2017 Edition

CONNECTED THINGS

New digital ecosystems – unlocking the growth potential of IoT

Arthur D Little

Telia

PREFACE

Connected things need to work together to unlock the full growth potential of IoT. Fulfilling this promise will require new digital ecosystems. In this year's edition of our Connected Things report, we look at the state of IoT in the Nordic and Baltic region and what it will take to unlock the potential in these ecosystems.

The Nordic countries continue to be global showcases for IoT, with up to six connected things per person expected by 2021 – four times as many as in the rest of the world. We also explore the trajectory of IoT in the Baltic countries, who are now digitalizing rapidly, strengthening already-close business and trade relations with the Nordics. Innovative start-ups as well as pioneering governments and large corporations are driving innovation. Combined with a digitally skilled population, the Baltic countries should be watched closely in the coming years. Together, the region constitutes a EUR 17bn IoT market opportunity in 2021.

As things become interconnected, traditional value chains are reshaped into new digital ecosystems, increasingly dependent on new business logic of co-creation and partnership. Close to 40 percent of the total IoT opportunity will come from interoperable solutions. Entirely new services are created as previously analogue service providers become a part of the digital ecosystems. Many of these will be local or regional in order to cater to the purchasing behavior and regulatory requirements of their customers.

How will the new ecosystem around my business take shape and what role should we play? These are questions that are increasingly at the top of the CxO agenda and which will be crucial for future competitiveness and success. We explore how early movers in the region are gearing for success, exemplified by smart industry and smart cities, highlighting benefits to businesses, people and society.

We believe that the insights presented in this report can be used by your company or organization, in order to understand how IoT can create value and how to shape your digital ecosystems of tomorrow.

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TRANSFORMING INDUSTRIES AND SOCIETY

There has been a steady flow of IoT developments since last year's report. As described already in the 2014 edition of Connected Things, we continue to see the clear trend of how Artificial Intelligence (AI) solutions are becoming cheaper and increasingly integral into consumer gadgets and smart homes. One of the most prevalent areas at this year's CES was perhaps the smart home assistant Amazon Echo. Though initially launched in 2014, it turned up the temperature in the last year as the first widely successful "smart home assistant", beating Google and Apple to the pole position, against expectations of many analysts.

The rapid uptake for Connected Vehicles is also continuing, with Volvo Cars announcing a partnership for self-driving cars with Uber, along with Audi and Nvidia as well as BMW and Intel. Many regulators, not least in the Nordics have taken a positive stance to this. For example, Trafikverket in Sweden is supporting large scale testing with Volvo Cars in Gothenburg. However, there is also emerging pressure back from authorities and interest groups like Consumer Watchdog in California, challenging self-driving vehicles on regulatory and safety grounds. In parallel, connected car services for infotainment, Wi-Fi, as well as usage based insurance and smart maintenance is rapidly gaining ground with both open retrofit ecosystems such as Telia Sense, and proprietary OEM solutions.

Smart Cities in the Nordics and elsewhere have seen a surge in activity. Even though the concept of smart cities is not new, the initial focus on single use cases, such as connected parking meters, has now shifted towards integrated and open approaches. When data is shared across applications, citizens could, for example, know whether to ride their bikes or take the bus, based on data from traffic monitoring, the public transportation company, and others. This kind of interconnectivity is becoming more evident as essential to deliver on the full potential value for both citizens and businesses. Initiatives implementing this logic include the city of Copenhagen who recently launched the *City Data Exchange*, which is a marketplace for city-related datasets generated by both city-owned and other IoT devices. Another example is the city

WHAT IS A CONNECTED THING?

When physical objects can communicate with each other and the outside world, they are said to be connected things or smart objects: One can interact with them remotely, query how they are doing and change their state as required. In the report, laptops, tablets, desktop computers, ICT infrastructure and mobile phones are excluded from connected things market figures

Connected Vehicle includes machines (regardless of modus, i.e. road, air, rail, water), that transport passengers or cargo

Connected People includes humans or living animals, e.g. tracking of people's geographical position, activity and measurement of bio markers

Connected Consumer Gadget includes electronic equipment intended for entertainment, communications and/or leisure, e.g. cameras, TVs, white goods, consumer wearables

Connected Money includes devices for payment and related services, e.g. vending machines, points-of-sale

Connected Building includes physical structures used as homes, office or a public facility

Connected Industrial Process is defined as part of a larger commercial process e.g. machinery

Connected Infrastructure includes physical objects optimized for public needs or regulatory demands, e.g. energy optimization

of Vienna, which has integrated means of urban transportation to offer integrated travel planning and full fare integration across several modes of transport.

IoT is also continuing to increase its importance in industrial settings, and during last year a multitude of new "specialized" IoT platforms have gained ground. For example the GE Predix, bringing the benefits of out-of-the-box capabilities for machines in industrial settings. The German government was among the first to recognize the national strategic importance of IoT in industry through its annual EUR 200mn investments in its national "Industrie 4.0" initiative. With 2016's shifting political landscape in several OECD countries, government and private sector efforts to leverage digital technologies to retain or even regain national and regional competitiveness for industrial jobs is expected to increase further in 2017 and beyond.

INCREASING COMMERCIAL FOCUS FOR INVESTMENTS

Although many investments in past years have been made in IoT companies without proven revenue models, the long-term success of investments depends on the ability to generate profitable revenues. Companies and investors alike are shifting the focus to commercialization and scale-up of solutions. But too many start-ups and initiatives today are still stuck at the proof-of-concepts stages. According to a 2015 survey,

Four out of the top eleven IoT investors in 2016 were large corporations

70 percent of companies did not generate any service revenues from IoT, 13 percent provided IoT solutions that integrated with third-party offerings and only 10 percent had developed open platforms and APIs. Adding more money to the equation may not solve the issue; the smart home company Nest has been struggling to launch a widely successful product despite being acquired for USD3.2bn by Google.

Correspondingly, the nature of investments in IoT is changing. Venture-capital funding of IoT, which increased by 30 percent yearly during 2012-2015, experienced a mere four percent growth during 2016, with the number of deals falling by five percent. Four of the top eleven IoT investors during 2012-2016 were, in fact, large-corporation venture arms. In 2016 GE ventures climbed to reach second place behind Intel Capital, indicating that an increasing share of IoT development is driven by large, established players. These large corporations are now seeking to leverage their investments in start-ups to expand their current customer offerings.

THE STATE OF IOT IN THE NORDICS AND BALTICS

The Nordics continue to be at the global forefront of the IoT. The average number of connected things per person in the region reached close to three by the end of 2016, and is expected to more than double to six connected things per person by 2021[1]. This will be about four times as many as in the rest of the world.

We observe several visionary developments in the region, such as Helsinki's mobility-on-demand service and Estonia's e-residency. Finnish elevator and escalator company KONE has partnered with IBM to build an IoT solution for predicting product issues and adapting the customer experience. Shipping giant Maersk has, with the help of Ericsson, connected a large part of its fleet and containers, giving greater supply chain transparency.

Fundamentally favorable conditions for uptake are expected to contribute to continued IoT leadership for the region. Citizens and businesses are technologically progressive and governments and authorities are providing funds for projects such as the IoT for Sweden program.

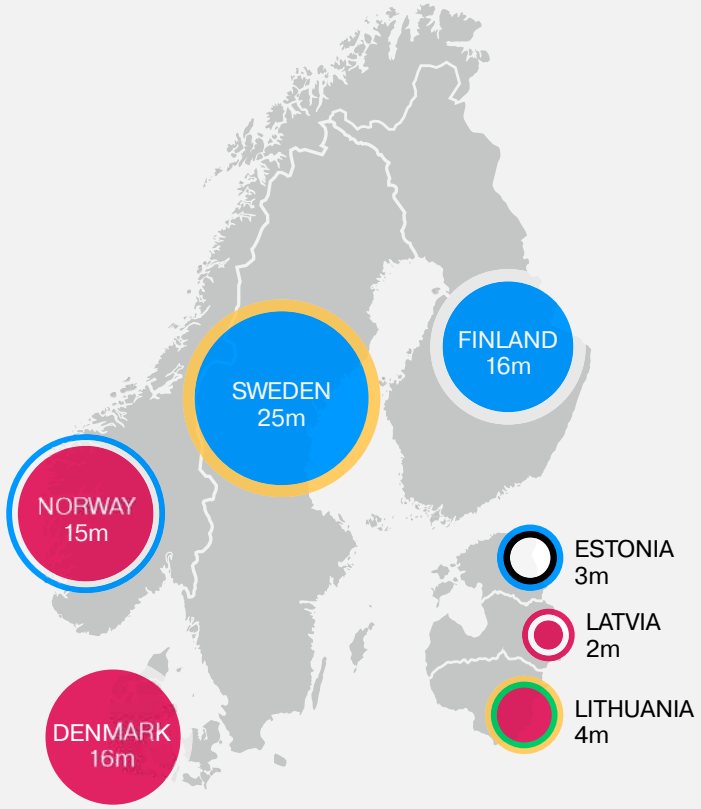
ICT-infrastructure is widespread, with high penetration of 4G and fiber. 5G development in the Nordics and Baltics will also contribute to securing the region's leadership position going forward. In Sweden, Ericsson and Telia performed the first outdoor tests of 5G in Europe as an initial step in a development which is expected to open up for a range of new use cases. This was a milestone in achieving the goal of having customers in Stockholm and Tallinn experience 5G services in 2018.

Narrow band IoT is another key technological development. It creates an economic rationale for applications that do not consume a lot of data per transmission and do not require full real-time communication. For example, smart systems for monitoring irrigation in agriculture. The narrow band technology is growing rapidly and it is estimated that the number of connections will increase by 175 percent annually through 2021.

COLLABORATION ACROSS THE REGION

Though often discussed as two separate regions, the Nordics and the Baltics are becoming increasingly integrated, driven in no small part

IOT MARKET SIZE OF NORDICS AND BALTICS 2016 (€m)



Source: Machina Research

EXAMPLES OF 5G IOT USE CASES

Connected autonumous vehicles
Real-time vehicle-to-vehicle and vehicle-to-infrastructure communication enabling e.g. coordinated speed and breaking for traffic flow optimization

Remote surgery
Remote surgery on mobile connection by offering very low latency and high definition video streams

Automated threat detection
Real-time analytics (e.g. face recognition) of high definition video streams to automatically detect threats and alert

1) Throughout the report, the number of connected things and revenues for the Nordics and Baltics per Connected Group, are based on Machina Research data, unless otherwise stated

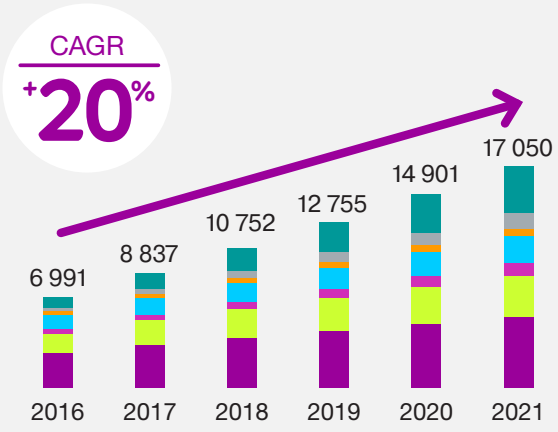
by digitalization. There is already a strong business relationship between the countries in the region, and many Nordic companies are present in, for example, the financial sector, real estate and manufacturing in the Baltics. Around 50 percent of foreign direct investments in the Baltics were made by Nordic companies in 2015.

The Nordic countries are also among the top trade partners of Baltic companies. In 2015, there were close to 3,000 Swedish companies in the Baltics and Sweden is Estonia's largest export market with close to 20 percent of the total export. Furthermore, it was recently announced that Finland and Estonia have agreed on merging their national data-exchange layers to enable automatic exchange of population register data. This will bring benefits such as simplifying mobility between the two countries.

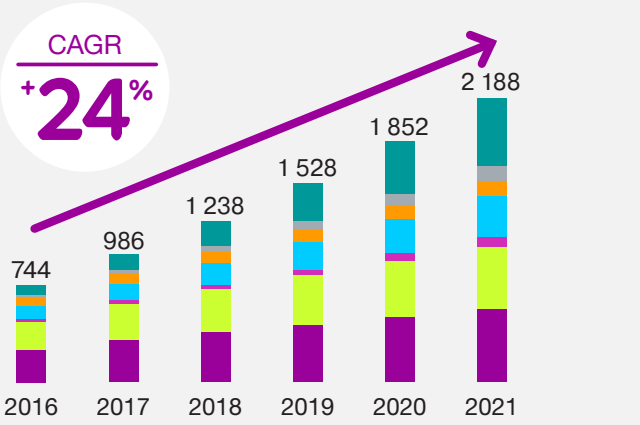
Moreover, regional collaboration projects such as the Baltic Sea Region Stars program, linking research, clusters and SME networks, further strengthen the region. As visionaries within digitalization of public services, exemplified by Estonian e-residency, the Baltics have a good foundation for building digital ecosystems. While the Baltic countries are currently less mature, with fewer connected things and lower IoT revenues per capita, the Baltic market is catching up, growing at a faster rate and expected to triple in size by 2021.

Growth in the Nordics and Baltics will primarily be driven by the Connected Vehicle and Connected Building segments. Usage-based insurance, vehicle diagnostics and vehicle platforms will drive growth in Connected Vehicle highlighting a shift from the previous focus on "basic applications" such as navigation and e-call. For Connected Building, automation and security of commercial and residential buildings is the most significant growth driver. The fastest-growing connected group is Connected People. Applications, such as, remote monitoring and assisted living are expected to drive this growth during the coming years, resulting in an increase in the number of Connected People devices by 500 percent by 2021.

IOT MARKET SIZE OF NORDICS 2016 (€m)



IOT MARKET SIZE OF BALTICS 2016 (€m)



Source: Machina Research

IOT INNOVATION AT THE TOP OF EUROPE

The Nordics and Baltics keep producing a steady flow of innovative IoT efforts. The University of Tartu in Estonia, in collaboration with Telia Company, launched an IoT lab during 2016 with the aim to create an environment for testing and creating new applications, for example

in agriculture, transportation, healthcare and education. The US-based IoT startup Cujo has also chosen to set up a development team in Lithuania that will work on developing smart home Internet security technology. In Sweden, the government innovation agency Vinnova and Uppsala University are continuing to invest in the *IoT for Sweden* program. The program engages industry and academia to develop and test use cases to find sustainable solutions to society's challenges, with the aim of making Sweden "the best country in the world" for harnessing the benefits of IoT. Nordic smart cities are leading the development for opening up and sharing data, unlocking the potential of IoT. The Norwegian city of Stavanger is participating in the Triangulum program, which aims to demonstrate and spread smart city technologies. Helsinki is part of the CitySDK project, an open-data project carried out by eight European cities. Stockholm is running Digital Demo, a collaborative project to pilot smartcity solutions involving the Royal Institute of Technology and industry actors such as Ericsson and ABB.

Implementation of IoT in industrial processes is estimated to harbor the largest value potential of any connected group, and companies in the region are pioneering solutions to capture this opportunity. ABB has helped clients such as Boliden to connect and automate mining processes. Scania is implementing an IoT solution that connects manufacturing robots to a platform, allowing data analysis for monitoring and optimization.

CONNECTED GROUPS INCREASINGLY INTERCONNECTED

	Today	In the future	Regional frontrunners
Vehicle	Focus on navigation and e-call, services such as usage based insurance and predictive maintenance are emerging	Vehicles will form intelligent transportation systems where they communicate to optimize mobility on a city/country level	**Volvo**
People	Single use cases focused on fitness applications with very little integration to healthcare providers	Wearables will connect patients to physicians, the hospital and analytics enabling advanced remote examination and monitoring as well as preventive care	**Kry**
Consumer Gadget	Segment is dominated by audio visual displays and personal multimedia	Consumer gadgets will increasingly talk to each other, e.g. the smart watch will be alerted by the fridge when restocking is needed	**Electrolux**
Money	Segment so far dominated by payment terminals resulting from laws requiring card payments to be exercised at customers' tables	More things being connected means any asset will become as easily indexed, searched and traded opening up an "economy of things"	**iZettle Klarna**
Building	Security applications have been commercialized for some time, HVAC and building automation applications are emerging	The smart home and smart building will be seamlessly integrated with other segments such as infrastructure, forming smart cities	**Minut**
Industrial Process	Mainly single use case supply chain tracking and process monitoring applications, a small share of the collected data is used	Companies will use IoT to collect and share data that will be used to optimize processes value networks	**ABB Scania**
Infrastructure	Several countries in the region have installed Smart meters, driving the growth of the segment	Smart grid development will enable distributed production and increased efficiency	**Fortum**

ECOSYSTEMS UNLOCK THE GROWTH POTENTIAL IN IOT

The trend towards increasingly intelligent and interconnected things is expected to continue through 2021 and beyond. Connected things are becoming more intelligent by moving from simple remote-control and -monitoring, to new services enabled by data analysis, and eventually toward solutions that are autonomous and integrated into the most critical systems of society. In parallel, things are becoming increasingly interconnected; connected cars become part of Intelligent Transportation Systems (ITS), connected medical devices become smart healthcare systems, and connected homes become smart cities.

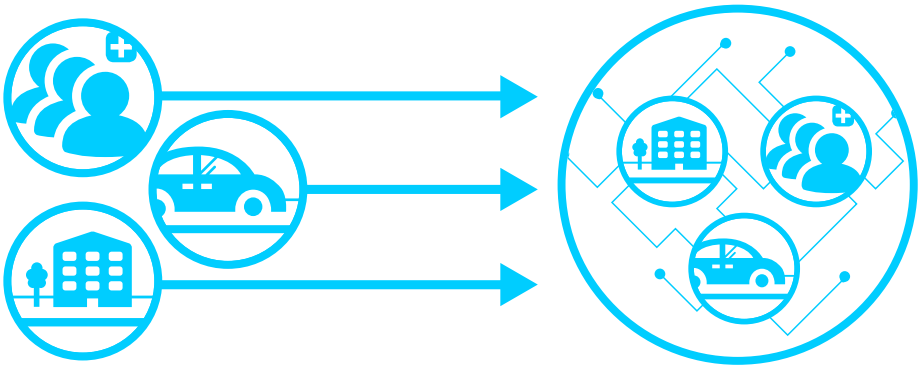
IoT is transforming traditional industry boundaries and value chains. New digital ecosystems emerge in their stead. The result is a new business logic where companies will no longer control many of their competitive assets and competencies by themselves. They will increasingly depend on partners and customers to drive innovation and commercial benefits. This development can be seen already in, for example, the area of Connected Vehicles, in which companies such as Volvo, Mercedes and Uber are co-creating new urban mobility systems with autonomous vehicles. We expect that close to 40 percent of the total value potential of IoT is dependent on interoperability.

WHAT IS A DIGITAL ECOSYSTEM?

A digital ecosystem is created when companies, with the help of digital technology such as IoT, connect and adapt their business models for co-creation of value in a networklike structure (“value networks”). This is opposed to a classic value chain, in which a good or service is linearly passed from one value chain actor to the next, with each one adding value.

Ultimately, when things become interconnected and highly autonomous, entirely new business opportunities will emerge, creating an “economy of things”. Factories can automatically order and purchase new assembly parts, manage stock logistics as well as predictive maintenance efforts, transportation systems that can deliver an autonomous car to citizens matching the train or plane’s exact arrival. Equally important, in the connected everyday, IoT will transform previously “analogue” transactions to automated services for example ordering service if there is a water leakage at home, even if the home owner is away on vacation.

Previously separated ecosystems are converging into a fully integrated system – the connected society



These are but a few of the possible future scenarios. IBM has estimated that in connected commercial buildings unlocking capacity from autonomous management and transactions for vacancies, hoteling and workspace sharing would unlock an annual net economic value of USD 128bn in the US. Similarly, the total revenues obtained from digitalization and integration of IoT in manufacturing is estimated to be more than USD 600bn globally. Key technologies to enable this opportunity are now becoming available. These include 5G, block-chain, machine learning and ecosystem management platforms. The latter enables cross-organization, integrated and flexile provisioning, billing and management.

IOT ECOSYSTEMS ARE STILL IMMATURE

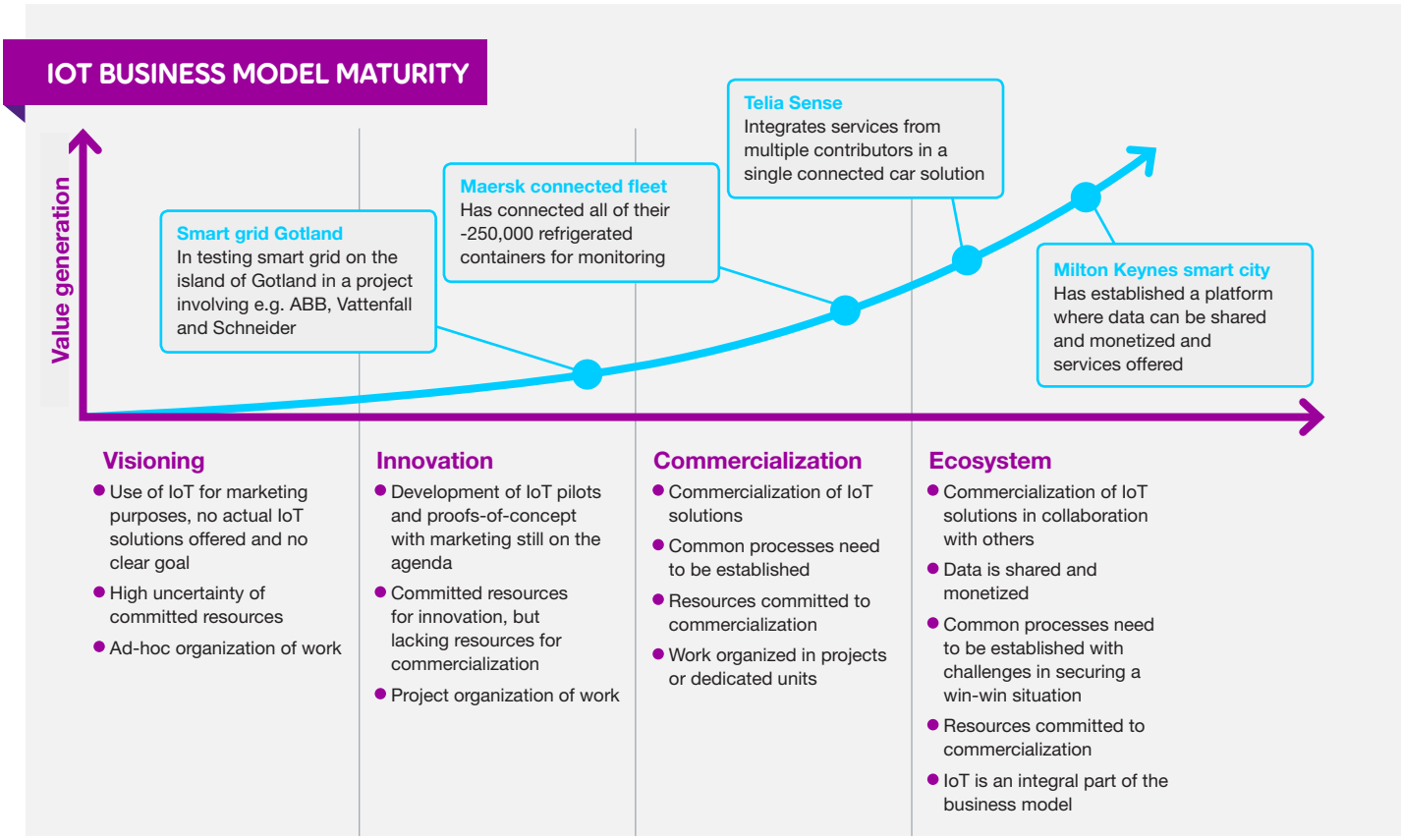
A 2016 survey showed that 90 percent of responding companies were still in the visioning and innovation stages. Only 20 percent expected to have commercialized IoT solutions by 2020. There are several barriers to account for this, both external to the ecosystem and within. From an external perspective, inflexible regulation, slow standard setting and complicated governance questions are main barriers to adoption. Internally it takes time to gear the company's strategy, organization, steering and investment to support an IoT business model.

> Close to 40 percent of the total value potential of IoT is dependent on interoperability

MASTER DIGITAL ECOSYSTEMS TO ENSURE FUTURE COMPETITIVENESS

Overcoming these barriers will require business leaders to make bold decisions. The questions to solve are many:

What role should our company play? What new values will we bring to our customers and with what business model? Who will be our new



partners and competitors? What technologies and technical platforms will deliver most value now and tomorrow? What transformative actions will we need to realize our future model of operations?

But the two fundamental strategic choices, indeed the starting point for success, is the definition of *where to play* and *how*. Players should therefore start by clearly formulating an ambition for the company's future business, envisioning the future ecosystem(s) for their industry. In doing so Ecosystem pioneers will also have to consider the various forms that an ecosystem can take:

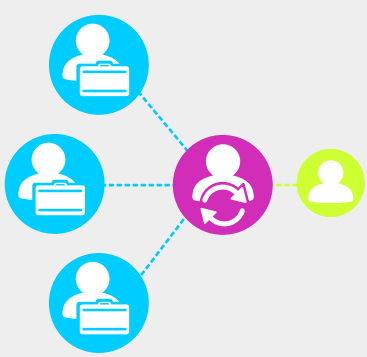
Aggregator and **Marketplace** constitute two ecosystems archetypes. In an aggregator ecosystem, one actor brings together services from a number of contributors to offer to an end-customer. In a marketplace ecosystem, a number of actors offer their services on a platform in which the end-customer relationship is owned by the individual service contributor. Aggregator networks and marketplaces can also be combined with ecosystem drivers aggregating services from contributors and offering them via a marketplace.

A marketplace ecosystem is emerging around the smart city of Stockholm, in which companies will be able to offer services on a city-run platform. For comparison, smart home company Qivicon offers an aggregation service in which the company is bringing together services of its contributing partners on its smart home platform, both from a technological and go-to-market perspective.

Having established a clear vision for the ecosystem, players need to carefully design their positioning to be successful, before launching on the transformational journey to deliver commercial results. They should start by selecting which role to position around. This can be either a *leading* or *contributing* role.

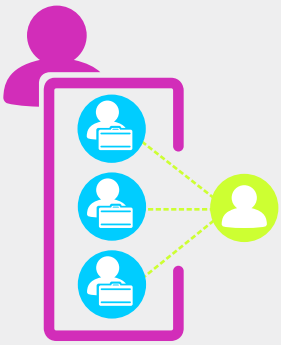
The rationale for selecting position should consider a definition of what is "core" and "near-core" businesses, for example cars and car repair service for an automotive manufacturer. There, the existing market position and closeness to customers can be leveraged to become an ecosystem aggregator, whilst for complementary and adjacent services, such as enabling delivery to the car, could be more suitable for a service contributor role.

ECOSYSTEM TYPES



Aggregator

- An Ecosystem driver brings together services from multiple Service contributors
- The aggregator owns the customer relationship
- Network is selective



Marketplace

- A Marketplace facilitator runs a marketplace where Service contributors offer services
- The customer relationship is owned by the individual Service contributors
- Network is open and actors joint/ leave frequently

End-consumer

Leading roles

Marketplace facilitator
Operates a marketplace where Service contributors can offer services

Ecosystem driver
Brings together services from multiple contributors with own offerings to the end customer

Contributing roles

Service contributor
Offers own services in a marketplace or an aggregator ecosystem

Platform enabler
Provides technical solutions (horizontal and vertical) that enable the ecosystem

Companies such as Google operate as marketplace facilitators, while those such as Telia act as ecosystem aggregators in the Telia Sense ecosystem. Service contributors, such as Folksam and Bilia, in the Telia Sense case, offer services via marketplaces or through aggregators, while platform enablers delivers the technical platform that supports the ecosystem. Prominent platform enablers include IBM and GE, with the Watson and Predix platforms respectively.

THE RISE OF REGIONAL ECOSYSTEMS

Clearly, the development of globally scalable IoT solutions and applications will continue in many of the connected groups, such as Connected Consumer Gadgets. At the same time, there is an emerging parallel development towards regional ecosystems. This can be seen in for example, Connected Vehicles, smart cities but also Connected People (such as smart healthcare), where local and regional regulations, customer purchasing behaviors as well as data security concerns, drives the need for regional digital ecosystems.

Simply put, a majority of businesses today are not global corporations, nor do they have an offering that reasonably can be fully scaled globally. The same goes for the large public services sectors in the Nordics and Baltic region including healthcare, public transport, as well as safety and emergency response.

In these regional ecosystems, selecting the right partners will be crucial for success. For example, for selecting *platform enablement*-partners local and regional data storage and regulatory compliance is key, as well as superior connectivity coverage and performance. For *service contributor* partners it will be the local customer base and insights that matters.

DIGITAL ECOSYSTEM MANAGEMENT PLATFORMS:

Realizing the ecosystem vision requires a platform supporting the shared business processes. New platform solutions enable ecosystem actors to sell retail products and services to end customers and wholesale to other actors in the ecosystem. Actors are also able to onboard and manage their own services and purchase services from other actors.

Milton Keynes, a frontrunner in smart cities, has launched a city-wide data platform powered by a digital ecosystem management platform. Today, third-party developers can access over 70 sensor feeds to develop new services that add value for business, the city and its inhabitants.

The next section of the report dives deeper into smart cities and the manufacturing industry to investigate the current state of ecosystem development in the Nordics and Baltics, key success factors and the potential value to be realized. Development of cities and the manufacturing industry are key determinants of the future competitiveness of the Nordic and Baltic states that we will show how the development of IoT ecosystems can help secure.

Regional ecosystems are emerging as previously analogue services become digital - in health, transportation, but also the multitude of traditional businesses that make up our everyday life

TAKING THE LEAD WITHIN SMART CITY ECOSYSTEMS

More and more cities are going “smart” as a response to the challenges of urbanization. New initiatives are evolving in the Nordics and Baltics as well as globally. At present, over 100 cities worldwide are implementing some kind of smart city solutions. Global Smart City market revenues are expected to increase to EUR 2.2 trillion by 2020, with annual growth of around 15 percent. The four largest verticals in terms of revenue, energy, building automation, transportation & logistics and financial services, make up 70 percent of the total opportunity. During the coming years, a shift in focus is expected towards more complex and integrated solutions such as smart transportation-, smart health- and smart governance systems.

The smart city is one of the most sophisticated IoT ecosystems models around. Smart cities have been pioneers in data sharing and construction of platforms for integration of various vertical services that enable increased value creation. Smart cities constitute a great opportunity for the Nordics and Baltics, with considerable value for citizens and businesses.

However, today the smart city ecosystems in the Nordics and Baltics are characterized by fragmented pilots rather than integrated strategies with commercialized solutions. This approach leads to a vertically driven, non-integrated service concept which fails to unlock the full market potential. However, several interesting initiatives in the Nordics and Baltics illustrate ongoing efforts to accelerate development of the ecosystems in different areas. A number of smart cities across the Nordics and Baltics are building Marketplace-type ecosystems, with some departments within the city as Marketplace Facilitators and public and private actors as Service Contributors. The Copenhagen city data exchange and Stockholm open-data initiative are examples of Big Data-enabled services and providing information to the private sector to develop “open” smart city services.

> “Smart Cities need smart insights, and that’s only possible if everybody has all the facts at their disposal”
> *– Frank Jensen, Mayor of Copenhagen*

DEFINITION OF SEGMENT:

A smart city uses modern technologies and innovative policies to meet the demands of its citizens. Through the provision of more accurate and readily available data it allows communities and government bodies to make informed decisions. Smart-city processes must have a positive impact on the local community in terms of efficiencies, innovation and resource allocation.

Some cities, such as Helsinki, have begun launching projects across verticals, including subplatforms, such as, mobility- or water- and waste management. Helsinki is also participating in the UK-run CitySDK project, a service development kit that enables new services and applications to be rapidly developed, scaled and reused. Other initiatives include the city of Stavanger getting involved with the Triangulum project, a joint effort together with Manchester and Eindhoven to develop and implement smart city solutions. For other cities, the vision to move towards a city-wide platform approach is, to a large extent, communicated but not yet initiated.

Estonia is working on implementing its vision of a digital society, characterized by open and easy-to-integrate platforms, connecting government agencies, businesses and citizens. This is expected to generate benefits, for example, in healthcare, education, public safety and energy management. In Estonia, all citizens have electronic ID that is equally valid as physical ID. All the material in the Estonian parliament is digital, and its president uses his electronic ID to sign new laws. Furthermore, the country offers a special “e-Residency”, which allows anyone to become a digital citizen of the country. Through this, Estonia is in a pole position for smart-city developments, and, looking ahead, going from smart city to smart country.

OPENING THE DIGITAL GATES TO THE CITY

The "smartization" of cities is a critical question for the Nordic-Baltic region. Even the largest cities in the region are relatively small and will therefore struggle to be competitive on a global level. However, when cities become smart, this logic changes. Highly developed ICT infrastructure in the region and a tradition of collaboration and openness means there is potential to form strong city clusters in which data and services are shared. Significant synergies can be realized by sharing non-geographically bound city services and opening up new opportunities for businesses and citizens to collaborate across cities. To create this, strong smart-region ecosystem leaders will have to collaborate with service contributors and enablers to form the appropriate ecosystem architecture and set up rules for mutually sustainable collaboration.

But in order to realize the value of collaboration, focus should lie on building enabling platforms rather than specific applications. The different open data and data sharing initiatives are examples of this. We also observe that local ecosystems expand through collaboration. For example, in Vienna, what started as a local public smart transportation project has grown to a regional ecosystem including public as well as local private companies and national actors such as Austrian Railways. The nature of most services that makes up smart city ecosystems implies that the local and regional collaborations are the logical step in the short term, going from smart cities to smart regions and smart countries.

"Through cooperating with other cities in the implementation of a number of energy efficiency projects, Riga has been able to introduce new innovative technologies that add to our comfort and make our lives more environment-friendly"

– Nils Ušakovs, Mayor of Riga

USE CASE

CREATING BETTER CITIES THROUGH SMARTER PUBLIC TRANSPORTATION

In today's cities, traffic jams and inefficient transportation waste both time and money, and have a negative impact on the environment. For this reason, smart public transportation is one main area of investments for many cities. Improvements in public transportation are beneficial for both citizens and businesses in terms of increased efficiency as well as for the environment. Cities in the Nordic and Baltic region are forerunners in this area, with many interesting new initiatives, but prominent examples can also be found outside the region.

In Sweden, interesting developments include the government's program launched in 2015, aiming to invest around EUR 200m in different local and regional smart public transportation solutions. The Swedish company Fält Communications offers an open IoT platform for smart public transportation where different applications can be added. The public region of Skåne is investing in smart public transportation, and all buses in the region are equipped with smart-public transportation functionality.

Helsinki is aiming at making car ownership superfluous in the near future. One of the most aspiring projects in the city is MAAS Global's app Whim, which offers multimodal transportation, combining public and private transportation. The app went live in late 2016 and marks a big step in offering true mobility as a service in the city.

Cities outside the region are also investing heavily in smart public transportation. One notable example is Vienna, where the SMILE project was launched in order to increase the share of public transport in the city. The project aims to offer a fully multimodal solution for passengers in the city. SMILE produces tailor-made intermodal routes and offers spontaneous mobility information and one-click reservation and payment. The ecosystem required for all this is extensive and governed by Vienna's public transport operator and Austrian Railways. An increase in the share of public transport of almost 10 percentage points is expected by 2020.

USE CASE

INTEGRATING SMART CITIES WITH OPEN DATA INITIATIVES

Up to now, data from individual smart-city initiatives has been kept in silos. But several initiatives in the Nordics and Baltics open up city-related databases for cross-department collaboration and third-party development. This enables more complex ecosystems to capture the potential of IoT across verticals.

Helsinki is participating in the CitySDK program, which is aimed at simplifying development of applications that run on city data by establishing a standardized way for data to be accessed. This means applications can easily be deployed in multiple participating cities, as long as the required data sets are available. Innovative applications include:

- BlindSquare, a smartphone app that helps blind people navigate the city. The product now works in dozens of countries.
- Helsinki city council's paperless system, Ahjo, has been opened up. A web-based interface for browsing the database and a smartphone app now lets anyone keep up with almost any decision the city council has made.
- The city of Vantaa's financial data has been used to make a computer game in which the player's job is to knock down towers that illustrate Vantaa's budget, which helps them to understand the scale of the budget of Vantaa in an amusing way.

Copenhagen and the electrical tools company Hitachi have joined forces to launch an integrated data service to eliminate data silos. In addition to smart-city data integration, this solution enables the integration of data from private companies and open data from public authorities. The aim is to build a digital marketplace gathering players across different sectors and industries, either as data suppliers or as data consumers. Entrepreneurs and application developers will be able to use the data to develop new services and software solutions for their customers, such as benchmarking energy consumption, finding an available parking space or determining where best to locate a business.

NEW IOT-ENABLED OPPORTUNITIES FOR INDUSTRIAL PROCESSES

Manufacturing is a historically important industry in the Nordics and Baltics. The industry makes up around 15 percent of the region's GDP and generates more than 500,000 jobs in Sweden alone. Most of the value stems from exports to larger economies such as the US and China. The implementation of IoT in industrial processes is expected to contribute 25 percent of the total value generation potential of the IoT until 2025, driving more value than any other segment, with a potential yearly economic impact of over USD1.2 trillion globally. The number of connected devices in the segment in the Nordics and Baltics is expected to grow by 16 percent yearly, reaching over 8 million by 2021.

However, the industry is under pressure by competition from low-wage countries and an aging workforce. In OECD-countries the average age of workforce participants has went from 37 to 42 between 1980 and 2015. On top of that, the industry is pressured by high costs, not least the cost of labor, which has increased around 25 percent in absolute terms since 1990. Another challenge is an increasing skill gap as the babyboomer generation retires, which will further diminish the advantage over low-wage countries.

Moreover, manufacturing companies in the Nordics and Baltics are continuously being pressured by demands for improved quality and increased customization as well as cost reduction and rising global competition. The common answer to the challenges has been increased automation, further enabled by the emergence of IoT. When every component and machine is connected a manufacturer gets a full digital representation of its production, which enables overarching company collaboration and integration of suppliers, customers and other third parties, as well as realtime production networking.

> "Gaining insight and early access to business models, technology and ideas that can change the environment in which we are active will further strengthen us in the future"
> *– Henrik Henriksson, CEO, Scania*

DEFINITION OF SEGMENT:

Connected industrial processes include the use of IoT technologies to connect industrial value chains, enabling collaborative R&D, increased supply-chain flexibility, efficiency analytics, etc.

Connecting industrial processes in the IoT offers opportunities to improve output, decrease time-to-market and reduce resource requirements in all kinds of operations processes, such as R&D, procurement, production, logistics and customer relationship management.

Digitalization, including the emergence of IoT, represents an opportunity to handle the threats that manufacturing in the region is facing. Increased automation leads to lower labor costs. Thus, manufacturers in the region will be able to leverage what historically has made them successful – a strong cluster of suppliers, competing firms, lead users and enablers. Companies in the region have realized this and are investing in IoT, with ABB and Scania as prominent examples. The argument can be made that the Nordic-Baltic region, as a strong industrial cluster, can realize relatively high potential from IoT ecosystem business models, simply because there are a lot of prominent companies that can collaborate to create value.

Improvements in robotics and automation of production have been reducing the number of production-related jobs throughout the world for some years now. At the same time, there is a trend in manufacturing of moving production closer to the customers, which for many companies in the Nordics and Baltics are outside the region. This has left many with a fear that the region is losing its position as a top region for manufacturing.

However, as IoT enables remote monitoring and control of factories, combined with increased automation of production, means that few jobs are actually leaving the region. Instead, there is a shift in the demand for competencies, from actual production to other areas such as production planning, monitoring and R&D. We expect that companies in the region will remain competitive by keeping these functions in the region and just moving the actual production outside the Nordics and Baltics. In order to realize this there is a need to strengthen collaborations between actors in the ecosystem. By building competence clusters, securing efficient production processes and innovative R&D, companies can leverage the existing competitive edge advantage the region already has.

REALIZING THE VALUE

Today, many companies in manufacturing are past the innovation stage on the IoT business-model maturity curve. They are working with IoT in a structured way, with dedicated organizational units and resources to commercialize single use-case solutions, primarily in process monitoring. For example, Scania in Södertälje has connected industrial machinery to a platform, enabling a comprehensive overview of the factory. However, fewer companies employ ecosystem business models. A small share of the total amount of data collected in industrial processes today is used, and mostly for simpler use cases such as productionline monitoring. An even smaller share of the data collected is in some way shared with other stake holders in the value network. Since close to 40 percent of the total value of IoT ecosystems in general is estimated to lie in interoperable solutions, finding horizontal opportunities for collaboration is a major leverage point for realizing the IoT value potential in the Nordics, Baltics and beyond.

Even though the Nordics have frequently been viewed as a role model in harnessing the benefits of IoT, in the smart industrial processes segment there are few examples of truly leading solutions being implemented in the region. Instead, some of the most exciting solutions have been launched in Germany, where the state is investing EUR 200m annually in the “Industrie 4.0” project, with the aim to digitalizing the manufacturing industry further. Manufacturers and governments in the Nordics and Baltics need to take action to avoid falling behind the competition further. If they manage to reinvent their business models and capture the opportunities created by, for example, 5G and narrow band IoT development, there is an opportunity to gain a leading position. This will, however, require a structured and well-funded effort to identify opportunities for collaboration, develop mutually sustainable business models and implement solutions using the appropriate technological platforms.

"The competition is getting tougher, but automation and the development of smart factories also make it more attractive to produce in Sweden"

– Mikael Damberg, Minister for Enterprise and Innovation, Sweden

USE CASE THE FUTURE OF MINING

ABB, as a supplier of industrial machinery and automation platforms, is helping its customers capture IoT opportunities, and is helping Boliden become one of the most digitalized companies in the mining industry. In collaboration with Scandinavian ICT and industry actors such as Ericsson, Telia, Volvo and ABB, Boliden is pioneering connected mine solutions as part of the PIMM project (Pilot for Industrial Mobile Communication in Mining).

Insufficient ICT infrastructure has previously been a barrier to digitalization of mining, but new, "5G-like" technologies are opening up possibilities for increased automation and cross-company collaboration. In Boliden's Garpenberg mine ABB has delivered a technical automation platform that allows for automating large parts of the mining process. The automation platform enables IoT connectivity of the mining machinery delivered by ABB. This enables ABB to offer 24/7 monitoring with both remote and on-location service, in which the mine is constantly monitored in one of ABB's European service centers and technicians are alerted if needed.

This solution constitutes an example of an emerging ecosystem IoT business model in which Boliden has opened up to allow ABB to monitor its equipment and supply services based on data collected.

After Boliden and ABB completed the project on time in mid-2014, Garpenberg's milled-ore tonnage rose about 60 percent to 2.22 million tons, a figure set to climb to 2.5 million tons by the end of 2015. Costs per ton plunged with less energy consumption, water use and noise for the 500 residents who live nearby.

USE CASE INDUSTRIE 4.0

The SmartFactoryKL in Kaiserslautern, Germany, is a test facility for smart-manufacturing solutions that are developed jointly by a network of over 40 companies and the research institutions. One of the main goals of the SmartFactoryKL project is to create a platform for cross-vendor solutions in manufacturing. This stands in contrast to traditional manufacturing setups that are vendor-specific and stand-alone.

In order to achieve the goal, a modular production line has been designed where 16 different partners in the project contributes with different plant modules or components based on their respective core competencies. The result is a leading plug-and-play production facility that allows for flexible adaptation to e.g. order situation and customer requirements. Production modules can easily be removed, added or substituted to adapt the production line.

Contributing to achieving the project goal is also a tight integration of automation and IT systems. Machines in the production as well as components are connected with the ambition to create a fully digital, real-time representation of the entire factory. This results in superior transparency as well as opportunities to run analytics to optimize production. Precision making becomes more precise and feedback loops shorter. Collaboration between enterprises becomes easier. New services in the fields of remote diagnostics and maintenance are enabled.

The SmartFactoryKL is the first European vendor independent demonstration factory and a key step to realizing the estimated yearly economic impact of IoT in factory environments valued at over USD 1.2 trillion globally.

SEIZE THE ECOSYSTEM OPPORTUNITY

The Internet of Things is no longer a distant vision. For a growing number of companies, it is at the top of the management agenda. Seventy-six percent of the companies in a recent global survey responded that IoT would be critical for the future success of their industry. However, while IoT and digitalization is quickly becoming the new normal, it is far from business as usual.

New ecosystems are emerging in the Nordic and Baltic region at a rapid pace, such as urban mobility, smart industry and smart cities. The result is a new business logic for companies across all industries. IoT is a driving force of this transformation; products become services, linear innovation becomes partner and customer driven co-creation, along with increasing customer expectations for offerings to be experienced and continuously enhanced in new ways. When things are connected entirely new services can also be created, such as usage based insurance for Connected Vehicles, unlocking new benefits to consumers, businesses and society. In order to enable reinvention of business models and expansion of the ecosystems, scalable technological platforms that allows for provisioning and payments need to be adopted at an early stage.

Contrary to much of the reporting on IoT, which tends to focus on global platforms and players, we find that many of the new digital ecosystems that are now taking shape are primarily local or regional. This is where the majority of Nordic and Baltic businesses and organizations operate, this is where public services are provided, and this is where citizens live their lives. Adding analogue services to digital ecosystems also creates a need for local and regional enablers with a trusted brand, who are flexible and can meet the needs of local and regional customers.

Decision makers should consider the excellent preconditions in the Nordic and Baltic region to both explore globally scalable opportunities and securing local and regional leadership. The region has a leading digital infrastructure; gigabit fiber broadband and early 5G roll-out in the making. Already, there are four times as many connected devices per person in the Nordics as in the rest of the world.

Whilst the IoT creates new business opportunities in digital ecosystems, it also puts increasing demands on companies' ability to successfully shape their future. Players that do not act, risk facing increased competition from digital leaders with more attractive offers and more effective operating models. They may be pushed back or even pushed out of the future value network, facing a decreasing relevance to their customers.

The time to act is now. As demonstrated in this years' Connected Things report, innovative players in the Nordics and Baltics are taking action now to become the digital leaders of tomorrow. They proactively create new value networks, securing the right partners as well as their positioning to move IoT solutions for successful commercialization.

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ABOUT TELIASONERA GLOBAL IoT SOLUTIONS

Telia Company, a New Generation Telco that serve millions of customers every day in one of the world's most connected regions. With a strong connectivity base, we're the hub in the digital ecosystem, empowering people, companies and societies to stay in touch with everything that matters 24/7 – on their terms.

Telia Global IoT Solutions part of Division X is responsible for business-critical IoT solutions and applications helping customers deliver value from connected solutions. We connect and integrate everything from Tesla cars to business processes and believe that IoT has the power to digitally transform the way companies do business as well as how people live their lives.

Read more on **iot.teliacompany.com/en/**

ABOUT ARTHUR D. LITTLE

Arthur D. Little has been at the forefront of innovation since 1886. We are an acknowledged thought leader in linking strategy, innovation and transformation in technology-intensive and converging industries. We navigate our clients through changing business ecosystems to uncover new growth opportunities. We enable our clients to build innovation capabilities and transform their organizations. Our consultants have strong practical industry experience combined with excellent knowledge of key trends and dynamics. Arthur D. Little is present in the most important business centers around the world. We are proud to serve most of the Fortune 1000 companies, in addition to other leading firms and public sector organizations. For further information please visit **www.adlittle.com**

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