Home Service Delivery, service providers that use an engineering "field force" to help sell their smart home portfolios have a big advantage. Centrica in the UK and Vivint in North America are good examples of this, and home automation firm Control4 has had much success working with high-end hi-fi retailers to the same effect. Service providers and retailers that employ field engineers will provide a more successful sales channel than the standard high street or online store.

- Vendors must take measures against customer apathy, frustration, and lack of trust. Not only will these things discourage existing customers from purchasing more products, but the lack of positive customer recommendations will also curtail smart home growth. Therefore, vendors must continue to innovate and evolve their products to find more points of engagement with consumers, as well as quickly fix any defects or points of customer frustration.

CONTACT US

AI assistants are gaining traction at home

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The role of AI assistants as key enablers of home automation is strengthening, as competition among key vendors such as Amazon and Google intensifies. However, the failure of AI assistants to understand spoken requests is generating frustrations and doubts among consumers. Many vendors are working to fill the gaps in current AI assistants' performances, but further work is needed to offer the seamless experience they promise.

The AI-enabled smart home industry is growing rapidly and recent initiatives in this space have focused on making AI assistants more useful and omnipresent at home. Technology vendors are investing significantly in the sector, and the number of new smart home assistants introduced into the market jumped significantly in 2H17.

2017 witnessed the rise of the AI-enabled smart speaker

The AI-enabled smart home industry is growing rapidly and recent initiatives in this space have focused on making AI assistants more useful and omnipresent at home. Technology vendors are investing significantly in the sector, and the number of new smart home assistants introduced into the market jumped significantly in 2H17. The role of AI assistants as key enablers of home automation is strengthening, as competition among key vendors such as Amazon and Google intensifies. However, the failure of AI assistants to understand spoken requests is generating frustrations and doubts among consumers. Many vendors are working to fill the gaps in current AI assistants' performances, but further work is needed to offer the seamless experience they promise.

Competitors Amazon and Google have gone to great lengths to boost the functionality of their AI assistants while introducing new smart devices aimed at revolutionizing the consumer experience at home. Amazon has been fast to emerge as a market leader, not only because it has introduced innovative solutions first, but also due to its rich ecosystem of partners and developers that most companies in this industry wish to work with. Google remains the only vendor capable of posing a real threat to Amazon, but mainly by playing catch-up with a similar market strategy.

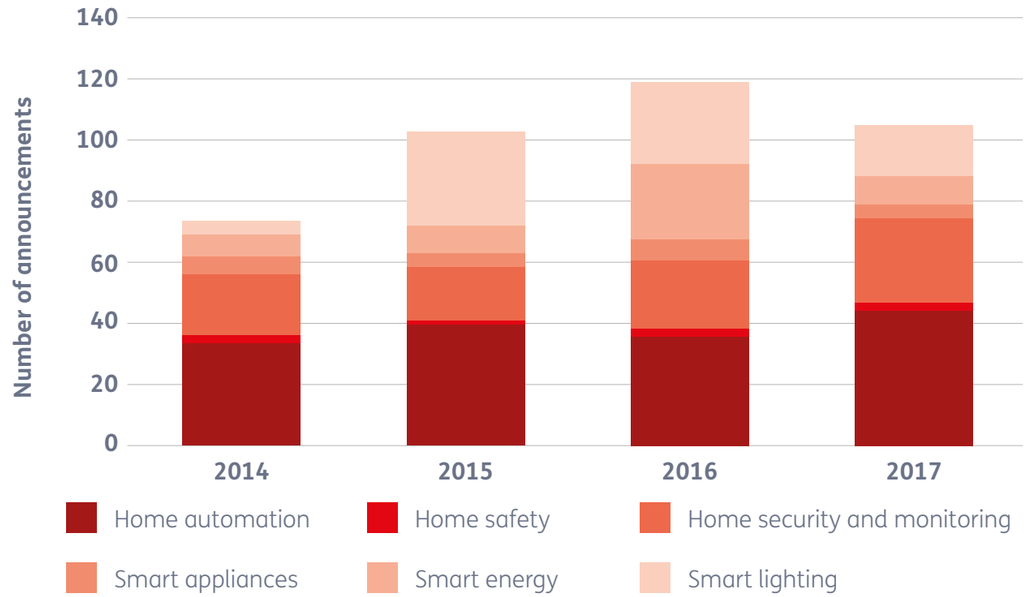
In 2017, the increased number of announcements in the home automation area basically revolved around the launch of new AI smart speakers as Figure 1 shows. These are some examples for 2H17:

- Amazon released Echo Plus to simplify the smart home journey.
- Google unveiled the Home Mini smart speaker to challenge Amazon's Echo Dot.
- Alibaba launched a home assistant speaker known as Tmall Genie X1.
- Sonos released a smart speaker that supports multiple voice assistants, including Alexa and Google Assistant.
- Sony launched a new smart home speaker with built-in Google Assistant and gesture controls.
- Kakao launched its own AI-based speaker to compete with the likes of SKT's Nugu.

Based on Ovum's Smart Home Vendor Tracker, 2H17 rankings, Amazon has consolidated its leadership in the smart home industry, outpacing vendors such as Samsung and Google which are both active contenders with fast-growing product portfolios and ecosystems.

Despite its strong brand, Apple has been slow to consolidate its market position. The setback has been driven by its selective approach to choose HomeKit partners and its main focus on positioning Apple HomePod as a premium speaker with limited functionality for the smart home.

Figure 1: Announcements by smart home segment, 2014–17

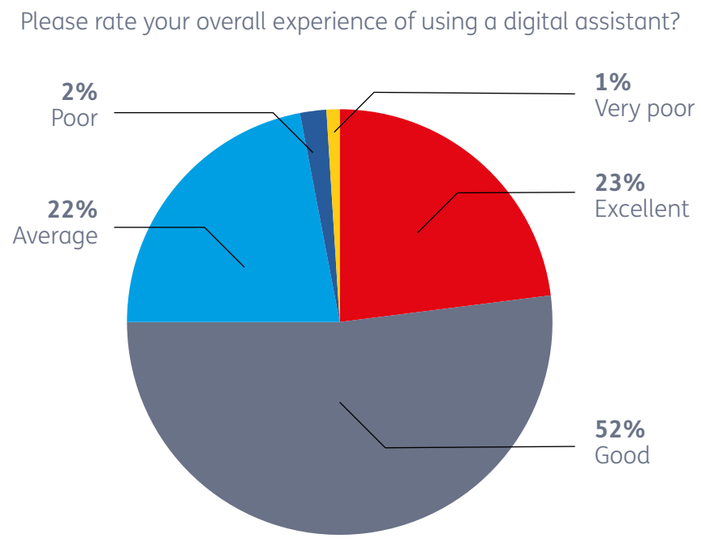


Source: Ovum Smart Home Vendor Tracker, 2H17

For consumers, AI assistants are gaining popularity, but the experience sometimes falls short

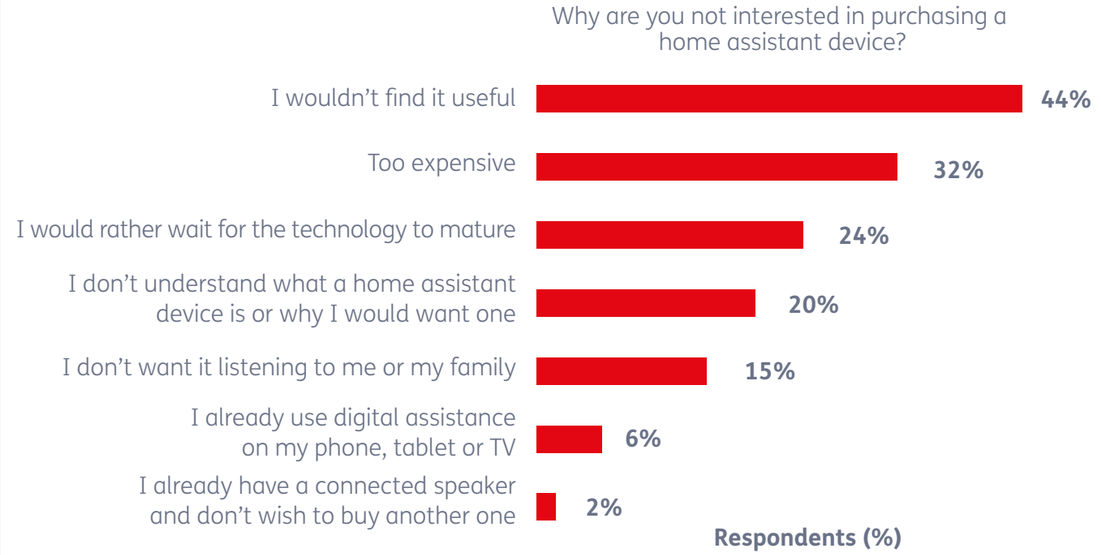
AI assistant speakers have already shown some success on the sales floor and they are gradually making progress at home.

Figure 2: Customer satisfaction with digital assistants



Source: Ovum Digital Consumer Insights 2017: Smart Living

Figure 3: Why customers are not interested in purchasing home assistant devices



Source: Ovum

For most people, the overall experience of using digital assistants is satisfactory as Figure 2 shows. In terms of functionality, the amount of skills AI assistants can perform has increased exponentially. Their capacity to handle more advanced requests has also improved, enhancing the overall customer experience.

However, AI assistants are not offering a natural conversational experience and usage is still limited to basic tasks such as playing music or checking weather forecasts. At present, interacting with AI assistants is not always a frustration-free experience. For instance, users need to learn specific voice commands for the assistant to be able to control certain smart home devices such as a light or thermostat. On top of this, AI voice assistants do not always understand what users are saying or who is talking. As Figure 3 shows, many people are not necessarily convinced about the need of a home assistant device, sometimes finding it too expensive or even intrusive as smart speakers are always listening and waiting for the wake word to take commands. Other respondents have indicated that they prefer to wait for the technology to mature to make the spending worthwhile.

Vendors in the AI assistant space such as Amazon and Google are aware of these problems and are trying to solve them fast to avoid a slowdown in adoption. This means that once users have embraced the idea of having a AI home assistant, it is important to continue educating them to not only promote further usage, but also to reduce current frustrations levels and even stop them giving up on the technology. Consequently, further investment is needed to offer a seamless AI experience, including initiatives to improve voice recognition and natural language capabilities. Ovum believes vendors must continue to invest to make assistants smarter, enabling them to sustain more contextual conversations beyond the two-question interaction that most AI assistants offer right now.

In this sense, language support has also become a pressing issue in the AI assistant battle for supremacy. For example, Google has announced that by the end of 2018, Google Assistant will be available in more than 30 languages and become multilingual, initially supporting English, French, and German simultaneously. Google has a global language advantage over Amazon as Alexa only speaks English (with American, Canadian, British, Australian, and Indian accents), German, and Japanese for the time being.

Comprehensive language support will be imperative to cement AI assistants as one of the main interfaces for the home at the global level. However, the development of local ecosystems of partners and developers willing to bring onboard local functionality, products, and services will be equally important to promote adoption among users by country. Ovum expects key vendors in this space will work to build lucrative ecosystems at local level, while also generating a positive spillover effect over the local smart home market as a whole.

Recommendations

- **For vendors: Take time to perfect new market initiatives before launching them.** Although the revolution in the AI-enabled smart home world requires vendors to be quick off the mark to introduce new features for their assistants, they must take the necessary time to get things right at the start to avoid reputational damage.
- **For service providers: Invest in proprietary assistants only if there is a concrete opportunity to add value.** The functionality of existing assistants will be more difficult to match as competition intensifies. If their market approach is via a proprietary assistant, service providers must be able to convince consumers they can add value and provide a better experience at all times.

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Successful Smart Cities Start with an Integrated Strategy

Integrated planning is crucial for positive smart city IoT outcomes

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Smart city initiatives are important in the push for government transformation. Limited budgets and fragmented approaches mean that cities often limit themselves to small, targeted smart city initiatives covering only a single application or neighborhood. But there is only so much that can be achieved through point solutions and quick wins such as limited smart parking, connected rubbish bins, and smart street-lighting deployments. As digital initiatives gather momentum across government, there is growing pressure for smart city initiatives to be driven in a much more structured way.

A strategic plan is needed to guide successful smart cities initiatives. City authorities cannot afford to see such initiatives as just technical considerations, somehow separate from mainstream city administration. Instead, smart city plans must become more closely integrated into the core of a city's ongoing strategic investment strategy.

Ovum view

- The lack of an organization-wide strategy is one of the top inhibitors for digital government initiatives, as is the lack of citizen and other stakeholder engagement.
- Smart cities are not a new concept, and IoT-based solutions are a core element. However, many cities continue to report challenges related to the lack of standards and packaged solutions, as well as the lack of business case, which results in the risk that projects stall at the proof-of-concept stage.
- There is little guidance on which solutions are appropriate, and little appetite to learn from other cities that superficially are deemed to be too different to one's own.

Recommendations

Cities and would-be smart city solutions providers should:

- Resist the temptation to adopt quick, ad-hoc solutions that just focus on a single problem of short-term concern to a select constituency.
- Ensure smart city initiatives are built on the foundation of a vision, with a framework developed in a clear and methodical way through identifying drivers as the first step. Take care to involve stakeholders in each phase.
- Embed business cases in any smart city strategy, as well as looking at a proof-of-concept to demonstrate long-term value.
- Investigate lessons learned from other cities. Service providers can also assist in facilitating introductions and engagement with other stakeholders or partners.

Smart cities need a well-articulated, holistic plan in order to succeed

Ad-hoc solutions, though tempting, are not the answer

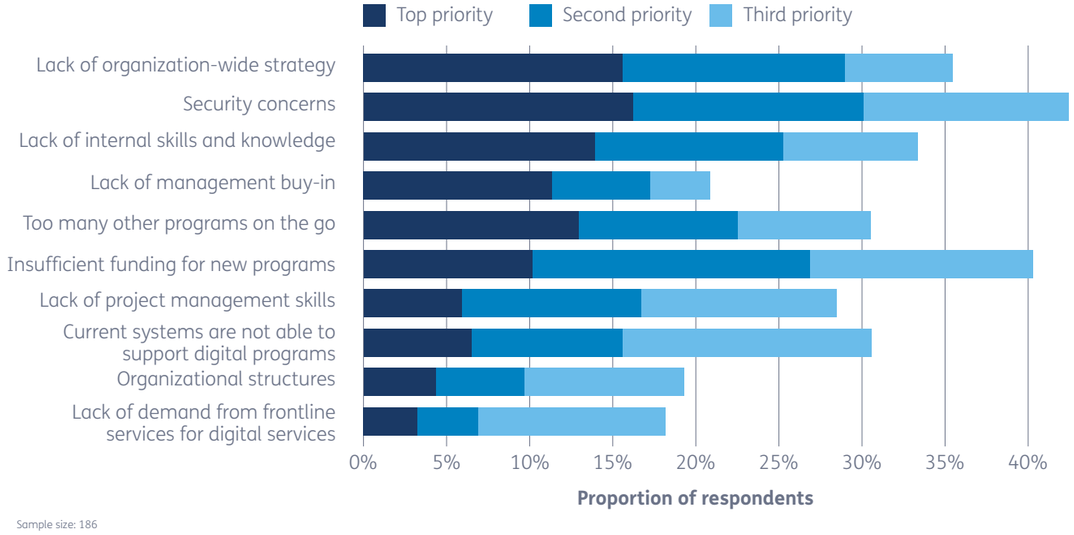
Most countries around the world need to address the growing challenges brought about by rapid urbanization. These include traffic congestion, economic and tourism development, citizen engagement, resilience, downtown renewal, aging populations, and public safety. Although technology exists that provides new and innovative solutions for dealing with these challenges, pressure to deliver quick outcomes can deliver unintended consequences. Ad hoc solutions may stall at the proof-of-concept stage, or technology initiatives that are successful at the beginning may in reality be hiding potential downstream problems.

Some of the challenges have been illustrated in Columbus, Ohio, the winner of the US Department of Transport's Smart Cities Challenge in 2016. A traffic collision prevention project using camera sensors on city buses to detect oncoming pedestrians and vehicles did not work at night, when most collisions occurred. In another example, an application for delivery truck drivers to reserve times for loading and unloading on streets could not be enforced without prohibiting the public from using those spaces. City authorities subsequently 'paused' deployments to allow time for more feedback and citizen consultation – which, as discussed below, is key to success.

Successful smart cities follow organization-wide strategies

To be successful, smart city initiatives need to have a well-thought out vision, as a recent Ovum global government survey clearly shows (see Figure 1). The lack of an organization-wide strategy was identified by respondents as one of the top-three inhibitors for digital government initiatives. The other two major inhibitors were concerns about cybersecurity and insufficient funding for new programs; addressing these two factors should necessarily form part of a smart city strategy.

Figure 1: Top challenges holding back digital government initiatives



Sample size: 186

Question: What are the top-three challenges holding back your organization from undertaking digital programs that support the transformation of services?

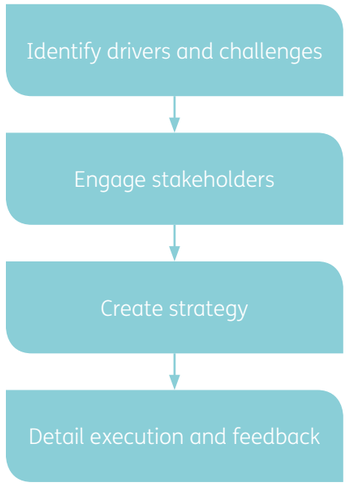
Vertical: Government. Government agencies: Community amenities and housing, environmental protection, public order and safety, social protection, and transportation/public works/ infrastructure. Country: All. Enterprise size: All.

Source: Ovum

Use a robust process to create a strategic framework for a smart city

Moving away from ad hoc solutions to an explicit strategy results in a strong foundation for smart city success. There are certain steps that should be taken in order to address the factors that constitute the plan, including inclusion of stakeholders, partners, and lessons learned from other jurisdictions. Importantly, the plan must recognize that the first step needs to address what the challenges and drivers are for the city. The answers to these challenges will form the outcomes for the plan. They will also indicate what types of technologies and applications need to be pursued.

Figure 2: Smart City Planning: A four-step framework



Source: Ovum

Identify which city-specific drivers need to be addressed

Smart cities are not new to IoT-based solutions. However, many cities continue to report challenges related to the lack of standards and packaged technology solutions. As a result, it is difficult for both cities and service providers to determine which IoT applications will deliver the best outcomes both now and as the city grows.

Of course, cities have the added challenge of political pressure to create something to show value to taxpayers and voters. As a result, there is often a focus on high-visibility, ad hoc point solutions. But if cities do not solicit citizen engagement or other stakeholder buy-in before solution execution, projects may fail to show the desired results, or to win budget renewal approval. A further risk is that the key champion fails to be reelected.

Successful city authorities need to determine the most important drivers and challenges for their cities, and then seek smart city solutions to address each. These tend to fall into common groups:

- Demographic sustainability: Population growth, urbanization, inner city decline, aging populations.
- Economic development: Attracting business investment, tourism, quality-of-life indices.
- Environmental: Pollution, waste and water management.
- Mobility: Transportation, ride sharing, multimodal transport, autonomous vehicles, fleet tracking and management.
- Financial/operations: Efficiencies, alternative financing, budgetary constraints.
- Resilience: Disaster preparation, cybersecurity.

This list is by no means comprehensive. The key is to determine which are the city's priority outcomes, and then work back to what needs to be done in the context of smart city deployment to enable these.

Focus on stakeholder engagement

Due to the nature of their services, city governments are far more visible to tax payers and voters than any other layer of government. If citizen/stakeholder engagement is not given sufficient attention upfront, key smart city initiatives can easily fail, despite their technical advantages.
To be successful, a smart city strategy must have stakeholder engagement as a core requirement. There is a potential role for the service provider to be actively involved in participating in citizen engagement, as well as in deployment.

Create the strategy

Many cities have publicly available plans that detail their most pressing issues and what they wish to accomplish in the future. These plans can ultimately serve as both frameworks and playbooks for successful smart city deployments. Choice of technology is crucial. Some cities have chosen to deploy connectivity backbones to support IoT smart city applications. This is a key issue for service providers to engage in; again, their involvement does not necessarily need to stop just at network deployment level. Vendors are already engaged with cities to create 'living labs' to pilot smart cities applications and services. Google is doing this with Toronto and Bosch with San Francisco, for example. Service providers are engaged in partner ecosystems with cities, as well for their living labs, such as KPN with Amsterdam.

Citizens can also be engaged in testing smart cities applications in working and living environments, to provide real-time crowdsourced data and collaboration. Ovum's research on government approaches to smart city projects in the Asia-Pacific region indicates widespread and increasing use of crowdsourcing as a key part of testing regimes.

Implement lessons learned from others during the execution stage

Cities cannot afford to be insular when looking at their challenges. They must acknowledge that urbanization issues have no geographic barriers. A city in the US undergoing urbanization can have similar demographic issues and use similar solutions to one in the UK. A Latin American city employing antiseismic sensors and citizen notifications can utilize a similar solution to that is used by governments to warn citizens of impending tsunamis in Asia. Equally, a failure in implementing a parking solution can be a learning process for cities everywhere who face the difficult balance between driving revenues, and creating intangible value through improved citizen experiences and public service provision. Lessons from both success and failure can be learned and shared by cities and vendors, regardless of location. Being aware of these lessons, as well as regularly monitoring progress, will serve to create a strong feedback loop that serves to ameliorate smart city applications and plans as they are being implemented.

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IoT Disruption Creates New Opportunities and Challenges for Insurance Providers

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The insurance sector is often highlighted as one of the industries likeliest to see significant disruption from the IoT. But growth and take-up has been patchy. The number of telematics-linked auto insurance policies issued globally will grow at a solid 36% CAGR over 2015–20, while IoT-linked home insurance is showing only very modest growth so far.

Ovum's view is that the prospects for IoT-enabled insurance prospects are still excellent, but a clear understanding of the industry itself is needed in order to inform a successful strategy.

To understand how IoT will impact the insurance industry, it is useful to first paint a vision of today's insurance proposition and how it will change over the next few years.

For the vast majority of insurance carriers today, personal lines insurance offerings share a number of common characteristics. To arrive at a premium to charge a customer, most insurers use a number of fairly static indicators such as previous claim history, credit ratings, and zip or postcodes. These are used to assess how likely someone is to make a claim. From the customer's perspective, this is a very opaque process, with the average policyholder having very little idea why their premiums are as they are. This approach does not allow an insurer to price risk down to the level of an individual policyholder; it only allows a policyholder to be placed in a broad risk category

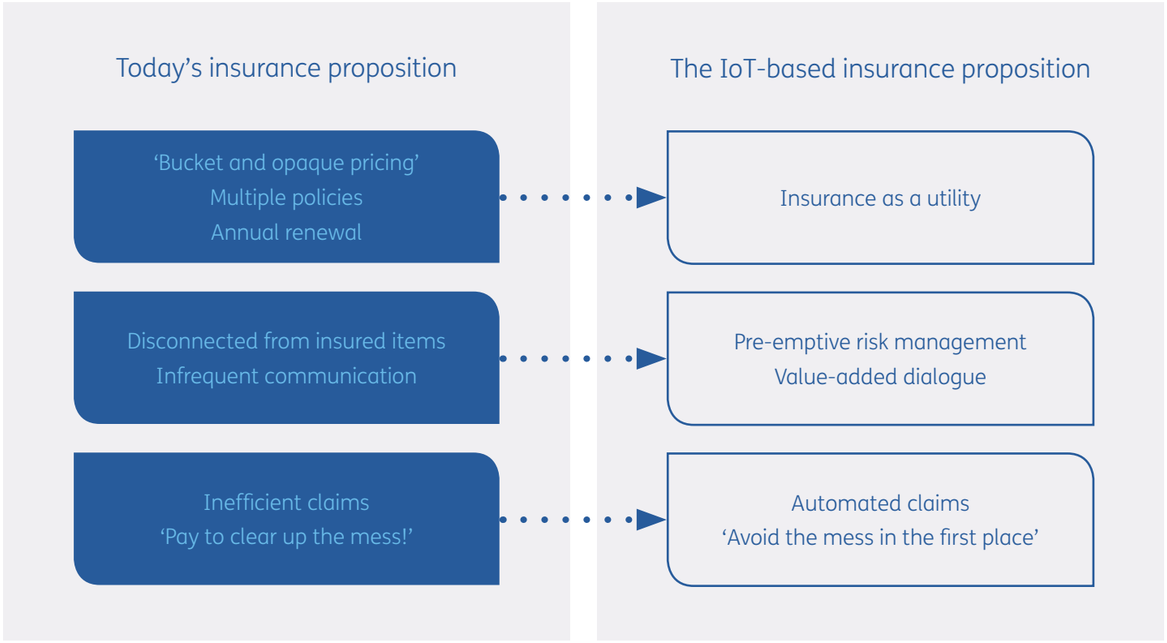
Today, most insurers remain completely disconnected from the asset they are insuring. Most auto insurers, for example, have only a very limited idea of how many miles a policyholder drives in any year, despite the fact that this is the single most important determinant of how likely a customer is to make a claim. Equally, most insurers have no idea what risks a customer is taking while they are driving. For example, behavior such as using a mobile phone while driving significantly increases the risk of accidents.

To make a claim, the policyholder themselves must initiate the process. This 'first notice of loss' can sometimes be some time after the incident has occurred, which can complicate the task of gaining an accurate picture of the incident.

The claims process is then often time-consuming, needing assessors or loss adjusters to carry out an inspection and produce a report. All of this can take days (or weeks) to resolve, costing the insurance carrier money and further frustrating the customer.

The emerging IoT insurance proposition

Figure 1: Evolution of the insurance proposition using IoT



Source: Ovum

As summarized in Figure 1, the use of IoT and telematics technology can improve both the customer's and the insurer's experiences.

IoT allows the insurer to actually be connected to the items being insured. For example, we have seen the emergence of vehicle telematics over the last few years that provide insurers with information about time and duration of journeys and, in some cases, location data and how safely a driver is driving. The implication is that an insurer is now in a position to assess the risk posed by a specific policyholder. This offers the possibility for dynamically-priced insurance that reflects both the true risk posed and the amount of insurance a policyholder is actually consuming – in other words, usage-based insurance (UBI).

Beyond providing a better understanding of the true risks being faced by an insurer, IoT technology can enable insurers to manage and mitigate some risks. Driving apps that provide feedback about driving habits and how driving can be improved are a good example, with growing evidence that such apps can reduce the number of accidents by as much as 40%. Providers include Aviva (AvivaDrive), Allstate (Drivewise), and Nationwide (SmartRide).

IoT technology can also have a major impact on today's claim process. There are already a number of examples of insurers using telematics devices within vehicles to automatically detect and report crashes in real time. With the detailed data available, they can instantly assess the likely severity, what sort of response is needed, and likely claims costs. Such data also helps to identify potentially fraudulent claims.

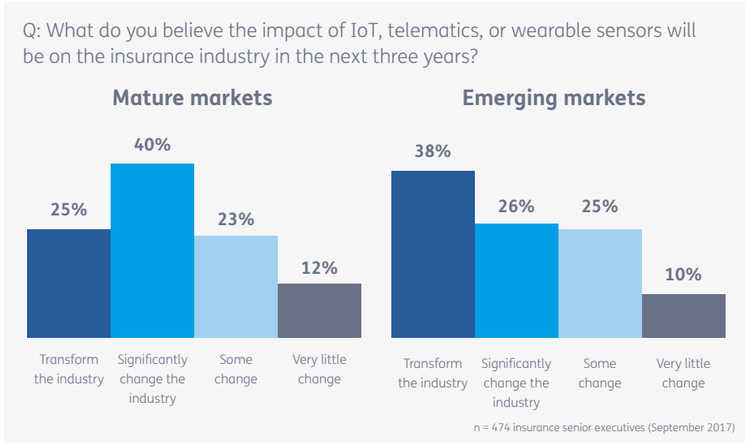
IoT will not solve every insurance problem – a house full of IoT sensors will not stop a hurricane or a major flood. However, integrating IoT technology can help insurers move away from a proposition that is often seen as a paying to clean up a mess after the event, toward a more valued, preemptive risk management service offering.

Most insurers believe IoT will change the industry

As part of our ICT Enterprise Insight survey of 474 insurance CIOs from around the world, Ovum asked respondents what they believed would be the impact of IoT, telematics, and wearable technology on the insurance industry, and by implication on their business, over the next three years.

Overall, some two-thirds of respondents believe IoT will (at least) significantly change the insurance industry, and about one-quarter of respondents believe it will transform the industry, over the next three years. Conversely, only a small minority (approximately 10% of insurers) believe IoT will only have very limited impact on the industry.

Figure 2: Insurers expect significant or even transformational impact from IoT



Source: Ovum ICT Enterprise Insight Survey

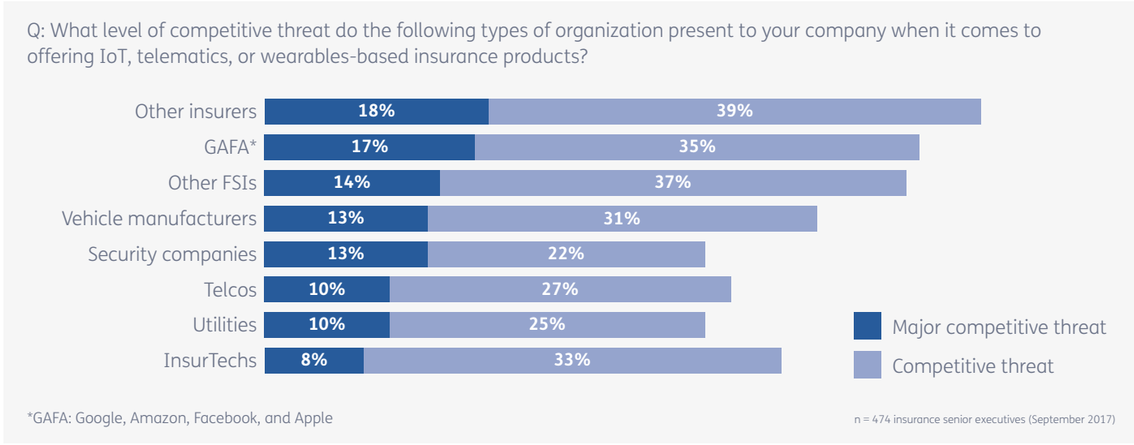
Results differed somewhat between mature markets – principally North America, Japan, and Western Europe – and emerging markets such as India, China, and Indonesia. The latter group are more likely to see the IoT as transformational for the insurance sector. This likely reflects the lower overall level of maturity of the sector in these markets – in some ways they present more of a 'greenfield' for IoT-based insurance, and so the pace of adoption and product innovation may be faster.

Although full-scale IoT-based insurance offerings at scale may be some years away from being fully realized, IoT's impact will begin to be felt by many insurers much sooner. While many insurers have already been looking seriously at the role IoT-based insurance could play in their product offerings, three years is not a long time to prepare and implement those plans. To deliver new IoT-based insurance propositions will inevitably mean significant restructuring and realignment for many of today's insurers.

IoT will change the competitive dynamics

Another question posed in the Ovum survey was what about the level of competitive threat posed by various players when it comes to offering IoT-based insurance products.

Figure 3: Perceived level of competitive threat for IoT-based insurance provision



Source: Ovum ICT Enterprise Insight Survey

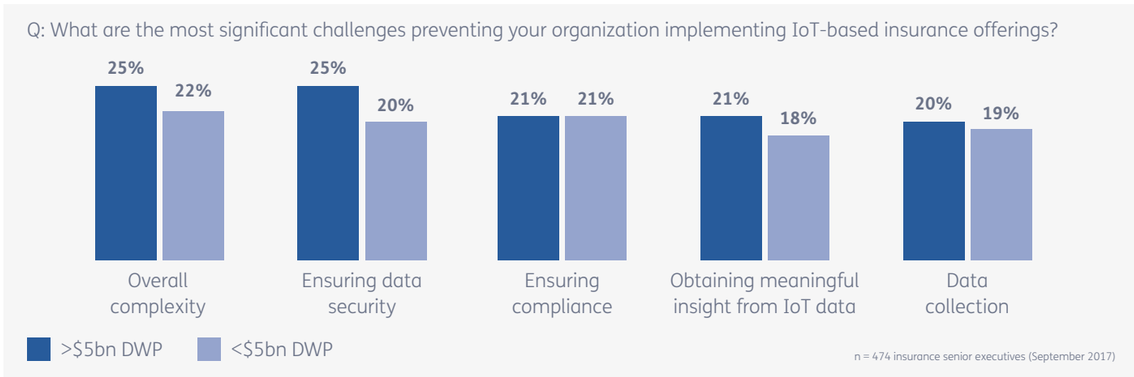
The results show that the GAFA group, consisting of Google, Amazon, Facebook, and Apple, are seen by insurers as major threats. This group is dynamic and could also include other players such as Tencent, Baidu, and Alibaba, depending on the specific market.

The most striking point to emerge is that the GAFA group were not on insurers' collective radar as a competitive threat when Ovum conducted this survey three years ago, reinforcing the profound impact IoT is having on the insurance industry.

Data management is the key challenge

The survey also examined the key challenges faced by insurers in responding to IoT. Figure 4 shows the highest-scoring challenges, split by size of insurer in terms of direct written premium (DWP) value.

Figure 4: Data and complexity challenges are key barriers for insurers



Source: Ovum ICT Enterprise Insight Survey

The key benefit of IoT-based insurance is providing an insurer with data that can be used to derive accurate pricing, support customers better, and manage risk more effectively. However, as the survey shows, IoT data generates its own issues: How do insurers ensure that the vast amount of personal data acquired through IoT remains secure and compliant; how can they collect that data effectively; and more importantly, how can they obtain meaningful insight from that data that they can act on?

The key point that emerges is that data management is a critical factor for the successful implementation of IoT insurance products, and insurers need help overcoming these challenges. Would-be technology enablers should take note and ensure that support is offered to insurance sector customers to address this.

Conclusions

It is clear that insurance executives expect their industry to be profoundly affected by the emergence of IoT technology over the next few years.

The industry has already begun to respond, with most major North American and European auto insurers now offering a telematics or smartphone-based UBI product, as well as newer start-ups such as MetroMile, Insurify, and InsureTheBox. However, while there are clear opportunities, adjusting to the changes brought about by IoT will present significant challenges for many insurers. Some of these challenges are internally- and operationally-focused, as insurers realign their ICT infrastructure and in-house skill sets or supporting partnerships to address the complex data management issues presented by IoT.

Perhaps the most profound changes will be those brought about by the shift in competitive dynamics unleashed as a result of IoT. The insurance industry, while competitive, has always presented significant barriers to potential new entrants. However, insurers will need to rapidly adjust to powerful, more agile new competitors, such as Amazon or Google, that often lead technology change, have a detailed understanding of their customers, and a culture of moving rapidly to disrupt market sectors. Start-ups will also be important in driving disruption, and investment or M&A will be an important strategy to consider for traditional insurers. Insurers need to ensure they stay relevant for their customers, as consumers are increasingly offered more options and greater personalization when purchasing insurance.

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