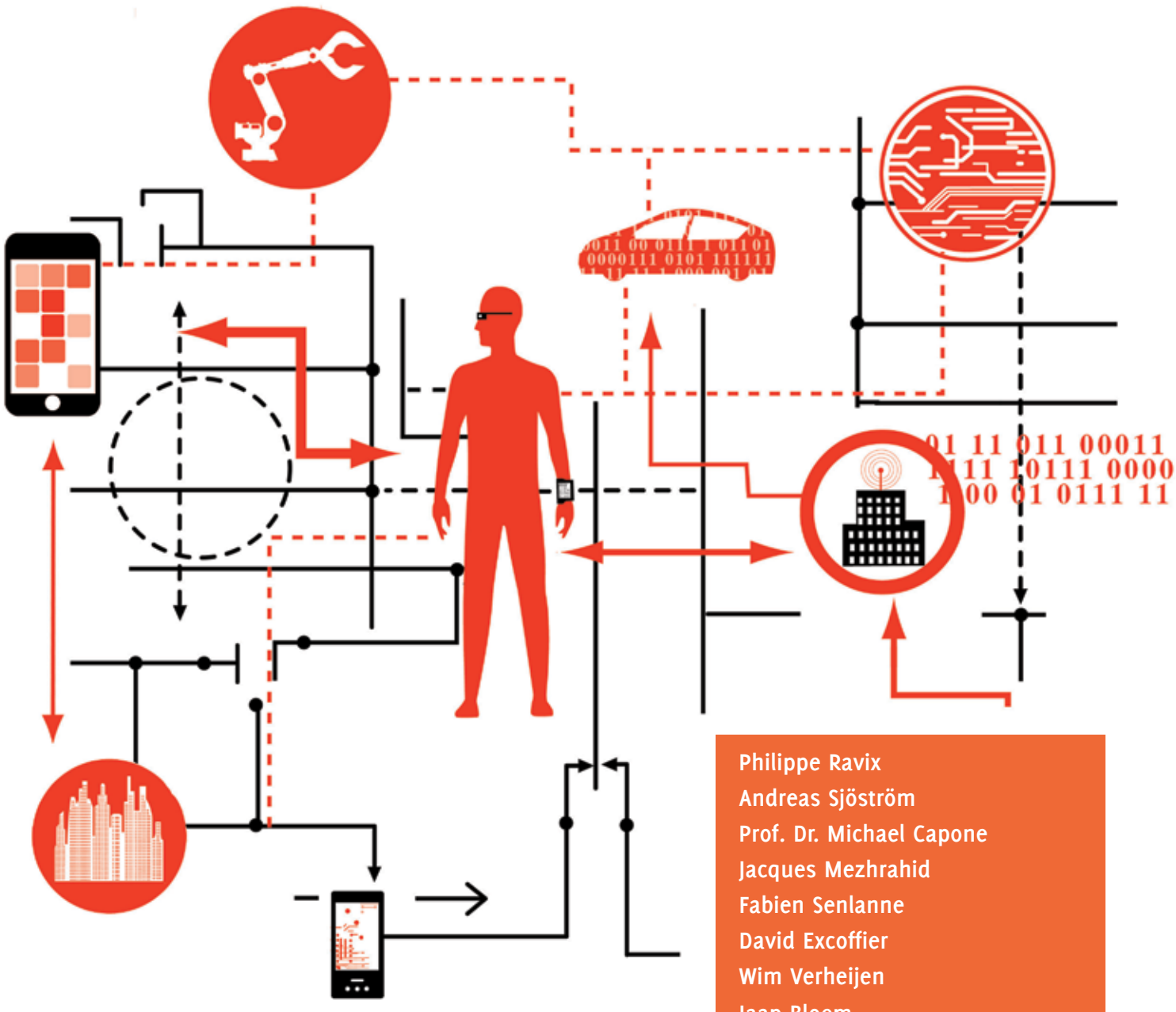
SOGETILABS

CONNECT • TALK • THINK • ACT

Developing Internet of Things & Industrial Internet Opportunities



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Foreword

Even though the hype around the so-called internet of Things (IoT) is sometimes deafening, I feel we are just scratching the surface of what will become possible in this Age of Customer Service Innovation. An instrumented, interconnected and intelligent world not only creates tremendous opportunity to make, transport and operate “Things”. It will also lead to stunningly better products based on real-time insight into how we use them – whether it concerns a turbine in a power plant, an electric toothbrush, and everything in between.

Undoubtedly the most exciting IoT opportunity comes from the insight gained through advanced analytics of collected sensor data. By making products intelligent and interconnected, companies can create value-adding services to better meet customer needs, make product use more efficient and create a far more rewarding customer experience in a true Internet of Things & Services.

But there’s no free lunch! It takes a lot of well-concerted effort to instrument and interconnect our processes, our practices and our lifestyles. Complex trade-offs are required, which already start at the level of sensors capturing the data. Often, “Things” operate in remote places where electricity and connectivity are scarcely available. Smart decisions must determine what information to keep and what to discard, since real-time data at high sample rates tend to explode quite quickly.

After all the relevant sensor information is aggregated, analyses must fuel insight – preferably predictive – into what is happening and what should be done. Ultimately, effective action is needed, ranging from dispatching a service mechanic, commanding an actuator or instructing a call-center agent to connect to a customer. Creating closed real-time loops like this often proofs to be complex, especially with respect to reliability and security.

The report before you does not offer instant recipes for success. That would grossly underestimate the complexity of IoT solutions. Instead you’ll find a clear explanation of IoT opportunities from industrial to consumer markets that are too compelling too ignore. It helps you focus on “Things” from your own perspective and develop solutions that will enhance your competitive edge. I hope you will have as much pleasure reading our report as we had writing it.

Michiel Boreel, Chief Technology Officer Sogeti

Introduction: Connect • Talk • Think • Act

This report follows upon the successful fourfold series from SogetiLabs on the Internet of Things (IoT) and the Industrial Internet (of Things: IIoT). Both flavors are "two of a kind", transforming the ways in which enterprises operate, collaborate and engage with customers. In this report, the focus is on Sogeti's vision and client experience in industrial and consumer markets, and everything in between: from turbine to toothbrush, so to speak.

Currently, a final "Internet of Anything" or "Anything Internet" phase is much to the fore, marrying the consumer side and the industrial side of the Internet of Things through a myriad of connected services within and beyond company boundaries. This lays the foundation for product and service innovation, intensified customer engagement, new business models and revenue streams.

GE's Industrial Internet

Starting with General Electric's Industrial Internet and the development of advanced analytics software for GE Aviation, we set out to explain how the scope of the Internet of Things touches the operational excellence and customer intimacy efforts of all enterprises through product and service leadership. We introduce the Connect-Talk-Think-Act paradigm, and the corresponding straightforward 5A architecture of IoT systems.

What Customers Want and Expect: Connected Service eXperience (CSX)

Dealer-FX Group is among the fastest growing enterprises in North America. The company serves as a convincing poster child for the urge all companies should feel to embrace a digitally connected service approach before competition takes the lead and trumps reactive business models overnight in a disruptive way. We proceed to help you make your business case by explaining what a Connected Service eXperience (CSX) involves, what steps should be taken, what maturity means in this context, which complexities arise, how we can assist you in overcoming them in a cost-effective manner, and what security concerns must be taken into account.

Things and Services from Michelin and Philips

Of course Michelin will continue to be the renowned tire manufacturer selling its quality products, but the company is also gradually evolving towards service provisioning. With smart sensors and in-vehicle telematics, Michelin has started to sell miles for vehicles, or a number of landings for aircraft. In essence, it is the same move that General Electric has made leasing turbine engines to various sorts of operators.

The multi-talented architect Le Corbusier memorably defined: "light creates ambiance, light makes the feel of a space, and light is also the expression of structure."

He was right, but connected lighting does even more, as the Philips *hue* bulbs show. Lighting may be personal and wirelessly controlled nowadays, even over the Internet, and connected for convenience and security to, for instance, smart thermostats like Google's Nest and intelligent door lock systems.

IOT with Sogeti

Let the Philips Sonicare toothbrush represent the consumer end of the sensor connected world we live in, and GE's talking turbines the industrial end of the spectrum. We tend to refer casually to these telling examples, and everything in between, in terms of the Internet of Things and the Industrial Internet. Increasingly industries will engage in both, as our sensorized world is rapidly growing by billions of nodes each year.

We present the three angles from which organizations tend to approach the new business opportunities and conclude by highlighting inspiring examples from our own practice, of companies that are actually building out new Connected Service eXperience opportunities by delivering real business value to customers through the application of IoT solutions.

IoT Benefits

The world has started to embrace the Internet of Things: retailers, media, airlines, and car makers; insurance companies, telecom operators, product manufacturers, and software companies; transportation & logistics, cities, farmers, armies and individuals. Better products and services, new functionalities, faster customer feedback loops and value chains, a remarkable increase in innovation and start-up activities, new business models, cross-industry benefits, and last but not least a healthier and more efficient human lifestyle are just a few generic highlights from the impressive longlist of applications that our sensorized IoT world has to offer.

Connecting the IoT Dots

Every major progress comes at a cost and the IoT is no exception. Learning by doing, we experience today what it means to *Connect* objects, machines, devices, components and people; what these actors should *Talk* about; how we can let them *Think* with us and among themselves; and what *Actions* we consider necessary and desirable in specific business contexts.

This Connect-Talk-Think-Act paradigm is the concise way of explaining A) what the implementation of IoT solutions would mean in a specific context, B) which complexities and challenges arise, and C) how the simple CTTA mantra governs the more technical 5A scope of data Acquisition, Aggregation and Analysis, the automated Assignment of tasks, and the Actions to be taken: see Chapter 2.

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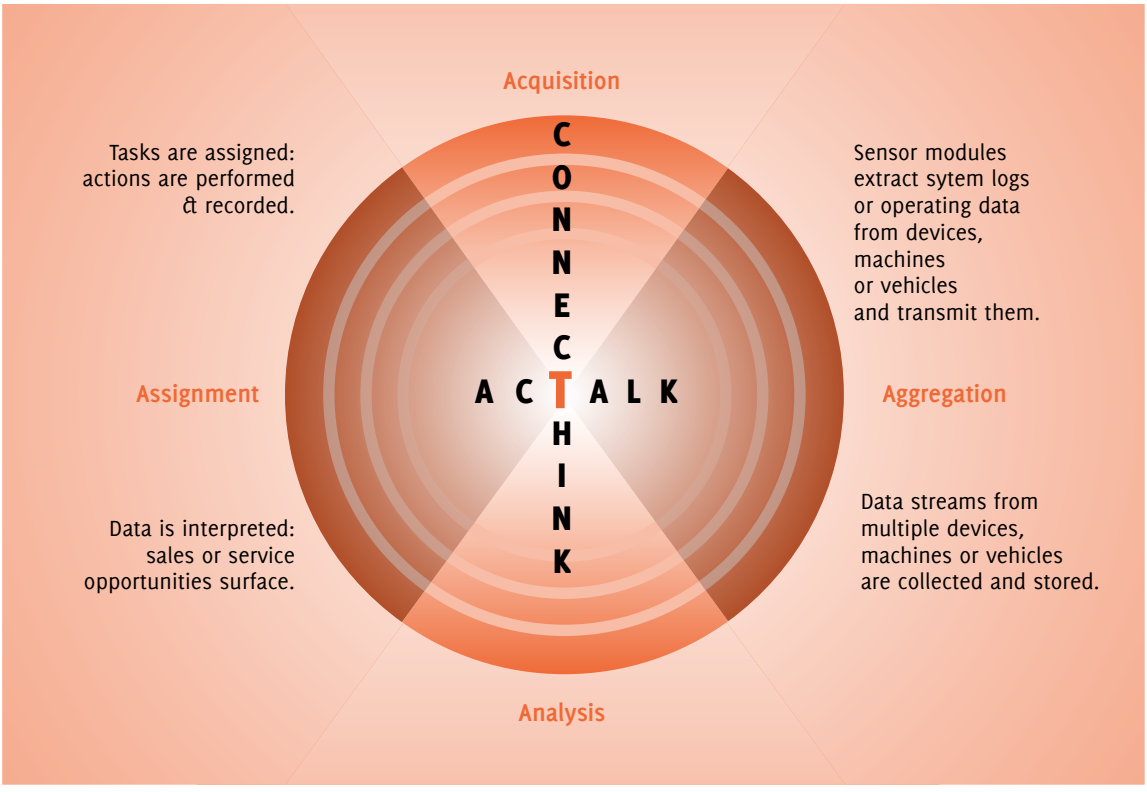
acquire aggregate analyze assign

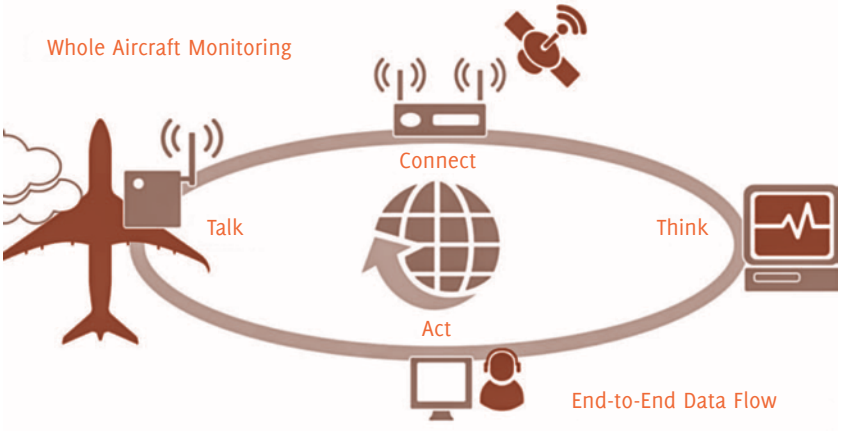


The architecture of any Internet of Things or Industrial Internet application consists of a four-tier structure in which the Connect phase is the start of data Acquisition; the automated communication phase (Talk) corresponds with Aggregation of data; Think equals data Analysis; and Action follows upon the (automated) Assignment of tasks.

1 GE's Industrial Internet (of Things and Services that is)

General Electric, famously co-founded by Thomas Edison, was one of the first companies to grasp the enormous innovation potential that an instrumented, connected and intelligent world would offer, and is acting decisively upon the opportunities. GE's Predix predictive maintenance platform is among today's major hallmarks of what "connected things and services" can do in ecosystems of manufacturers, business partners, and customers throughout the economy – as GE operates through these seven segments: Power and Water, Oil and Gas, Energy Management, Aviation, Healthcare, Transportation, and Capital.

A fine example of General Electric's appetite for industrial innovation is the development of the core Integrated Vehicle Health Management application (IVHM) for GE Aviation. From medical imaging, to aircraft engines, energy and rail monitoring, GE and its affiliates monitor hundreds of thousands of different devices, including tens of thousands of engines.



Adapted from "Integrated Vehicle Health Management – Connecting You with Your Aircraft," General Electric 2010

GE's IVHM application now provides worldwide wireless connection 24/7 to aircraft health status in the broadest sense – including prioritized alerts and analyses of airframe, systems, and engines. The latter can be bought, leased and financed by General Electric Aviation Services (GECAS) from various companies, including GE, CFM, Rolls-Royce, Pratt & Whitney, IAE and Engine Alliance. GECAS offers short-term leases ranging up to one year, and operates leases up to a term of 20 years. The company provides the largest and most diverse pool of spare engines in the marketplace.

The many benefits of GE Aviation's IVHM application that keep increasing include: reduced unscheduled and scheduled maintenance; reduced return to service time;

reduced overall operations and maintenance costs; automatic data downloads for Flight Operational Quality Assurance (FOQA) and health; quick identification of fleet-wide issues; improved aircraft availability and technical support; constantly revised insights in aircraft operation and performance.

Through this comprehensive web-based aircraft health management service, GE Aviation makes it possible for operators to monitor fleet trends, and detect and predict anomalies earlier, with greater confidence. Advanced data transmission software enables a quick, smart and automatically updated 24/7 web connection between customers and a central data repository. GE Aviation's IVHM uses artificial intelligence technology to learn from the data, enabling increased fault detection and prognostics that promptly halved the number of undetected faults when it was taken into production, back in 2010.

The Benefits of Predictivity for GE

Predix is GE's software platform for the Industrial Internet. It enables asset and operations optimization by providing a standard way of running industrial-scale analytics, connecting machines, data and people. Deployed on machines on-premises or in the cloud, Predix combines an industry-leading stack of technologies for distributed computing and big data analytics, asset management, machine-to-machine communication (M2M) and mobility – all focused on what GE calls "Predictivity."

Predictivity Industrial Internet solutions leverage connectivity, advanced analytics and innovative user experiences to advance assets and networks toward zero Unplanned Downtime and maximized productivity through Predictive Maintenance technology. With Predictivity, industrial organizations acquire better insight into the past, transparency into the present and foresight into the future. Vertical-specific Predictivity solutions range from condition-based maintenance and asset life cycle optimization to fuel consumption management and plant automation.

No Blips in the Relationship

The "health" of products and services determines whether organizations, brands and applications can maintain an optimal relationship with their customer base or not. Therefore, in both industrial and consumer-oriented economic environments, Predictive Maintenance in a broad sense is a key target to pursue, while doing away with reactive maintenance and complaining customers. There should be no Unplanned Downtime or other inconvenience: no blips in the relationship whatsoever. In other words: an optimal Connected Service eXperience!

Based on GE's experience and insight, the following table presents an overview of the cost of Unplanned Downtime versus the benefits of Predictive Maintenance for application domains as diverse as Aviation, Food Manufacturing, Railroads, Oil & Gas, Water Management in Process Industries, Mining, and Power Generation Turbines.

	Unplanned Downtime	Predictive Maintenance
Aviation	– Air turnbacks are costly. – Decrease in workforce productivity. – Added maintenance costs. – Airline industry maintenance cost for delays & cancellations: $45 million per day. – Loss per cancellation or diversion: $25-100 thousand. – A delay costs $6-8 thousand.	– Effective workforce & reduced maintenance costs. – On-time performance. – Customer satisfaction.
Food Manufacturing	– A packaging line breakdown means delayed delivery & revenue impact. – More inventory & labor cost. – Lost production.	– Lower energy cost per unit. – Reduced maintenance. – Reduced labor cost. – Predictive maintenance can reduce inventory by 15% and improve overall equipment effectiveness by 30%.
Rail	– Lost locomotive availability & crew costs. – Loss per locomotive per year: $150 thousand. – Network congestion & mission failures. – Reliability costs due to mainline failures and excess fleet needed for Class 1 railroad with an average number of locomotives: $400 million per year. – Customer order fulfillment misses.	– Improved availability & utilization. – Improved network velocity & capacity. – Lower maintenance cost.
Oil & Gas	– Lost production. – Average annual cost for a mid-sized LNG facility: $150 million. – A well out of commission offshore means revenue losses of $7 million per well per week for operators. – Slowed deliveries. – Workforce downtime.	– Maximized production. – Predictable delivery. – Lower maintenance costs.
Water Mgt in Process Industry	– Repairs for unplanned events equal 10 times the planned maintenance costs. – Interrupted production. – Capital asset replacement. – Profit loss for a refinery, processing 200 thousand barrels of crude oil per day: $800 thousand daily.	– Extended production runs. – Minimized cost for cleaning and repairs.
Mining	– A poorly maintained concentrator increases energy & maintenance costs. – Usually lost production.	– Increased stability & profitability. – Lower energy & maintenance cost. – Productivity improvement per concentrator: $8 million annualy. – Repair cost savings depending on ore mined: $2 million.
Power Generation Turbines	– Lost production. – Additional maintenance. – Lost revenue per refinery: $1 million per day. – For a utility, with average spark spread of $13.15 per megawatt per hour & production of 170 megawatt the lost operational profit opportunity equals $45 thousand per day.	– Identifying parts that are starting to degrade can prevent sudden downtime. – Lower maintenance cost & improved availability & utilization.

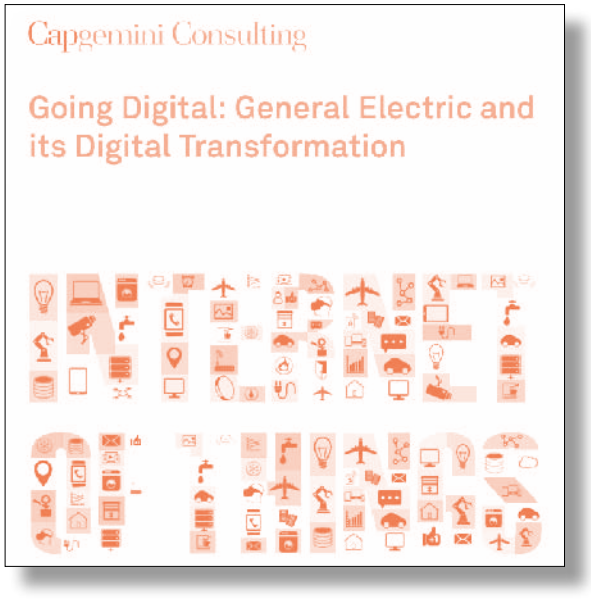
Source: https://www.gesoftware.com/ge-industrial-internet-infographic

For GE, responding to change is part of its modus operandi. This is a company that has famously made change a core capability and a constant in its history. For over 120 years, GE has ploughed forward under a banner of "Building, powering, moving and curing the world. Not just imagining. Doing." This constant focus on innovation and transformation has made the company the only one to still remain in the Dow Jones Industrial Index since the original index was established in 1896.

GE is betting big on software and analytics to bring about its transformation, with Jeff Immelt stating: "I took over an industrial company, now it will be known as an analytics company". GE's focus on data analytics was clear back in 2012 when it set aside up to $1.5 billion for small take-overs to boost its presence in analytics.

GE currently monitors and analyzes 50 million data elements from 10 million sensors on $1 trillion of managed assets daily to move customers toward zero unplanned downtime.

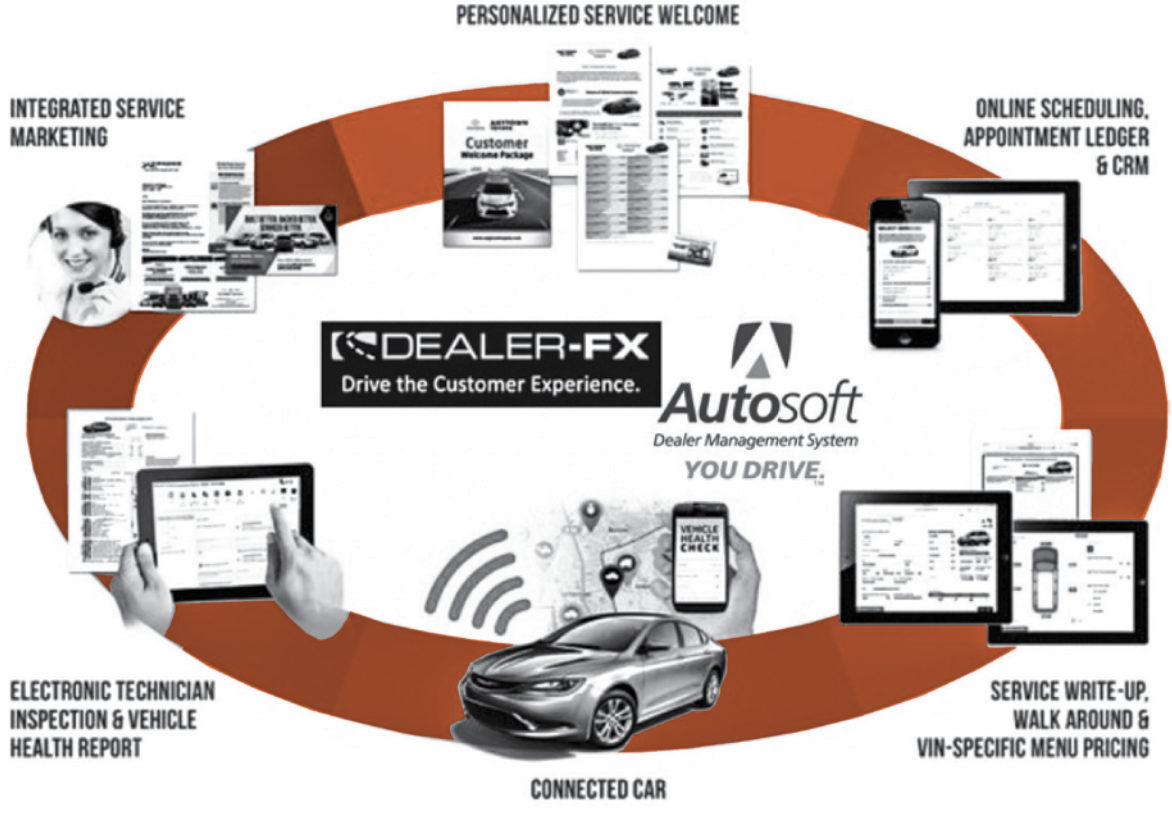
Want to know more? Then read this e-book!



Source: https://www.capgemini-consulting.com/general-electric-and-its-digital-transformation

2 What Customers Want and Expect: Connected Service eXperience (CSX)

Dealer-FX Group is among the fastest growing companies in North America. A trusted name in automotive retail software development and service solutions, the company empowers dealer and OEM clients to "Drive the Customer Experience" with their remarkably well executed product service, digital retention and relationship management strategies. Since 2013, Dealer-FX's Connected Service eXperience (CSX) has been based on AutoSoft's critically acclaimed Dealer Management System. In business now for 26 years, AutoSoft proudly calls itself "A Start-up with a History."



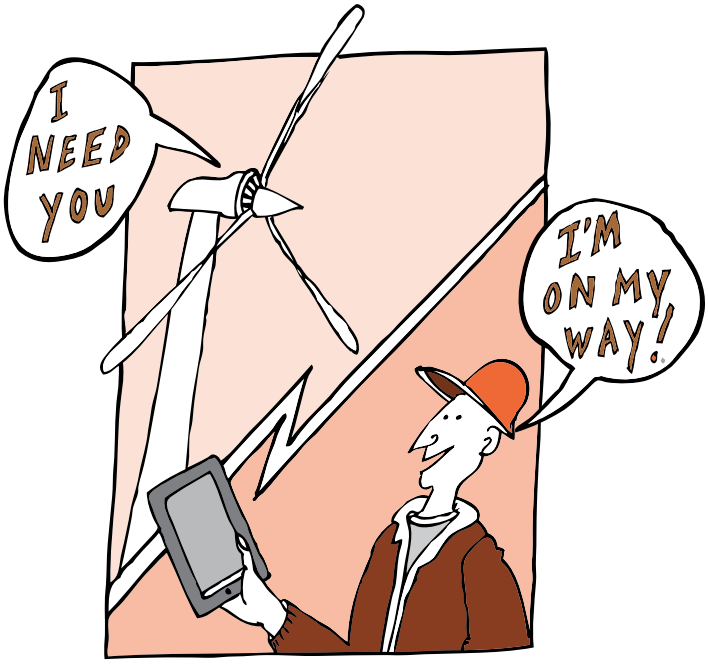
Setting a landmark example, the AutoSoft/Dealer-FX combination – FX stands for Fast & eXtreme, like in sports – continues to impress the whole automotive industry's ecosystem. Obviously, this kind of proactive and personalized connected services is exactly what customers want and expect nowadays, otherwise Dealer-FX would not have seen such tremendous growth in such a short period. Dealer-FX is a CSX poster child par excellence.

Every Connected Service eXperience involves using connected products data to trigger real or near-time interactions between sales, customer care, service and the customer through fully automated and semi-automated business processes. Therefore, the b2b and b2c combination of Connected Customer, Connected Car, and Connected Insights is at the heart of next-level car maintenance and ecosystemic customer servicing.

The process principle involved is quite straightforward: machine data (from machines, devices, tools, and components) automatically and proactively triggers valuable customer interactions. Outages and accidents are prevented, sales are captured, and customer dissatisfaction is being prevented. In GE's Industrial Internet context the Talking Turbines use case explains how things work:

Talking Turbines

In the city of Schenectady, New York, where Thomas Edison laid the foundation for what would become the General Electric Company, GE is currently deploying myriad sensors to collect information about what happens inside a massive steam-driven turbine generator that can light 750,000 homes: heat, vibrations, pressure and more. The sensors inside feed data into a computer system, related to factors like fuel costs, weather, demand for power in a particular area, and alternative supplies of electricity, all to find the optimal performance. Should the turbine run harder if a heat wave is coming up? Can wind turbines help out for a day or two? What about maintenance costs? How well trained is newly hired personnel?



If a turbine engine could talk, what would it say? Using data from remote sensors, engineers now have real-time information at their fingertips about how a machine is operating. For example, they will be alerted up front when maintenance is required to avoid unnecessary damage. Preventive and Predictive Maintenance are the main goals of the Industrial Internet, which connects machines to people in order to increase efficiency, minimize waste and change the way the world works.

Wind turbines packed with some 20,000 sensors can now be managed by a handful of people, replacing large numbers of local employees. Traditional servicing of machines and equipment remains important, but automated, data-driven management will be

far more efficient and effective. Problems can be spotted earlier, and there is much more knowledge about how things behave and interact with people and other things. GE's Measurement & Control division is devoted solely to this process: *"the machines are talking, we are listening, improving and optimizing",* is what it says on their website.

"Connected Customer, Connected Car, Connected Insights."

A merger of GE's three former units called Sensing, Inspection Technologies and Optimization & Control, the combined Measurement & Control business of General Electric is currently on its mission of *"connecting machines, data and people for the health of industry",* based on smart, predictive and integrated solutions.

"Connecting Machines, Data and People for the Health of Industry."

Connect, Talk, Think and Act before the competition does

In contrast to GE's best practices, most companies still only take action nowadays when the customer reports an issue. From a customer satisfaction perspective, reacting simply means being too late. Recent surveys show that 93% of companies fail to anticipate and act preventively. Although the technology to avoid this exists, as well as innovative and often disruptive use cases that are just waiting to be copied, many enterprises still wait for failure to happen and reports from customers before taking any action.

The situation is alarming: 99% of the data collected by companies today is latent while many opportunities are wasted. Companies apparently do not know how to use data to create value, and also fail to see that there are loads of cost-effective opportunities for them to improve and serve their customer remarkably better.

Reactive service processes that are bound to cause dissatisfied and complaining customers are typically H2H2S (Human-to-Human-to-System): manual, prone to subjectivity, and therefore extra time-consuming. If you recognize such situations, make sure to eliminate them before the competition does.

CSX: nine phases, five steps

Although most processes aiming at a better Customer Service eXperience (CSX) are only semi-automated at present – involving sales people, field service technicians, and customer care employees – they already make a huge difference in improved customer satisfaction. Across industries, these nine main Connect-Talk-Think-Act phases are typical of many practices today:

1. A connected machine or device generates data that is transmitted using a machine data gateway.
2. The data is aggregated and analyzed. When an anomaly is detected that can impact performance, a case is created.
3. The knowledge base or expert system is queried to identify the "next best action", e.g. skill set and part replacement.
4. The integration with the knowledge base or expert system identifies the service level and response time.

5 The integration with the HR system identifies the available co-worker with the proper skill set.
6 The integration with the inventory or PLM system (Product Lifecycle Management) ensures that the required part or service is available or ordered.
7 A ticket is created and a task is assigned.
8a A field service technician receives an alert on his mobile device. He informs a co-worker who performs the task and records the result on his mobile device, or …
8b sales or customer service receive a task in their CRM system (Customer Relationship Management). Then, sales sends an offer and/or customer support contacts the customer. The results are recorded in the CRM system.
9 The resolutions are analyzed, and the knowledge base or expert system (see 3) is updated.

Digitally optimized connected services typically relate to knowledge bases, expert systems, PLM and CRM systems – inside the enterprise and beyond its boundaries, tapping into partner ecosystems. Connect-Talk-Think-Act is a colloquial translation of the corresponding 5A cycle that includes these subsequent steps of data Acquisition, data Aggregation, data Analysis, the Assignment of tasks, and the required Action to be taken:

Step A1 – Acquisition. Sensor modules extract system logs or operating data from connected machines, devices or components and transmit the data. Some of these "connected things" generate data that is not transmitted, which requires additional action. Ideally, performance and usage data is acquired and transmitted every *n* seconds.

Step A2 – Aggregation. The operating data from multiple connected things is collected, aggregated and stored. The data is visualized. Most machine data stored nowadays is latent.

Step A3 – Analysis. Ideally, the data is being analyzed in real-time to identify issues. We distinguish between data visualization and analysis. When data is visualized, a person must monitor the data and decide if it is critical. This method is unreliable and subjective. Using historical and/or predictive tools, anomalies and issues can be automatically identified and trigger alerts set. Only a fully automated approach is reliable, objective, and timely.

Step A4 – Assignment. When the data indicates an anomaly or when an issue is identified that might cause a problem or represents an opportunity to eliminate dissatisfaction beforehand, ideally a case is automatically created. The most appropriate resolution is selected from the knowledge base or expert system, and assigned to the proper actor for handling.

Step A5 – Action. Interventions are performed to resolve the issue, and the process is recorded and analyzed. The results should be fed into the knowledge base or expert

system. In many cases, the actor is currently a sales representative, field service technician, or customer care agent as in the following scenarios:

i. Customer Care provides the operator tips and instructions.
ii. Sales & Marketing proactively sends the customer offers and orders, and/or …
iii. Technical Service is dispatched to perform maintenance or repair.
iv. The system sends messages, instructions and possibly software updates to the machine directly.

Consider these five A's the core of a more detailed Data Analysis Lifecycle:

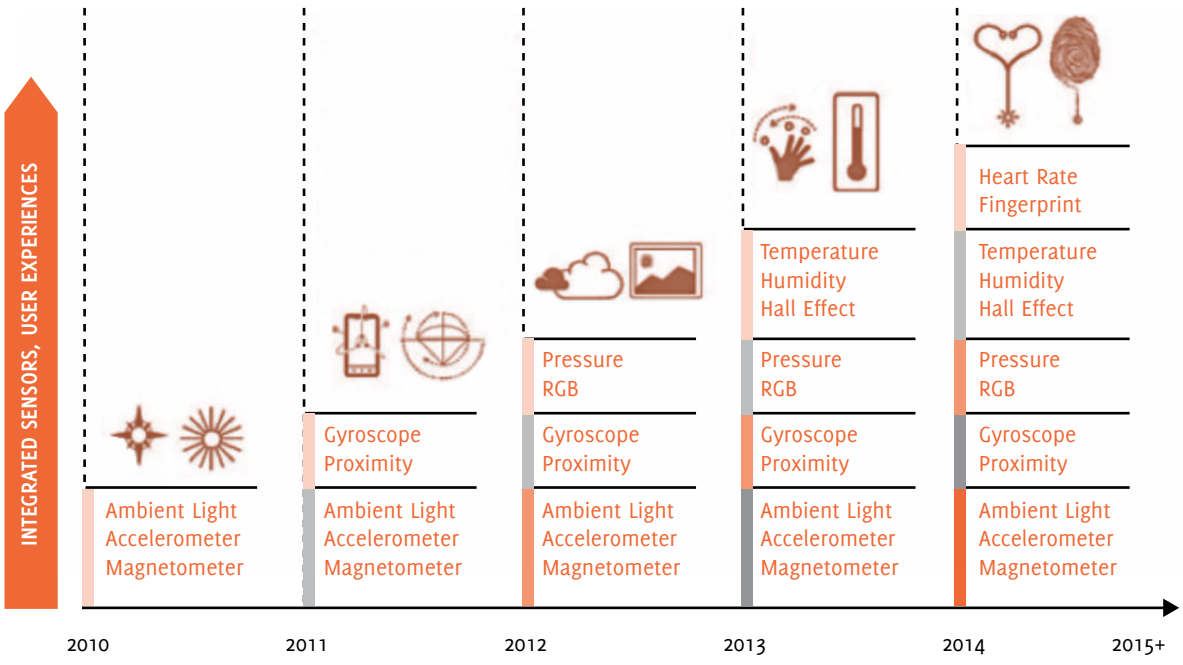
M2M (technical level) > IoT (system level) > CSX (business impact)

Any digitally optimized connected service involves the automated communication between machines, devices, tools, and components, to improve productivity, safety, and usability. We call this M2M: Machine-to-Machine. The systemic link between M2M (technical level) and CSX (business impact) is IoT, the Internet of Things (system level). IoT is about making the data from connected products and services available online for monitoring and reporting.

Over the last twenty years, M2M-based IoT systems have grown ever more powerful, practical and operable with increasing relevance for application in business contexts. Sensor-laden smartphones and the development of connected cars – aka "smartphones on wheels" – were among the first inspiring appified consumer IoT breakthroughs to greatly exceed customers' Connected Service eXperience.

Smartphones (On Wheels) have followed the well-known application of RFID tags for Collaborative Planning, Forecasting and Replenishment (CPFR) purposes at Procter & Gamble, where Kevin Ashton, head of the MIT Auto-ID Center, for the first time successfully implemented his Things That Think IoT at the end of the 20th century.

Today, Mr Ashton's "Internet of Things" – the phrase he coined – is transforming the way in which companies and industries operate. Increasingly, enterprises organize themselves around embedded automated sense & respond data feedback loops which enable better operations, faster product innovation, new service models, and vastly enhanced customer targeting and retainment.



Source: Overview of dramatically increased sensor integration in smartphones – Qualcomm

Common industrial and consumer-oriented sensor functions include light, audio, proximity, accelerometer, gyroscope, magnetometer, GPS. Also available are sensors for altitude, humidity, pressure, temperature, ultra-violet, gases and chemicals, air quality, radiation, blood glucose, alcohol, and breath analysis. The infamous Wikipedia List of Sensors counts well over 200 subcategories. Sensors are either built into devices and machines, or external, i.e. attached through wire or wirelessly connected, e.g. in the case of many wearable consumer devices. There are currently no significant technical barriers when it comes to placing more sensors in smartphones or any other apparatus, or to connect them.

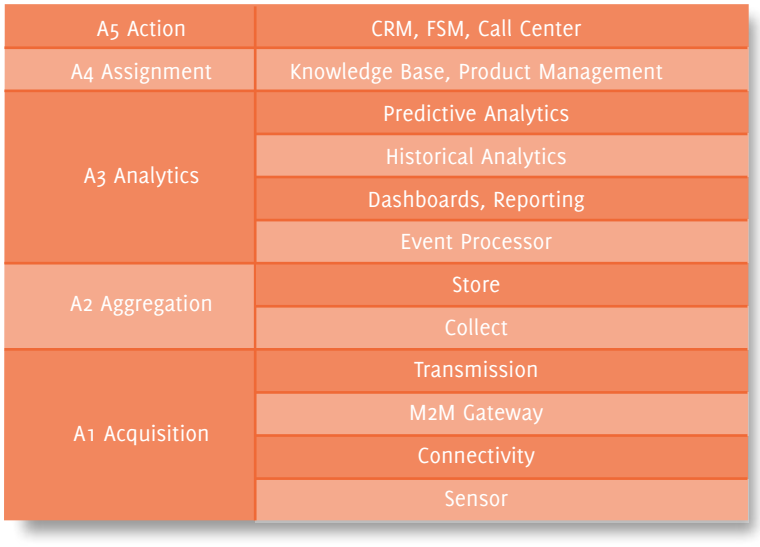
iCelsius RH, for instance, is a physically connected portable temperature and humidity sensor for iOS devices, while the IP1 and IP2 models are specific to food inspection. BT is an oral thermometer, and then you have the versatile iCelcius Pro on the one hand and the BBQ heat measurement solution on the other. Sensordrone, to mention a popular portable multipurpose device, consists of 13 different sensors, from gas oxidization to color intensity measurement. It can turn your smartphone into a carbon monoxide detector, a gas leak detector, a lux meter, a full-fledged weather station, and more.

IoT and M2M Complexities to Overcome in Your Connected Services Quest

Throughout the economy and in every corner of society, IoT applications have started out to demonstrate the combined effect of Moore's and Metcalfe's Laws on progress

and profit. Customer experience, operational processes, business models – all three areas of Digital Transformation are affected, while industry-specific applications and technological implications are some of the major points of discussion with clients (see the "IOT Tech Triad" in Chapter 4).

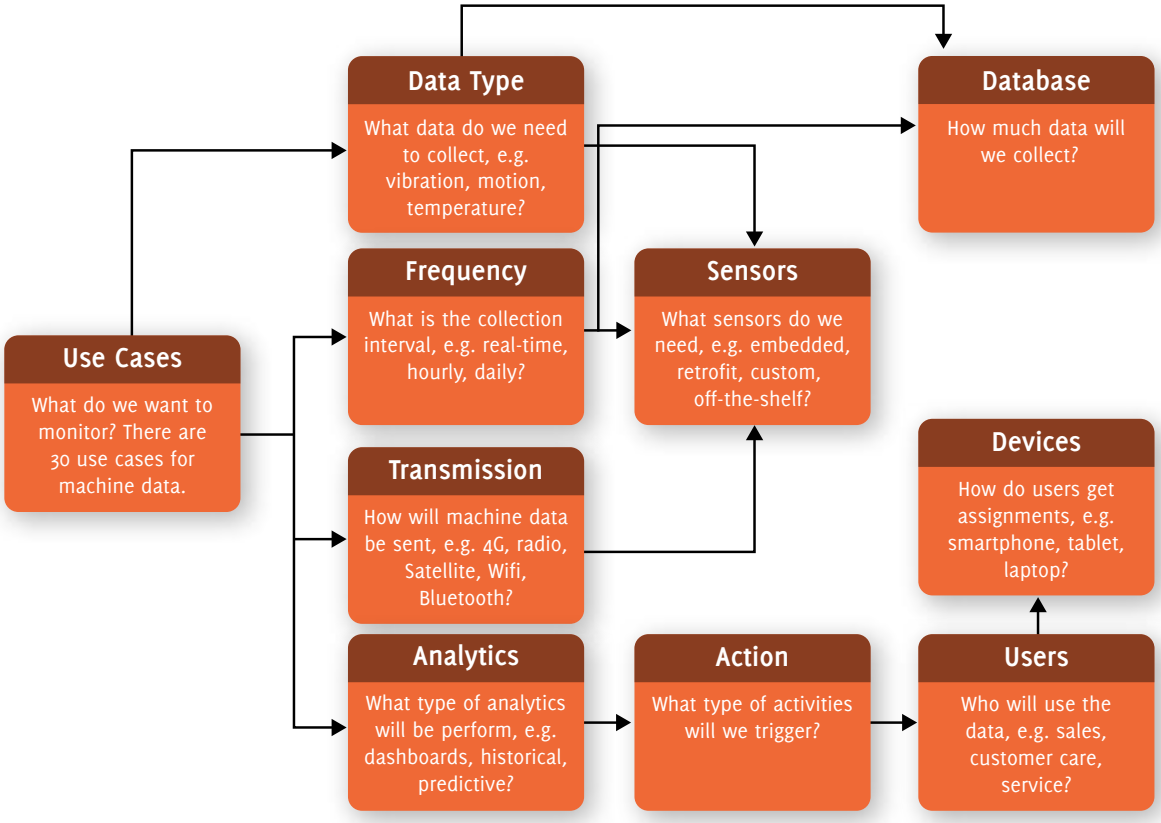
On the technology side, the 5 A's of secure and well tested automated data *Aquisition*, data *Aggregation*, data *Analysis*, the *Assignment* of tasks, and the *Actions* to be taken pose new challenges to organizations, as they are central to industry-specific ambitions with regard to, for example, predictive maintenance, smart monitoring, supply chain efficiency, and product and service innovation. The 5 A's are associated with these twelve challenging main areas:



To help organizations overcome these and other complexities, we currently have thirty M2M/IoT use cases at hand, drawn from our experience with clients, to rapidly address the most common issues so that we can get directly to the desired CSX solutions and build out the desired platform and tool set.

Organizations would naturally like to know what it takes for an M2M-based IoT system to become truly mature, so that their customers can benefit from optimal digitally connected services. Just walk down this decision tree and see where you may be in need of some help to solve CSX optimization issues and complexities:

From the Connect-Talk-Think-Act perspective, which is today's innovation focus, this relates to: [i] **connect**ing to the network and acquiring the data; [ii] getting the sensors to **talk** and aggregate the information; [iii] **think** or analyze the data in order to assign tasks and take appropriate **act**ion; and last but not least [iv] **secure** the end-to-end cycle. The last issue is one of the toughest.



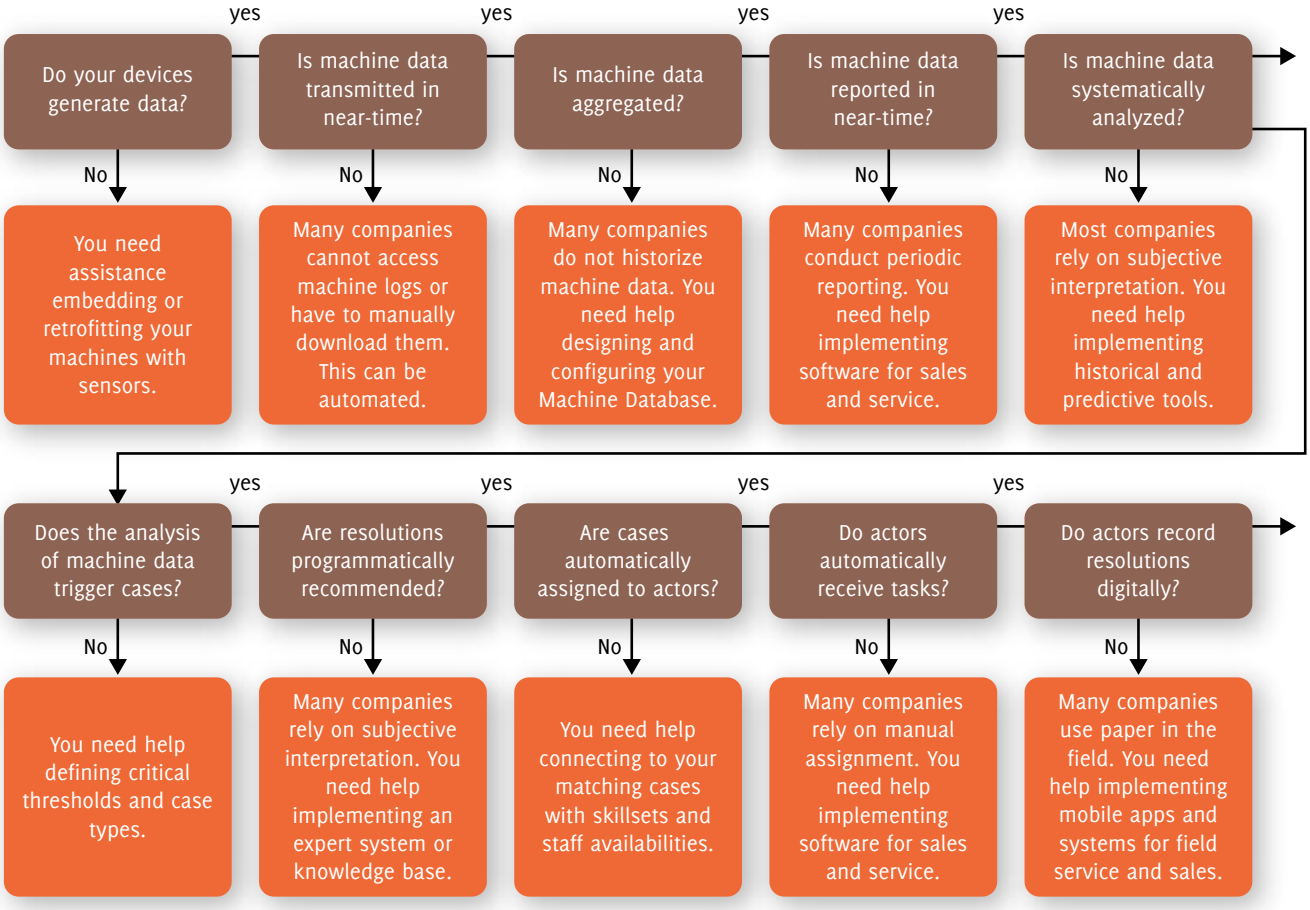
"As part of a large-scale hack over a number of weeks in 2014, Proofpoint found that more than 750,000 malicious emails were sent from more than 100,000 everyday devices, including – astonishingly – a refrigerator."

Securing the Internet of Things

To many people, the fact that their TV, toaster or baby monitor includes a web server still comes as a surprise, although some 300,000 toasters, cameras, cars and other "smart devices" are being added to the Internet every hour. However, the web application it hosts may well be poorly developed, which is a very unpleasant message indeed.

The most famous example to date is the case of the web application on TrendNet cameras that exposed a full video feed to anyone who accessed it. A simple "sign on" interface made users believe that only authorized people could access the feeds remotely. The Console Cowboys hacker group demonstrated that the authentication mechanism was just for show. Ultimately, the United Stated Federal Communications Commissions (FCC) stepped in and required TrendNet to redesign their products and submit them to a security assessment for the coming 20 years.

Before you think this is a minor problem, consider this: *"As part of a large-scale hack over a number of weeks in 2014, Proofpoint found that more than 750,000 malicious emails were sent from more than 100,000 everyday devices, including – astonishingly – a refrigerator."*



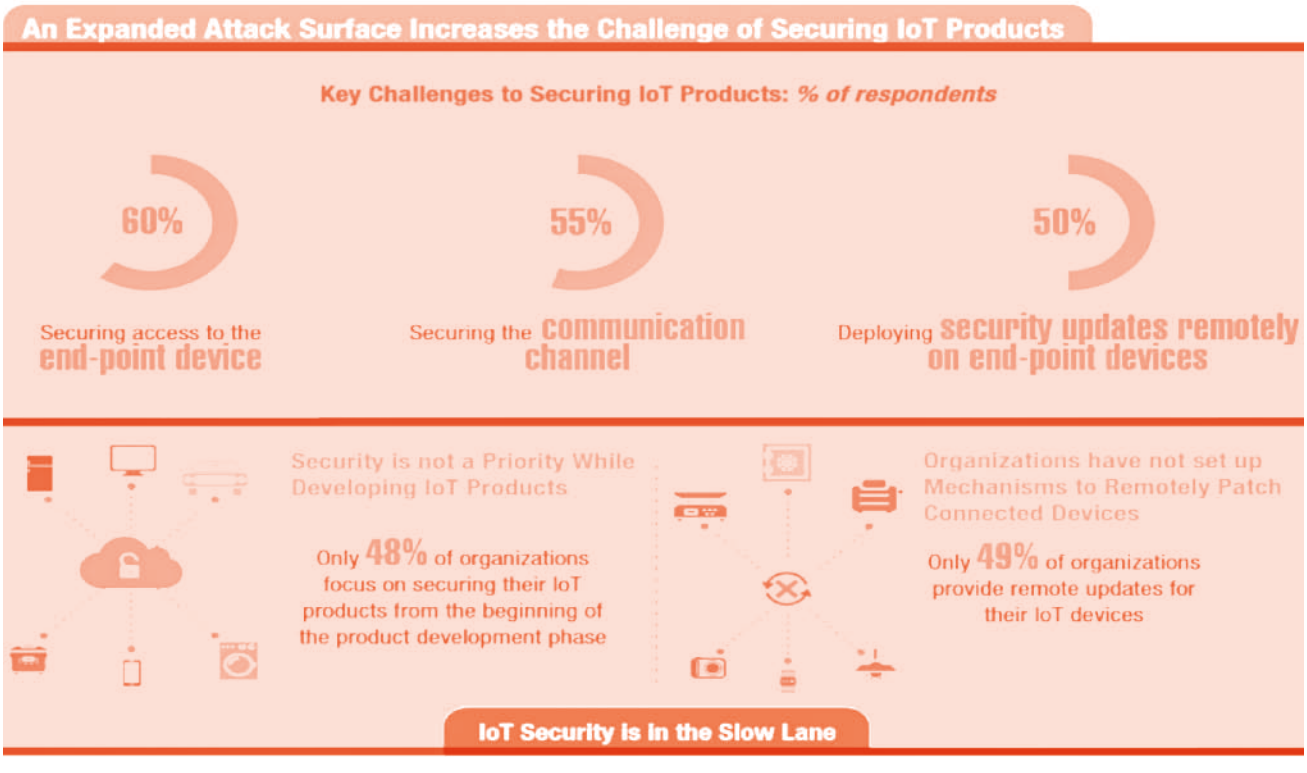
The IoT Top 10 list from OWASP, the Open Web Application Security Project, covers the following concepts familiar to application and network security experts as well as a few new items as well:

1. Insecure Web Interface
2. Insufficient Authentication/Authorization
3. Insecure Network Services
4. Lack of Transport Encryption
5. Privacy Concerns
6. Insecure Cloud Interface
7. Insecure Mobile Interface
8. Insufficient Security Configurability
9. Insecure Software/Firmware
10. Poor Physical Security

Source: http://resources.infosecinstitute.com/test-security-iot-smart-devices

The security of products and services is a key element of the overall security of an IoT system, but a number of factors is affecting organizations' ability to put in place rigorous security. These include an expanded attack surface, inefficiencies in the IoT product development process, the weak security architecture of the entire IoT system, lack of specialized security skill sets, and insufficient use of third-party support.

Securing an IoT system is a challenge because of its multiple points of vulnerability. These include the IoT product itself, and the embedded software and data residing within it. They also include the data aggregation platform, data centers used for analysis of sensor data, and communication channels, as the near future will see a vast increase in solutions and systems where starting with sensor data, actions are decided algorithmically and pushed automatically to physical and software components that will interfere and inform.



Source: Capgemini Consulting & Sogeti High Tech – Securing the Internet of Things Opportunity: Putting Cybersecurity at the Heart of the IoT, October 2014

3 Things and Services from Michelin and Philips

Turning tires into smart IoT devices

RFID chips in the tires of automobiles and aircraft have long been on the drawing board. For Michelin, IoT connectivity is allowing the company to step-by-step change the traditional business model of just selling tires in both the consumer and the industrial realms. To help achieve this, Michelin is working with special teams from business and IT, in swift iterations, prioritizing speed over complexity. This agile approach is focused on the essentials. At the same time, the company continues to develop its big data platform.

Of course Michelin will continue to be the renowned manufacturer selling its quality products, but at the same time it is gradually evolving towards service provisioning. With smart sensors and in-vehicle telematics, the company now sells miles for vehicles, or a number of landings for aircraft, instead of simply selling tires.

In essence, it is the same move that General Electric has made leasing their turbine engines to various sorts of operators. Michelin uses IoT technologies to collect a broad range of data such as tire pressure and vehicle behavior. Based on that information, Michelin's engineers and technicians can provide recommendations that improve profitability and safety, typically for a fleet of vehicles.

On the basis of the aggregated data and all analyses made, other new services were created. In June 2104, the company deployed its Road Usage Laboratory that operates in real time. Smart sensors were fitted to 2,800 vehicles throughout Europe, belonging to variously experienced drivers. Their journeys will be studied over a period of three years.

Understanding driving behavior is the cornerstone of a tire maker's development process. Michelin's Road Usage Laboratory findings are added to the knowledge already stored at the Michelin Technology Center with a view to increasing the solutions provided to drivers.

As a result, in May 2015, European motorists for the first time were able to purchase a summer tire that was also certified for use in winter. Michelin's new CrossClimate tires deliver an appropriate level of safety in all weather conditions, throughout the year. The product is an expression of Michelin's new Total Performance strategy, in which big data knowledge and sensorized research will continue to deliver truly remarkable new products and (connected) services in order to distinguish the company in their markets.

MICHELIN *CrossClimate* TIRE PERFORMANCE COMPARISON

	Braking on dry roads	Grip on wet bends	Climbing a snow-covered Hill
MICHELIN CrossClimate tire	★★★★★	★★★★★	★★★★★
SUMMER tire	★★★★★	★★★★½	★½☆☆☆
WINTER tire	★★★½☆	★★★★★	★★★★★
ALL-SEASON tire	★★★½☆	★★★★★	★★★★½

Rating according tot test results (MICHELIN CrossClimate tire result = indice 100)
Cd corresponds to the critical difference of the tests (dispersion of test results)

★★★★★	★★★★½	★★★★☆	★★★½☆
› 100-Cd	(85-Cd) to (100-Cd)	(90-Cd) to (95-Cd)	(85-Cd) to (90-Cd)
★★★☆☆	★★½☆☆	★★☆☆☆	★½☆☆☆
(80-Cd) to (85-Cd)	(80-Cd) to (85-Cd)	(70-Cd) to (75-Cd)	(65-Cd) to (70-Cd)

"Big data knowledge and sensorized research will continue to deliver truly remarkable new products and connected services."

The Sonicare Brush Busters

Philips is another interesting example of what value the Internet of Things can bring to companies that are active in the consumer space. Not only does "sensorizing" products make it possible for them to design and manufacture better products, based on the insights gained through analysis of how people use them in daily life. The data is also creating a huge opportunity for innovative services that enhance the experience and value for consumers.

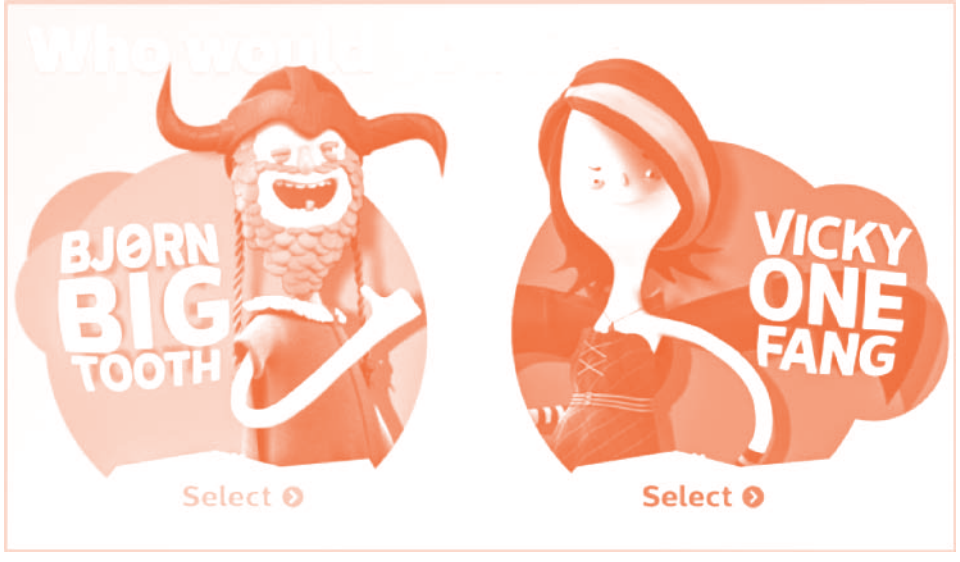
Philips has extended its Sonicare toothbrush range with a compelling mobile "Brush Busters" app for smartphones and tablets. Bjorn Big Tooth, a Viking, and Vicky One Fang, who is a vampire, help children, primarily to help them conduct their daily dental care program by projecting their brushing behavior in a game setting on a touch screen in front of them. This wireless remote monitoring and feedback of information – here, the hallmark of both the Industrial Internet and the consumer Internet of Things functions via a bluetooth connection.

The app is designed to help parents master one of their most difficult jobs: getting their offspring to brush their teeth properly as early in life as possible. The Brush Busters app connects by sensing the sound of the brush with the Sonicare toothbrush,

so that basically it knows when kids are brushing their teeth and when they are not. Sonicare toothbrushes combine a pressure sensor and advanced physical brushing technology.

The app contains a brushing tutorial to teach kids how to brush properly and win achievement badges. Parents can use the app to monitor how often and how well children are brushing, and customized awards can be added in addition to reinforce good brushing habits.

"Our Sonicare toothbrush is part of an ecosystem that may help people to have a much healthier lifestyle"



Jeroen Tas, CEO Informatics Services and Solutions at Philips Healthcare: "We don't see our Sonicare as a toothbrush anymore. It is part of an ecosystem that may help people to have a much healthier lifestyle."

Personal Wireless Lighting

Another example is personal lighting. The famous Swiss-French pioneer of modern architecture Le Corbusier memorably defined its importance: *"light creates ambiance, light makes the feel of a space, and light is also the expression of structure."* Le Corbusier was perfectly right, but connected lighting goes a lot further.

"Light creates ambiance, light makes the feel of a space, and light is also the expression of structure."

Lighting may be personal and wirelessly controlled nowadays, even over the Internet, and connected for convenience and security to, for instance, smart thermostats like Google's Nest and intelligent door lock systems. So, not just the saturation of colors, their brightness, and hue can be changed – the last being the name of Philips's personal wireless lighting system.

Philips hue lamps combine brilliant LED light with intuitive control in the palm of your hand. Together, the bulbs, the bridge and the app change the way we use light. People can experiment with shades of white, from invigorating blue to cozy yellow. You can play with all the 16 million colors in the spectrum to wake you up, help protect your home, relive your favorite memories, improve your mood, or keep you informed about the weather or the stock exchange. Hue developers from across the world have come up with ideas and apps for Android, Kindle, iOS and Windows to enjoy hue to the fullest.

The Myhue portal is an online control panel that connects people to hue, from anywhere in the world. For example, to make your house look like there are people present when you are actually relaxing on some beach far away or working in a hotel. The portal can save your personalized scenes and also keeps your bridge software up-to-date.

It's a Sensorized World

Let the *Philips Sonicare connected toothbrush* represent the consumer end of the sensor connected world we live in, and *General Electric's talking turbines* the much -discussed industrial end of the spectrum. We tend to refer casually to these telling examples, and everything in beween, in terms of the Internet of Things and the Industrial Internet. Increasingly industries will engage in both as our senzorized world is rapidly growing with billions of nodes each year.

works with nest

From turbine to toothbrush, sensors are everywhere today. They facilitate automated digital interaction between machines and humans to bring forth unprecedented customer experience, product and service innovation, reliability and flexibility, and major process and cost efficiencies throughout industries.

That blockbuster mix induces new ways of doing business and is even thoroughly transforming existing industries. It is all a matter of monitoring through sensors, apps and dashboards how machines, devices and their parts are behaving: what your toothbrush is contributing to the dental care you yourself are responsible for; or in the case of a turbine engine, for instance, how its rotations and vibrations cause wear and tear. As we have seen, there are many more applications.

4 IOT with Sogeti

The ongoing miniaturization of electronic circuits, omnipresent digital networks, the rapid development of high-sensitivity sensors, advanced data processing, diminishing cost, and efficient power consumption are the main instrumental drivers behind a huge increase of interest in what is commonly known as the Internet of Things (IoT).

In industrial as well as consumer domains, a complete set of affordable IoT technologies currently enables organizations in manufacturer and operator roles to automatically and constantly monitor the behavior of products and processes, as well as their interaction with other components and artifacts, with people, and with the narrow and broader environments they are in – from connected turbines to toothbrushes, from ambient lighting to medical equipment, and from smart energy solutions to fleet management, to name a few popular areas.

"If you went to bed last night as an industrial company, you're going to wake up this morning as a software and analytics company."

GE already offers predictive maintenance and optimization services for more than $1 trillion worth of Internet-connected industrial equipment: from medical equipment to jet engines. An ever-growing range of connected devices talking to businesses with valuable data was worth over $1 billion for GE over 2014, mostly in advanced asset performance management services. *"If you went to bed last night as an industrial company, you're going to wake up this morning as a software and analytics company."* That's how GE Chairman and CEO Jeffrey Immelt characterizes the transformation.

At the Salesforce's Dreamforce 2014 conference, Jeroen Tas, CEO Informatics Services and Solutions at Philips Healthcare, used similar words: *"When I rejoined Philips as a CIO, in my first meeting with the board I basically said: we are becoming a software company, and went on to explain what software is doing to the world and specifically what it will do to customer engagement."*

"When I rejoined Philips as a CIO, in my first meeting with the board I basically said: we are becoming a software company, and went on to explain what software is doing to the world and specifically what it will do to customer engagement."

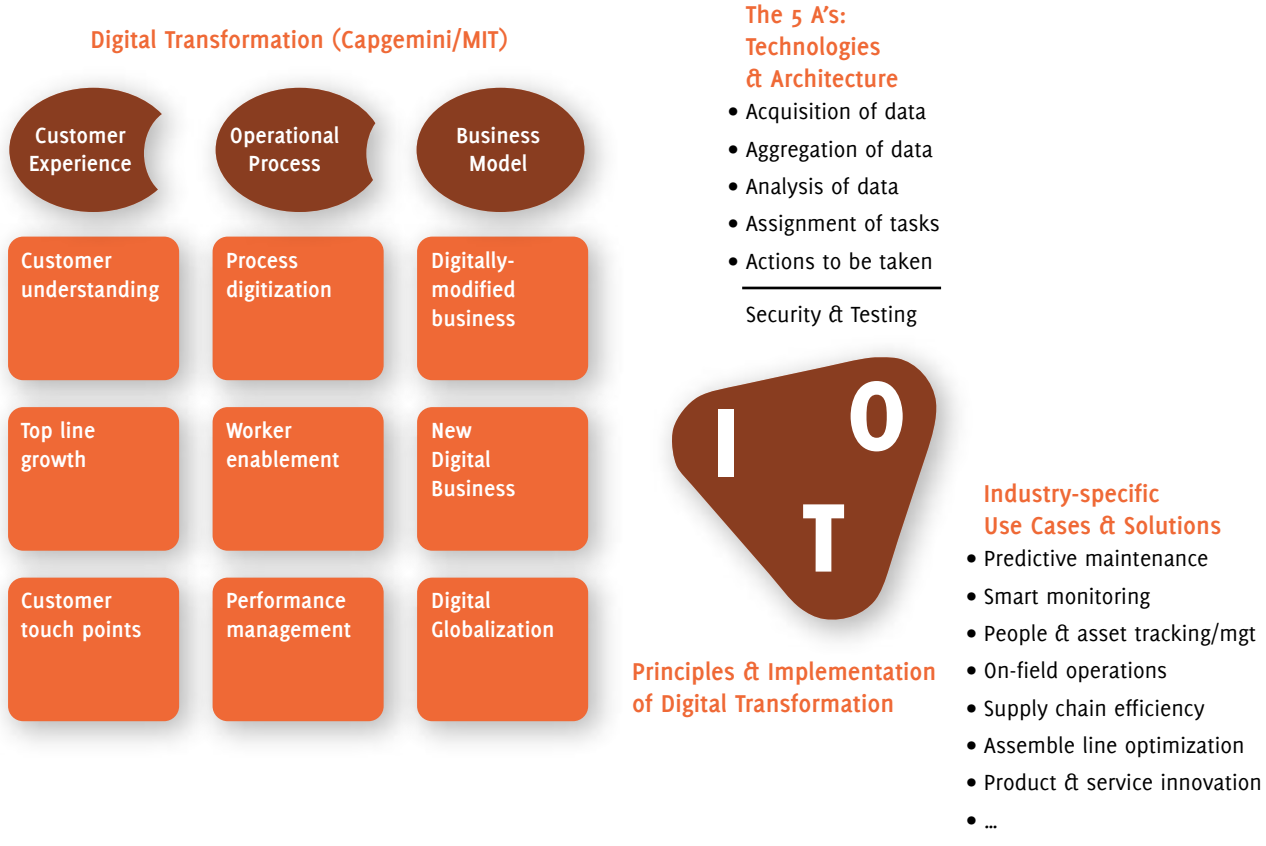
The CSX related consensus that Jeffrey and Jeroen share, has grown over the years throughout industries, and is now the foundation upon which new successful customer-oriented business practices are being developed. Sensors, software, services, and analytics are at the core of both the b2b and b2c customer journey with connected products as a lever: that is the name of the game every organization is in today.

In practice we see organizations look at the Internet of Things from three distinct perspectives. Firstly, the technical complexity of attaching sensors to products, aggregating the data from those sensors, analyzing them to produce relevant insights, deciding what actions are required plus the assignments of tasks. Secondly, industry specific use cases and solutions like preventive or predictive maintenance, or asset management. Thirdly, the digital transformation of the entire organization, determining a future enabled by the new technologies.

Today, the IOT Tech Triad domains of Information Technology (IT), Operational Technology (OT), and the so-called Internet of Things (IoT) are no longer separate

entities. The "Anything Internet" Innovation of Technology, all enterprises are in the midst of, started to blossom out at the start of the 21st century.

The IOT Tech Triad (IT+OT+IoT) and the Three Combined Customer Issue Domains: The 5A's, Industry Specifics, Digital Transformation

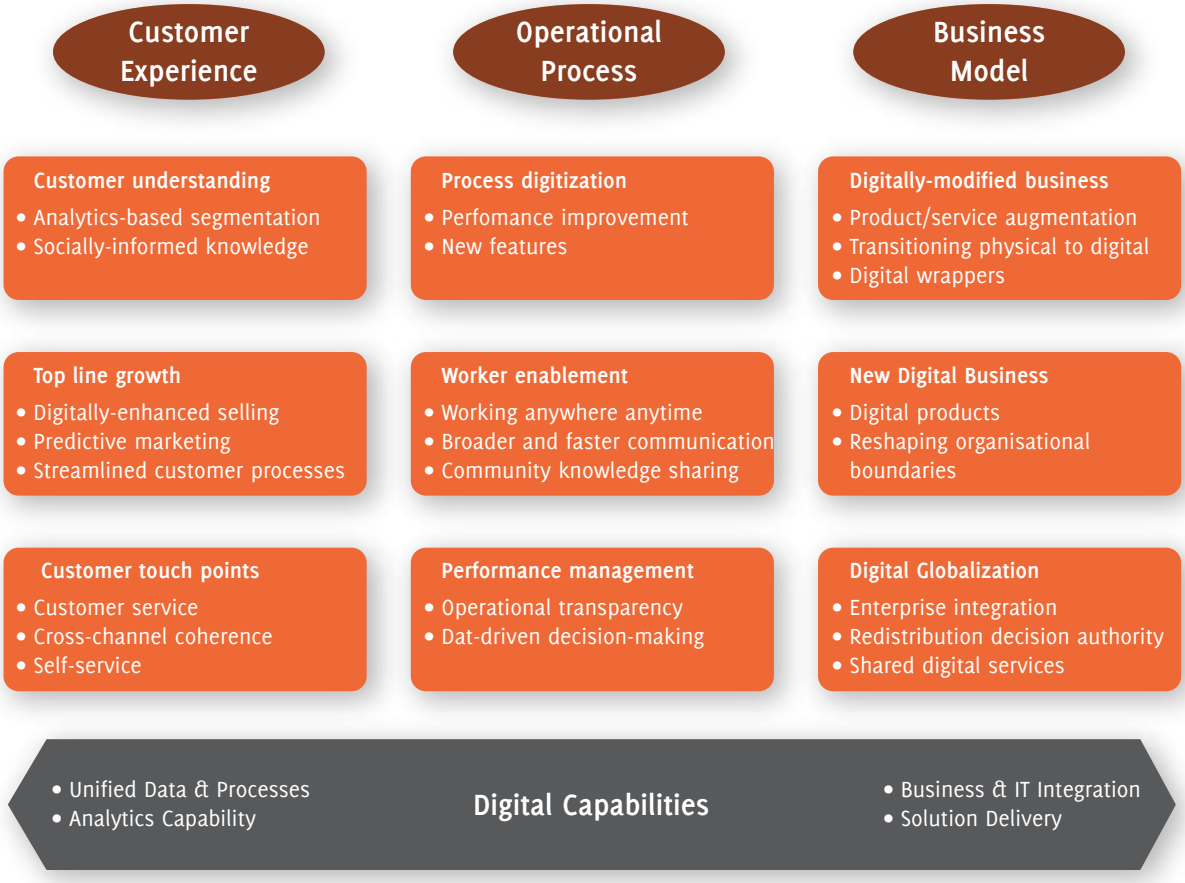


We consider this IOT Tech Triad in its entirety to be the single most important technology innovation since the World Wide Web.

The vast and largely unexploited area between and beyond the traditional IT and OT axes of business process and industrial automation – commonly known as the Internet of Things or the Industrial Internet – is now truly open to enthusiastic exploration and reaping commercial benefit. In this "Anything Internet" space, both IT and OT meet in sensorized products and processes, ranging from connected consumer gear or "wearables" to industrial robots working closely with humans.

Customers typically turn to Sogeti for its technology services with a focus on one of three angles in the illustration above, or a specific combination, as the IOT Tech Triad uniquely enables enterprises now to mix and match the principles and implementation of digital transformation with industry-specific use cases & solutions, plus technologies & architecture described by the 5 A's – security and testing included.

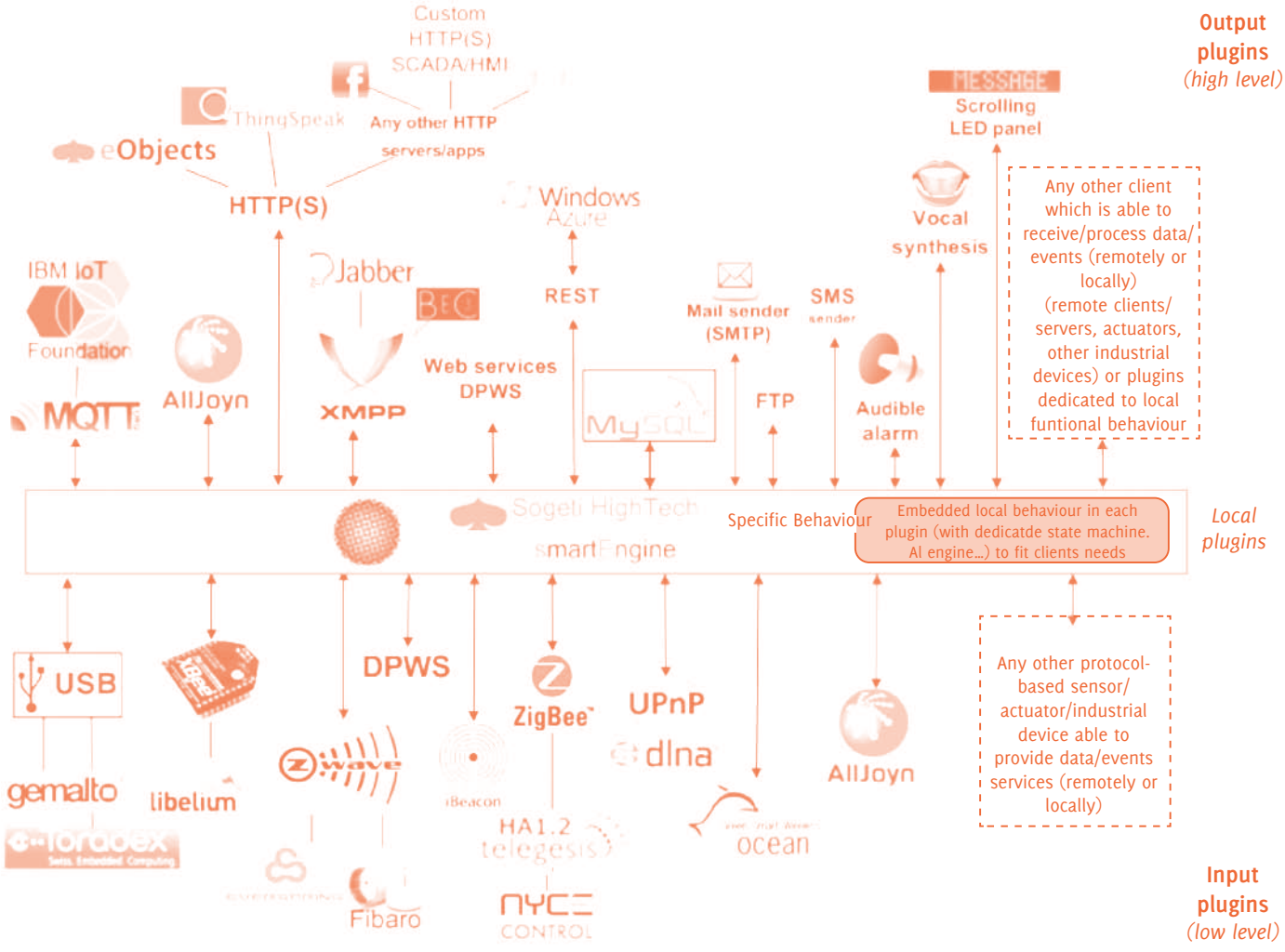
Complete Digital Transformation (Capgemini /MIT)



Source: https://www.capgemini-consulting.com/digital-transformation

SmartEngine and eObjects

At the heart of the five A's are the SmartEngine and eObjects connectivity solutions developed by Sogeti. The SmartEngine software package includes many common M2M protocols and can be installed on any existing gateway, a custom gateway or an off-the-shelf gateway. Using SmartEngine, available sensors, actuators or industrial devices are identified and self-provisioned. SmartEngine aggregates these devices data, simplifies the connection to a plethora of existing devices and facilitates the addition of new sensors, actuators, industrial devices, and (remote) applications to a system.

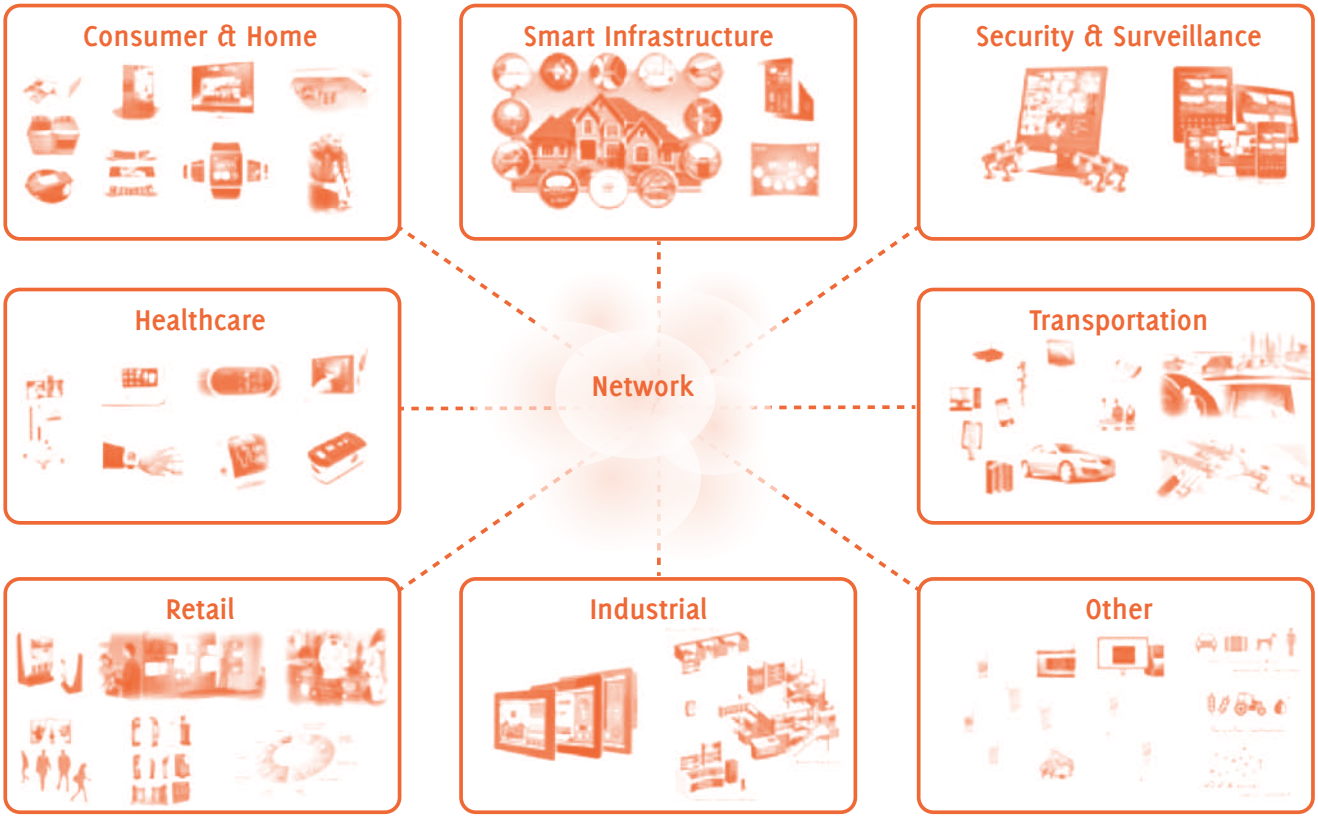


Sogeti's SmartEngine and eObjects M2M/IoT connectivity solutions are at the heart of the five A's, ready to facilitate an optimized Connected Service eXperience. A video showcasing our IoT worldwide demonstrator in action is available through the IBM YouTube channel: "Smart Buildings with Sogeti High Tech and IBM Internet of Things".

The eObjects package serves as data storage and management of the data flow from multiple systems. eObjects provides a secured infrastructure plus software to manage the fleet of connected devices, and also the possibility to connect or develop any "business" applications to visualize the added value of IoT solutions. Both SmartEngine and eObjects are Capgemini Sogeti Intellectual Property.

M2M, IoT, and CSX References

Before diving into a few of the many concrete examples of IoT related work that Sogeti continues to conduct at clients all over the world, this overview identifies the main sectors and domains our company is active in:



Pipeline Monitoring – Energy & Utilities

M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

One of our energy logistics clients is facing an aging network that requires increasingly heavy maintenance activities. Sogeti helps them monitor and protect pipelines from external aggressions, and ensure the integrity of pipelines by providing appropriate protection to the environment.

Condition Monitoring – Energy & Utilities

M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

Sogeti helps another energy logistics company to diversify their pipeline monitoring models in order to reduce the costs of aerial surveillance, reduce the environmental footprint of surveillance, improve the quality of supervision, and develop new usage.

Route Optimization – Transportation & Logistics
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

A big advertising company services billboards. Advertisements must be replaced on a regular basis. Their technicians maintain and update posters and panels. Sogeti helps them optimize the route and serve advertisers in a cost-effective way.

Web of Objects – ITEA2 (IT for European Advancement)
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

The purpose of this Sogeti project is to provide a framework to simplify the deployment, commissioning, maintenance, life and composition of services for connected objects and applications, e.g. smart buildings and homes, connected cars.

Health Monitoring – Healthcare
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

Sogeti helps a large university hospital automate the testing of the fragile state of the elderly, and reduce the cost of medical personnel. The solution uses smart sensors to measure walking speed, grip strength, recovery time, weight change, and cognitive abilities. The data is analyzed and used to generate diagnoses (A4, A5).

Network Optimization – Transportation & Logistics
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

As part of a modernization program, the company that operates the undergound transportation in one of the capital cities of the world is deploying systems to automate certain lines and improve the overall functioning. Sogeti is helping to analyze feedback on specific incidents, to identify causes and effects of problems, to implement fast analysis, to report on the operation of the systems, and to anticipate problems through predictive analytics behavioral systems (A4, A5). Predictive solutions can be very complex. Today, machine learning is becoming a key approach to better predict behavior.

Maintenance Management – Manufacturing & Aviation
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

A world leading manufacturer of helicopter engines has over 20,000 turbines in use and asked Sogeti to improve its maintenance and problem analysis system. The maintenance operator must be able to describe a breakdown in natural language, so the semantic analysis of text entered must be able display to the list of symptoms associated with such failure.

Test Analysis – Manufacturing & Aviation
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

In order to reduce the number of test flights, one of the largest aerospace companies in the world is working on the development of tools and methods to improve the analyses of data. In this context, Sogeti helps them in acoustic and vibration tests and analyses by setting up a machine learning system to analyze acoustic signature, using pre-processing algorithms to analyze acoustic signals and interpret the vibration while reducing analysis time by 40%.

Preventive Maintenance – Manufacturing
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

One of Sogeti's clients manufactures vacuum furnaces used by industrial customers. The company aims to improve the level of service on its products and offer new services to its customers: a typical CSX case. The targets Sogeti is helping achieve are: early diagnosis of incidents, preventive and predictive maintenance, better customer service through responsiveness and new services, and improved systems control. Sogeti developed an M2M gateway that supports the connection of several types of sensors and transmits data using different protocols and multiple media formats: WIFI, GPRS, Ethernet, and satellite.

Quality Assurance – Energy & Utilities
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

A world leader in the field of nuclear power and a major player in renewable energy has sought Sogeti's QA expertise. The construction of nuclear power plants is based on quality and inspection process to monitor all incoming systems in manufacturing activities. The targets Sogeti is helping achieve are: a direct productivity gain of about 10%, better integration and training of new inspectors and on time delivery.

Asset Tracking – Transportation & Logistics
M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

A large transportation company, responsible for the delivery of packages from their warehouses to distribution centers, delivers 300,000 packages per day over the entire territory. The company seeks traceability of incoming and outgoing containers from their warehouses to anticipate and optimize the allocation of personnel for the loading and unloading of packages. The targets Sogeti is helping achieve are: better prediction of the activity for the loading and unloading, traceability and location of the 3,000 containers, and an increase in aggregate productivity. Sogeti offers similar services in aviation (tool tracking for safety) and to hospitals (device tracking for safety and theft prevention).

Connected Factory – Manufacturing

M2M/IoT Steps A1, A2, A3, A4, A5: Acquire, Aggregate, Analyze, Assign, Act

One of Sogeti's clients has created a unique reprocessing plant for CO_2, H_2 CRYOCAP. The company would like to use it as a technological showcase to enhance its expertise. Air Liquide intends to develop a factory of the future concept using digital technologies for on-site operations. Sogeti is helping secure critical business processes, and to increase the productivity of maintenance work; to grow sales by predicting parts replacement and service, and proactively delivering offers, to decrease accidents by monitoring usage and triggering training alerts, and to improve efficiency by monitoring throughputs and triggering instructions. Today, many closely related projects are launched in factory environments, e.g. quality process optimization, manufacturing intelligence, asset tracking & monitoring, and energy management.

Support and Maintenance – Energy & Utilities

M2M/IoT Steps A1, A2, A3: Acquire, Aggregate, Analyze

A large energy company designs and installs equipment in production facilities, and is responsible for the maintenance of these systems. It wants to develop mobility and Big Data applications for the optimization of diagnostics and maintenance. The target Sogeti is helping achieve is: developing a system diagnostic aid for support and maintenance, based on the contextual consultation and analysis of the technical documentation and operating data of SCADA systems.

Butter Your Bread on Both Sides – Transportation & Logistics

M2M/IoT Steps A1, A2, A3, A4, A5: Acquire, Aggregate, Analyze, Assign, Act

IoT solutions typically enhances operational excellence and facilitates the creation of new services, as our experience has proven, e.g. in many fleet management cases. By offering a diverse range of vehicle monitoring services as well as driver behavior profiling tools, Sogeti and partners were able to optimize fleet management and associated maintenance, and also realized other benefits, e.g. related to insurance. Moreover, mobile apps associated with goods transportation can greatly enhance productivity by optimizing delivery success ratio. Also, by rethinking a company's value chain we provided new traceability services and thus were able to enrich the connected service catalog up to the establishment of different economic models such as real-time service and pay per use, as well as using real time sensor data to ensure regulatory compliance.

5 Wrap-up and Final Advice

The Internet of Things and the Industrial Internet are profoundly changing the way companies interact with their customers in that they are enabling a post-purchase relationship that did not previously exist. By connecting devices to the Internet, companies can gain insight into product performance and, more importantly, individual customer behavior with products, also called "Predictive Monitoring." The data collected from connected devices can be used to create many competitive advantages, because no competitor has this information and it has very valuable proactive applications.

We have identified thirty typical Connected Service eXperience use cases (CSX). Investments should be based on the measurable impact that has top and/or bottom lines. Problems and data from several seemingly unrelated sectors show that many businesses are burdened with similar challenges. Hospitals, manufacturers, logistics and energy companies, for instance, have a lot in common and can learn from each other. The solution implemented by a hospital to reduce the theft of equipment has valuable applications for a manufacturer and a shipping company.

The most common CSX application is predictive or preventive maintenance. As preventive maintenance can impact the top and bottom line in several ways, it is probably the most salient business case.

The many different use cases for the successful combination of M2M, IoT, and CSX solutions can be grouped in these main categories:

Things (What can be connected)	Process	Business Impact
1. Simple Assets	1. Supply Chain	1. Optimize
2. Complex machines	2. Manufacturing	2. Transformational
3. Shipments	3. Transportation	
4. Products	4. Sale	
5. People	5. Usage	

Don't hestitate: Connect • Talk • Think • Act, and call Sogeti

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On Sogeti, Capgemini, Sogeti High Tech, and Sogeti Labs

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