H2020 Work Programme 2016-2017
H202-IoT-02-2016
Duration: 36 months

CROSS FERTILISATION THROUGH ALIGNMENT, SYNCHRONISATION AND EXCHANGES FOR IoT

H2020 – CREATE-IoT Project

Deliverable 02.05

Business and sustainability models for large-scale IoT scenarios

Revision: 1.00
Due date: 31-03-2020 (m39)
Actual submission date: 27-03-2020
Lead partner: IDATE

Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Summary					
No and name	**D02.05 Business and sustainability models for large-scale IoT scenarios**				
Status	Released	**Due**	m39	**Date**	31-03-2020
Author(s)	B. Copigneaux (IDATE), T. Ramahandry (IDATE), S. Ropert (IDATE), N. Vlasov (IDATE), D. Pap (ATOS), D. Esteban (ATOS), M. Álvarez (GRAD), R. Muleiro (GRAD), O. Vermesan (SINTEF).				
Editor	B. Copigneaux (IDATE),				
DoW	This deliverable presents the analysis of the different business models derived from the experiences in the LSP and how they can be used for the creation of sustainability models not only restricted to individual domains but combining several.				
Comments					

Document history			
Rev.	**Date**	**Author**	**Description**
0.00	31-01-2019	IDATE	Template/Initial version with draft Table of Content and attribution of section editorial responsibility.
0.01	14-01-2020	IDATE	Refined Table of Content.
0.02	23-01-2020	IDATE	Initial contribution section 4.
0.03	07-02-2020	IDATE	Revised contribution to section 4.
0.04	18-02-2020	IDATE	Finalised section 4 contribution, contribution to section 3 and 5.
0.05	19-02-2020	ATOS	Contribution to section 5.
0.06	24-02-2020	ATOS	Contribution to section 5.
0.07	24-02-2020	IDATE	Integration of contributions, review and contributions to section 2 and 3.
0.08	27-02-2020	ATOS	Revised contribution to section 5.
0.09	03-03-2020	IDATE	Integration and review.
0.10	26-03-2020	GRAD	Contributions to section 3 and 6
0.11	27-03-2020	SINTEF	Contribution on the analysis of the LSP exploitation strategies (AUTOPILOT section 5). Internal review and comments considered.
1.00	27-03-2020	SINTEF	Final version released.

Table of contents

List of Figures

1. EXECUTIVE SUMMARY

The exploitation and sustainability strategy of research and innovation project is of key importance for the long-term impact of the project for the participating partners as well as more globally for the ecosystem as a whole and the success of the R&I programme.

The general objectives of this report and more globally of the task 2.2 of the CREATE-IoT project were to investigate the sustainability and exploitation strategies of the Large-Scale Pilot projects, provide supporting analysis, and identify and support commonalities between the projects.

CREATE-IoT supported the Large-Scale Pilot projects in the reflection on their sustainability and exploitation strategy through a series of workshops (described in more details in section 3) complemented by numerous interactions in the form of Activity Group 01 meetings, as well as focused interviews.

As a result, we present our key takeaways in this deliverable along 3 main topics:

- An analysis of the specific context in which the LSP projects developed with an analysis of key questions regarding IoT Business Models (developed in section 4).
- An analysis of the exploitation strategies of the IoT LSP projects and their commonalities (developed in section 5).
- A perspective on the drivers and barriers for the sustainability of the IoT LSP projects illustrated through a focus on two of the LSP projects (developed in section 6).

Our insights of the IoT business models context develops from an analysis of the IoT value chain. This make visible the strong importance taken by the Software and IT side (taking more than 65% of the ecosystem revenues). As such we considered important to consider the impact that this development and structure would have on the market of the innovations developed within the LSP projects. We considered two key aspects of transformation of the business models: the development of IoT platforms (for which we present a classification and ecosystem analysis) and the development of “Servicization” (the transition from product-oriented to service –oriented business models induced by the IoT).

These results were presented by CREATE-IoT to the LSP as support for their exploitation and sustainability strategies. In conjunction, we performed an analysis of the strategies for exploitation taken by the different projects. The key objective was here to identify commonalities, both in the approaches and issues encountered to foster exchanges and synergies between the LSP projects.

Our analysis points out two different approaches among the LSPs: one focusing more on use cases and another on the assets developed by the project. These approaches appear as complementary, one favouring more the continuity of deployments, and replication by extensions of use cases while the other favours the exploitation of the project results by a potential replication on alternate use cases.

Finally, we provide an analysis of the drivers and barriers regarding the sustainability of the IoT LSP project. This points out different issues around technology (lack of interoperability and standards, maturity of the offerings), pilot deployment (continuity of operation, scalability) and more importantly around the ecosystem.

Indeed, many of the barriers and approaches identified by LSPs regard the ecosystem dimension. Our analysis points out that large-scale pilot experimentation may provide good results in terms of technological validation, but may as well suffer from barriers coming from forces out of their direct control, such as regulatory uncertainties or the lack of a critical mass of demand pull.

2. INTRODUCTION

2.1 Purpose and target group

The purpose of this deliverable is to report on the activities of CREATE-IoT toward the sustainability and support to exploitation of the Large-Scale Pilots.

This report is intended to provide a general perspective on CREATE-IoT activity in this field, but also and more importantly to:

- Provide an accurate presentation of the LSP exploitation and sustainability strategies and approaches
- Identify and analyse similarities and common interests between the LSPs
- Provide insight on the context of their exploitation activities: the transformation to business models and ecosystems brought by the IoT.

The targeted audience of this deliverable is primarily the LSPs themselves, especially those responsible of exploitation strategy. Results of the workshop will be shared with the LSPs through AG01 (Activity Group on "IoT focus area sustainability").

Additionally, this deliverable can be of use for a larger audience interested in exploitation strategies of European projects, and the impact of IoT on business ecosystems.

2.2 Contributions of partners

IDATE: Preparation of the table of content, methodology and organization of the work, contributions to the analysis of IoT Business Model (section 4), the description of the methodology and workshops (section 3), and the commonalities in the exploitation strategies of the projects (section 5.1).

ATOS: Contribution on the analysis of the LSP exploitation strategies (section 5).

GRAD: Contribution to the description of the workshops (section 3) and the sustainability models (section 6).

SINTEF: Report processing and the contribution on the analysis of the LSP exploitation strategies (AUTOPILOT).

2.3 Relations to other activities in the project

This workshop is the third and final activity of CREATE-IoT around IoT LSP sustainability and exploitation. In the continuous process of exchanges with the LSPs, this activity aims to support the LSPs in their approach of exploitation from pilots' results. This deliverable echo a first workshop on sustainability (deliverable D02.06) and a second workshop on exploitation strategies (deliverable D02.07).

3. METHODOLOGY AND REPORT OF COLLABORATION ACTIVITIES

3.1 Objectives and general methodology

The general objectives of this report and more globally of the task T02.02 of the CREATE-IoT project were to investigate the sustainability and exploitation strategies of the Large-Scale Pilot projects, provide supporting analysis, and identify and support commonalities between the projects.

3.1.1 Operational objectives

To achieve these general objectives, a set of operational objectives were defined. They were submitted in October 2018 to the "AG01 IoT Focus Area Sustainability" activity group meeting in which the representatives from the LSP projects and the European Commission approved them. These operational objectives were to:

- To provide an analysis of the impact of IoT on business models, business ecosystems and value chains, in order to provide insights to the LSP project and their partners on the context in which the exploitation of their project will take place. This is illustrated in this deliverable by the work of section 4.
- To identify the methodological approaches of the LSP toward their exploitation strategy, as well as their key exploitation results. This is illustrated in this deliverable by the work of section 5.2 to 5.6
- To identify commonalities in the different LSP approach and exploitation objectives in order to better identify common interests and generate exchanges between the LSPs. This was illustrated through deliverable 2.6 and 2.7 workshops and summarized in section 5.1 of this deliverable.
- To identify sustainability models ensuring the continuation of the LSP dynamics and exchanges between their deployment sites beyond the completion of the projects. This is illustrated in this deliverable section 6.

3.1.2 Methodology

The methodology relied on regular exchanges with the LSP, individually through interviews, and through collective exchanges in workshops. It was supported by desk research and analytical work to refine and produce conclusions.

The following schedule of activity sums up the overall process:

- In June 2018, at the IoT Week meeting of the Activity Group 01 on IoT Focus Area Sustainability, an initial plan was presented to the LSP and European Commission representative. This plan contained the general outline and focus of this activity (a focus on LSP exploitation and sustainability work). It was agreed by the activity group that this would be the next focus of the Activity Group, following the work on the KPIs.
- In October 2018, a refined plan was presented at the next Activity Group 01 meeting of the IoT Focus Area. As mentioned above, this plan presented the general and operational objective of the action on exploitation and sustainability as well as a tentative schedule and methodology. The proposal was agreed upon by the Activity Group 01.
- The initial work of the activity, between the end of 2018 and early 2019 was to identify the key representative of each LSP to be involved in the consultation. The targeted audience was LSP representatives active in business modelling and exploitation work.

- In February 2019, a first workshop on the sustainability of the Large-Scale Pilot was organized in Lisbon. The workshop assembled representative from the LSPs and initiated the discussions and exchanges between the LSP on IoT business models and the exploitation strategies of the project. This workshop is documented in detail in Deliverable 2.6 and presented in a summarized form in section 3.2
- CREATE-IoT and U4IoT project initiated a close cooperation focused initiative on LSP exploitation activities. This initiative was one of the results of the Lisbon workshop and took form of regular exchanges and meetings between the teams, culminating in the preparation of the IoT Week Workshop.
- In preparation of the IoT Week Workshop, CREATE-IoT also launched dedicated interviews with each LSP representative in order to better assess their exploitation strategies, gather their inputs and vision, and prepare the workshop. These interviews took place between March and June 2019.
- In June 2019, the second workshop, focused on exploitation strategies was organized as part of the IoT Week in Aarhus. The workshop gathered representatives from each LSP and resulted in fruitful exchanges and interactions between the LSPs. It is also to be noted that the workshop was co-organized with representatives from U4IoT, as a result of the common initiative launched following the Lisbon workshop.
- Following the IoT week workshop, the study team focused on the production of this deliverable, resulting in further desk research on the impact of the IoT on business models and business ecosystems (presented in section 4).
- Finally, a final round of consultation of the LSP representative took place in early 2020 to update the existing vision on their exploitation strategies and finalize the deliverable conclusions.

3.2 Workshop on sustainability

3.2.1 Workshop Objectives

CREATE-IoT organized a fist workshop focused on the concept of sustainability of IoT LSPs. This workshop, duly reported in deliverable D02.06, took place in February 2019 in Lisbon, Portugal and involved several LSPs and external actors coming from DG CONNECT, other public administration and the private sector.

This workshop is the first activity of CREATE-IoT around the concept of IoT LSP sustainability and was intended as the first of several efforts to provide support to the LSPs in their seek of LSP sustainability goals.

It was implemented as a half-day workshop with participation of representatives from the LSPs and also external actors coming from DG CONNECT, public sector (Regional Ministry of Agriculture of Andalusia, Spain) and the private sector.

The workshop was designed to collect valuable inputs related different aspects of sustainability:

- Sustainability of IoT applications and deployment,
- Role of public administrations in ensuring sustainability of large innovation efforts,
- Different approaches LSPs are taking toward sustinability.

At the same time, the workshop tought to generate stimulus in LSPs to intensify their efforts in ensuring sustainability.

3.2.2 Report of Activity

The workshop on sustainability was organized as a half-day workshop in Lisbon, Portugal on 27 February 2019. The workshop involved several LSPs (AUTOPILOT, ACTIVAGE,

SYNCHRONICITY, MONICA) and external actors coming from DG CONNECT, other public administration and the private sector.

Following a keynote presentation from EC DG CONNECT laying down the expectations that the EC has in terms of sustainability, the LSPs had the chance to explain how they are approaching the sustainability dimension in their projects. Then a roundtable debate was organized among participants with the goal of generating exchanges of experiences among LSPs. An invited speech on the role of public procurement as a valid tool to ensure sustainability of IoT adoption and deployment introduced a second roundtable debate focused on the role of public administrations in the sustainability of large IoT innovation efforts such as the LSP Programme.

3.2.3 Key Takeaway and contributions to the deliverable

The format of the workshop and the open attitude of all participants allowed to expose relevant ideas and generate valuable insights for this deliverable that we will detail next. The participating LSPs expressed their satisfaction with the workshop and the benefits of exchanging experiences among projects as a stimulus for them to improve their activities towards sustainability.

As a key takeaway of the workshop for D02.05 we could state that *sustainability is a common goal for LSPs, with some common barriers, but where the application context introduces specific needs and barriers that call for adapted approaches in each vertical*.

Commonalities identified among LSPs:

- The importance of generating early demand
- The importance of standardization and, where applicable, a clear regulatory framework
- The importance of coordinating action among all stakeholders (private and public) involved in a specific IoT application field
- Market fragmentation is a key barrier against consolidation of deployments and sustainability

Among the differences identified among LSP application domains, the workshop allowed to identify the following:

- Stakeholder configuration: some cases involve a large variety of stakeholders that introduce complexity towards sustainability. For example, in AUTOPILOT's stakeholders are car manufacturers, telecom equipment manufacturers, telecom providers, public administrations (infrastructure management and regulation), citizens.
- Regulation as a barrier for take-up: in some cases, regulatory requirements are considered an important barrier. Some applications such as automated transport will require important regulatory efforts that should encompass technology readiness, and this can be considered as an important source of uncertainty.
- Investments as a barrier for take-up: Again, some application fields may require heavy investments (e.g. in public infrastructure) to allow for scalability, and therefore, sustainability of current innovation efforts.

Section 5 of this deliverable provides detailed information regarding the approach collected identified from each LSP.

3.3 Workshop on exploitation strategy

3.3.1 Workshop Objectives

Following the workshop on sustainability, this second workshop activity (reported in the D02.07 and falling under the WP02) intended to support the IoT LSPs in their project exploitation approach. The main objective of the workshop was to encourage the exchange between the LSPs with respect to their vision to sustain project results and relationships beyond the end of the project. Indeed, the LSP have their own exploitation and business modelling approach,

considering the specificities of their vertical application domain; the role of CREATE-IoT here was to support on common issues found across diverse application domains.

Thus, the workshop was structured in order to:
- Identify LSP commonalities in their exploitation approaches.
- Create exchange between LSP on common issues.

As far as exploitation of the project is concerned, three angles can be explored:
- Technologies: Economic exploitation of the assets that have been developed during the pilots like IoT platforms and other enablers.
- Business models: Economic exploitation of project deployments.
- Exploitation of the project relationships created with pilot sites.

3.3.2 Report of Activity

The workshop took place in Aarhus on the 20th of June 2019 and was part of the IoT Week conference, an annual event organized by the IoT Forum with hundreds of attendees composed of industry, academia, and policy representatives.

In order to favour the discussion between LSPs, the target group was restricted to LSPs themselves with the support of the two CSA - CREATE-IoT and U4IoT. In total, the workshop welcomed 18 participants among of which representatives from all the LSPs, and those in charge of exploitation strategy. As a work meeting, the 2,5-hour session was a great opportunity for the 5 LSPs representatives to present their exploitation approach, share common issues and retain best practices.

In terms of agenda, the workshop started with a session dedicated to present each LSP approach to exploitation successively followed by two round table discussions about LSPs commonalities in exploitation and about the exploitation of relationships developed by LSPs with pilot sites' partners. A keynote was also reserved to the presentation of IoT Catalogue, seen as a one option to ensure sustainability of the dissemination of LSPs' results.

3.3.3 Key Takeaway and contributions to the deliverable

The workshop has allowed an open discusion between LSPs in order to understand and to share their exploitation approach. It was the oportunity to exchange on best practices and ideas to support the sustainability of LSPs, with future economic development in mind.

The workshop has offered the opportunity to discuss about a series of topics :
- Exploitation plan and its roadmap;
- Continuity of the projetcs;
- Replicability of the pilots;
- Commonalities between LSPs;
- Sustainability of relationships with pilot site partners developed during the LSPs.

At the general level, LSPs commonly shared their concerns about the exploitation of their results but also about the form that would take the continuity of the programme beyond the end of the project.
- Properly to the exploitation of LSPs themselves, two different approaches to exploitation have been identified according to the nature of LSPs : exploitation per assets and exploitation per use case. The commonalities in exploitation models will be further detailed in the section 5.
- For some LSPs, the continuity could take the form of a digital hub innovation maintaining relationships with partners of the projects. Open calls are also an optoin to bring additional stakeholders and also extended the project to other sites.

Globally, as far as commonalities are concerned, LSPs all agreed on the importance of disseminating know-how and knowledge based on projects' results and best practices. The use of the IoT Catalog could be the answer for this issue and LSPs are already working on it. Another key common issue that came up relates to the economic approach involving the identification of business models and also the monetization of data.

Some differences between LSPs also came up during the workshop especially around the importance of exploitation in the development of LSPs. For some projects, exploitation was already taken into account at the beginning of the programme and pilots have been built with exploitation in mind. For other the question of exploitation is linked to the role of partners in the project.

Finally, the workshop was also the opportunity to discuss about the project of collaboration between LSPs that already occurs showing the ability for cross-domain information sharing.

4. IoT Business Models

This section presents a general perspective of the impact that the development of the Internet of Things is having on value chains and business models.

This analysis is based on a global value chain analysis, reinforced by the interaction enabled by the large-scale pilot approach.

Its key objective is to provide strategic perspective to the Large-Scale Pilot exploitation and the potential transformation of the partners involved in the initiative.

4.1 IoT Value Chains and trends

4.1.1 Distribution of the value

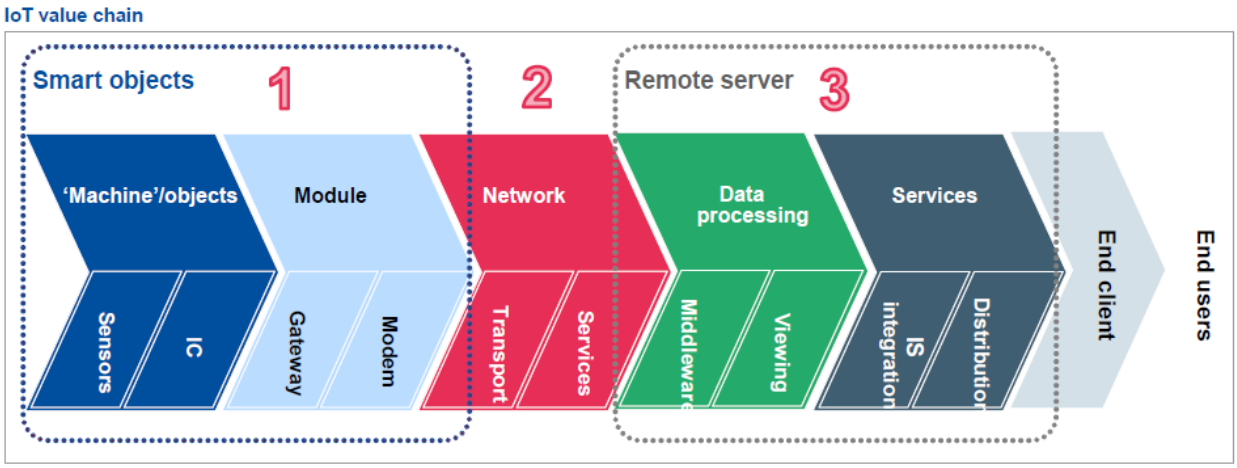

Figure 1: IoT Value Chain (Source: IDATE DigiWorld in World Cellular M2M market, September 2019)

Given that Internet of Things (IoT) is not considered as a standalone market but rather a combination of multiple vertical markets adopting connected solutions, the value chain is fragmented and complicated as it comprises various types of players and business models.

The IoT value chain is thus a combination of several separate value chains including electronic value chain, telecommunications value chain, computing value chain as well as the value chain of machines themselves.

Nevertheless, three main segments can be defined as the principam layers of the IoT ecosystem:

- Hardware and connected equipment
- Connectivity
- Software and IT

However, the dynamic and competitive IoT environments has urged players from these segements to start looking for new opportunities on other IoT markets.

For example of the largest players from hardware and connectivity layers have been seeking to extend their offerin to provide software and middleware solutions to their customers.

Such interest for non-core activities can be explained by the fact that the softawre segement today generates by far the largest part of the global cellular M2M market value: around 65% of all the revenues are represented by this layer.

The key players in this segment are IT companies providing data processing and services such as information system integration and distribution.

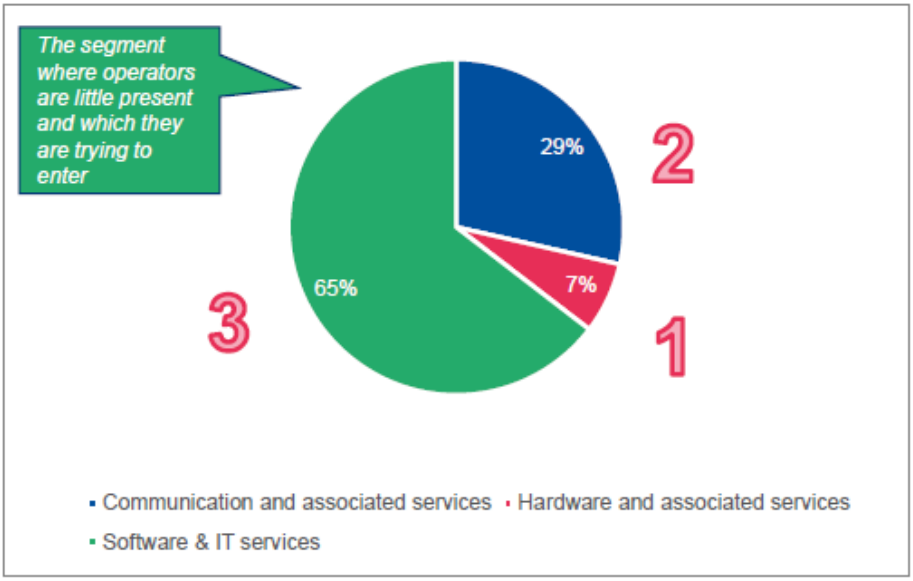

Figure 2: Distribution of global cellular M2M revenues by segment in 2022 (Source: IDATE DigiWorld in World Cellular M2M market, September 2019)

On of the most important parts of the IT offering in the IoT space is middleware – IoT platforms that seve as a connector for physical (hardware, connected objects) and digital (software applications) elements of the IoT ecosystem.

4.1.2 Key trends for the Hardware Module market

Historically, players from the hardware segment of the IoT ecosystem used to have a particular specialization in providing IoT hardware only. However, players have been changing strategy by developing more extensive offering including services and IT solutions with a particular focus on platforms. Such transformations of companies' strategies represent a way to increase and revenues by addressing other IoT segments.

Positions are increasingly shifting from hardware to software-based solutions.

In particular, all the major module manufacturers such as Gemalto, Sierra Wireless, Telit and Huawei have been developing IoT platforms for device and connectivity management.

	Sierra Wireless	Gemalto	Telit	Huawei
SIM card	✓	✓	✓	
Cellular	✓	✓	✓	✓
Wifi	✓		✓	✓
Bluetooth	✓		✓	✓
Satellite/GPS	✓		✓	✓
RF			✓	✓
Connectivity services	✓	✓	✓	✓
Platform services	✓	✓	✓	✓
Verticals	Traditional and consumer M2M	Traditional M2M	Traditional M2M	Traditional M2M
Key differentiators	End-to-end offering; large portfolio	End-to-end offering	Multiple technologies	Low cost

Figure 3: Comparison of main player position regarding technology on the Hardware Module market (Source: IDATE DigiWorld in World Cellular M2M market, September 2019)

This IoT offering is designed for enterprises, industrial OEM, consumer OEM, mobile network operators and cloud service providers. Platform solutions can be developed internally by hardware companies or through acquisitions and partnership with software specialists.

However, those platforms are not necessarily delivered as a separate product but are rather a part of a broader solution that also includes compatible modules and devices and IoT connectivity plans. Such plans are usually based on cellular or cellular IoT (NB-IoT/LTE-M) connectivity technologies.

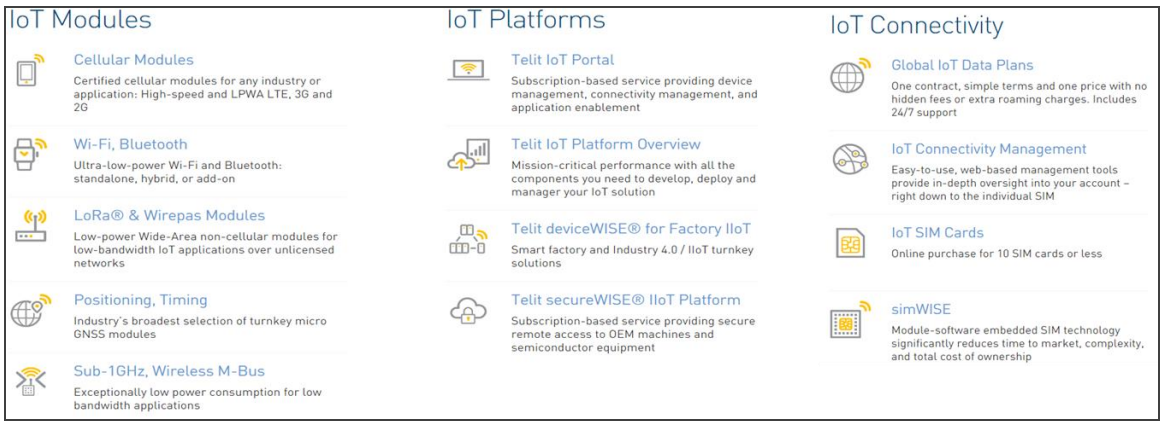

Figure 4: IoT offering by a module manufacturer Telit that comprises modules, connectivity plans and a device & connectivity platform (Source: Telit)

4.1.3 Key connectivity trends

Connectivity represents the second largest part of the IoT business ecosystem and is an essential element of any IoT solution as it provides communication between objects, devices and end users of use case-specific applications. The main players in this segment are telecom operators delivering fixed and wireless internet access, satellite operators and companies like Sigfox that provide LPWA connectivity with their proprietary technology. However, mobile network operators (MNOs) have traditionally played a central role in connectivity business.

Connectivity remains the core business of MNOs

However, IoT still represents a minor part of MNOs' activities. Only several of the largest operators such as Vodafone and Telefonica regularly disclose their IoT revenues. In general, MNOs prefer to communicate the number of devices connected through their network. The reason is that average revenue per user (ARPU) from IoT services is still rather low: even for the largest MNOs monthly ARPU is below 1 EUR. Nevertheless, it is expected that overall revenues of mobile operators from IoT will rise in the following years due to increasing interest of industrial companies to connected services. Consequently, operators tend to raise their investment into deployment of IoT networks and development of additional IoT services.

The IoT connectivity space has clear leaders while IoT has becoming a priority for all largest operators

Overall, the global IoT vertical markets are led by several largest MNOs (AT&T, Vodafone, Verizon, China Mobile) which have the most advanced offering and that have prioritised IoT development in their strategy. China Mobile is however an exception as it benefits from the enormous local market in China, even though the actual number of IoT connections claimed by the company can be doubted. At the same time, smaller players are often strong in particular industry/industries or in a limited geographical zone (DOCOMO in Japan or Zain in the Middle East). The third type of telecom operators providing IoT connectivity does not have any particular vertical priorities and offer industry-agnostic solutions that do not generally include other elements such as a platform or applications.

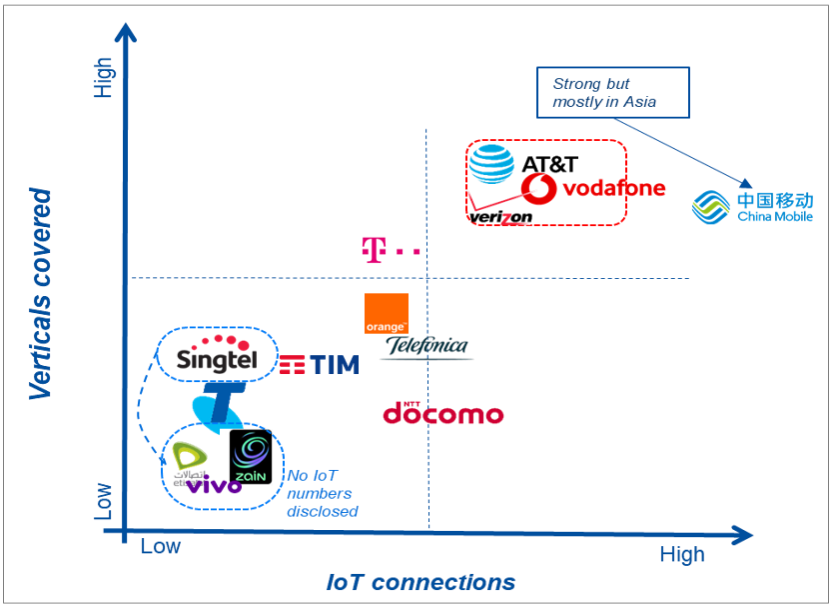

Figure 5: Distribution of global cellular M2M revenues by segment in 2022 (Source: IDATE DigiWorld, Key IoT Verticals, *December 2019)*

Mobile operators are thus keen to increase their profits by addressing the IT segment

An important shift in the IoT connectivity space has been seen in the recent years. Communication providers have been changing their strategy to move from providing pure industry- and use case-agnostic connectivity to deliver complete solutions for particular business need of their B2B clients. Today, all the major mobile operators offer end-to-end solutions for a number of industries. Such solutions usually include:

- Hardware/devices: can be provided in partnership with third party manufacturers or by directly by MNOs.
- Connectivity plans: wired, cellular, cellular IoT, LPWA and sometimes satellite (for example, Vodafone offers satellite IoT connectivity using the constellation of Inmarsat)
- Middleware: an IoT platform (usually a connectivity management platform designed to optimize SIM card configuration and maintenance
- Software applications: can be developed by an operator internally or third-party applications

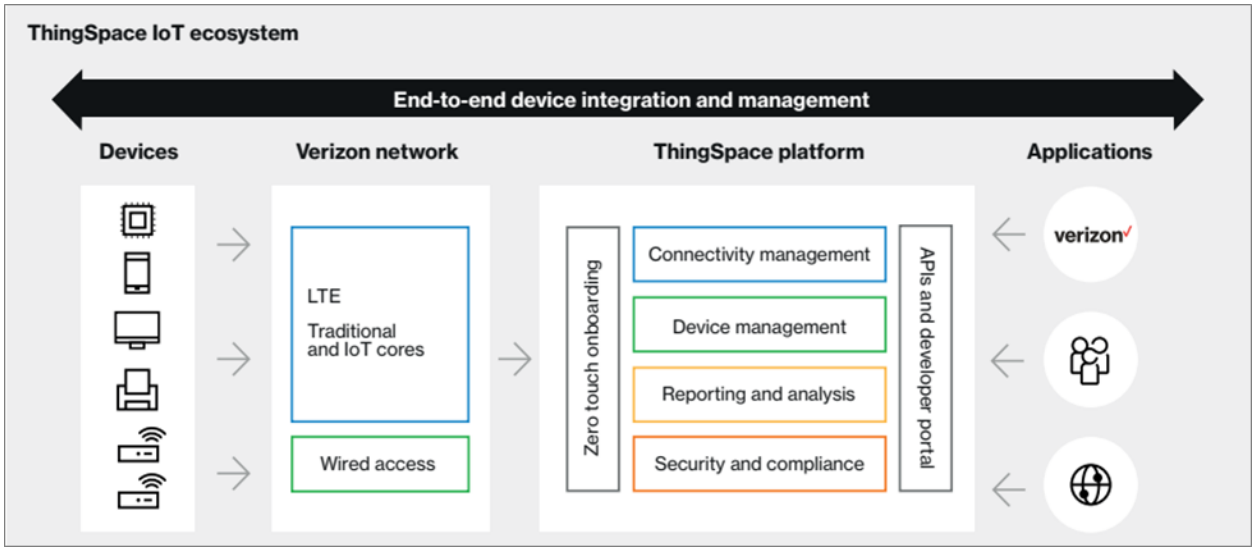

Figure 6: IoT offering of Verizon including the platform and applications (Source: Verizon)

Such end-to-end solutions are usually provided for a limited number of vertical markets. It mostly concerns large or rapidly developing markets for IoT such as automotive, energy,

manufacturing, logistics and healthcare. Currently, end-to-end logistics offerings tend to be the most mature and are offered by the majority of the world's largest operators. At the same time, operators have fewer references on other smaller vertical markets such as agriculture, mining or public safety.

Operators find it hard to compete with software market leaders

However, connectivity remains the core of operators' IoT business. At the same time, most of the largest players have been interested by addressing the IT/software segment, which represents the most opportunities in IoT. The main activity of MNOs in this field is providing connectivity and device management platforms and vertical market-specific use cases. Meanwhile, they can hardly compete with large IT providers such as IBM or Microsoft that have traditionally been experts in this domain and already have established relations with vertical players for managing their traditional IT back-end systems. IoT data collected will be handled by those IT companies and telcos do not have any real key differentiators to provide such solutions directly to industrials.

Competition in all the segments due to new entrants

In addition to domination of IT companies in the software segment of IoT, telecom operators are also facing the rising competition coming from new market entrants. In particular, this concerns competition from hardware and network equipment manufacturers, vertical players and large IT companies that are seeking to expand their existing offering. These players have been trying to address all the segments by offering end-to-end IoT solutions. Such development strategies of MNOs' competitors are often supported by establishing partnerships with players from other domains or acquisitions of companies providing those services or producing hardware.

4.1.4 Key software and IT trends

Increased competition in this segment

Even though players in the IT segment of IoT do not directly participate in connecting objects to the internet, products and services offered by them generate the most value in the IoT business. In the recent years, the level of competition has increased dramatically as all types of players along the IoT value chain are searching new opportunities to expand their business activities. This segment now comprises several types of players including large IT giants such as IBM or Microsoft, technological and industrial companies such as Bosch or Siemens, multiple tech start-ups delivering niche solutions, telecom equipment manufacturers such as Ericsson or Nokia hardware manufacturers and communication providers. In order to be able to enter a new competitive market, companies coming from other domains often choose an acquisition strategy: the purchase IoT platform player, application development companies, AI and big data specialists. These players typically offer IoT platforms of all types and software applications designed for multiple IoT use cases. Most solutions tend to be provided on an as-a-service basis.

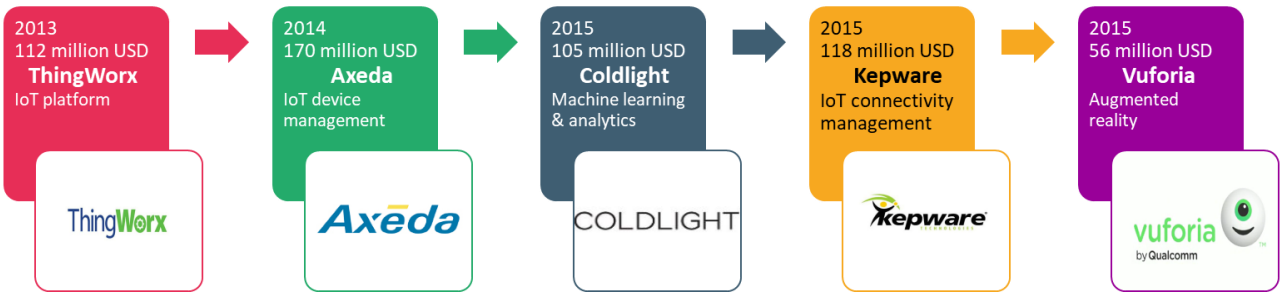

Figure 7: Timeline of the IoT-related strategic acquisitions by PTC (Source: IDATE DigiWorld in World Cellular M2M market, *July 2019)*

Value is in the data management and storage

IoT data management software has significantly evolved during the past years from simple operations such as data collection, storage and visualization to complex scenarios including advanced big data analytics. Today, enormous amounts of data coming from all types of devices and sensors are processed by IoT platforms to generate additional data and services.

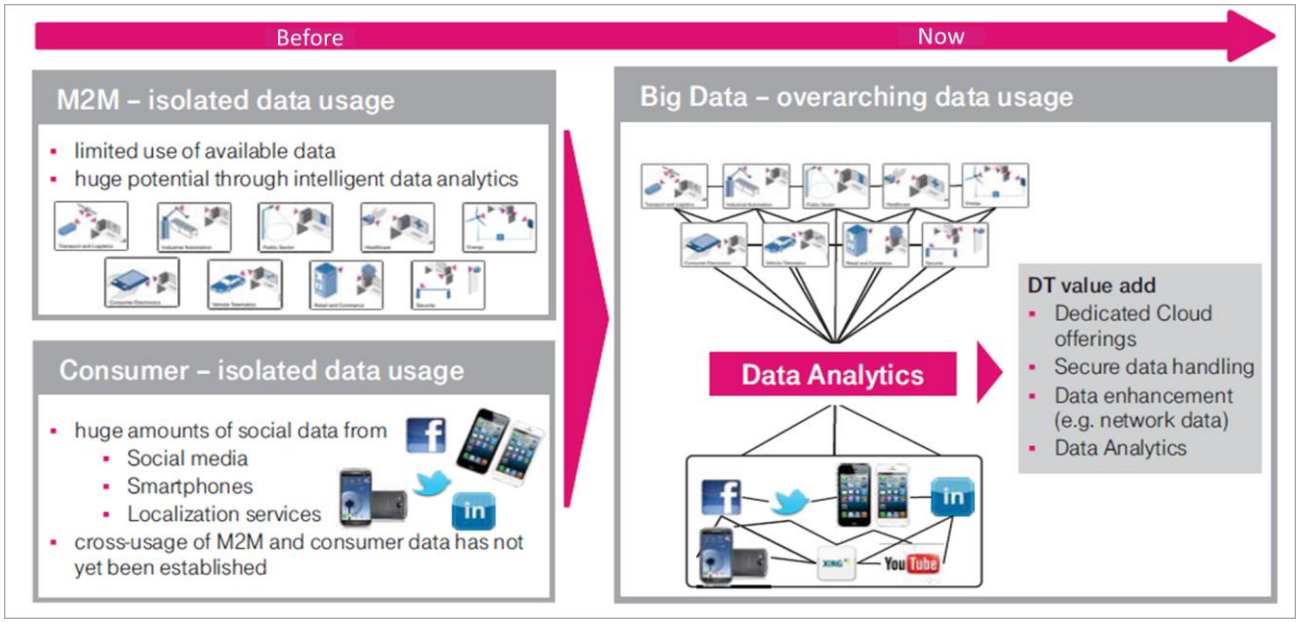

Figure 8: Changing strategy concerning IoT data management (Source: T-Mobile)

4.2 IoT and the Platform Models

4.2.1 Definition and classification

The term **'IoT Platform' is widely used** both by companies involved in the IoT value chain and by the press. However, there is still some **confusion around its real-life definition**. Companies offering 'IoT Platforms' often provide only **separate elements** such as connectivity management, software applications for IoT verticals or cloud services.

Definition

That is why it is crucial to have a **clear understanding of what is a complete IoT platform** as well as its role in the entire IoT solution ecosystem.

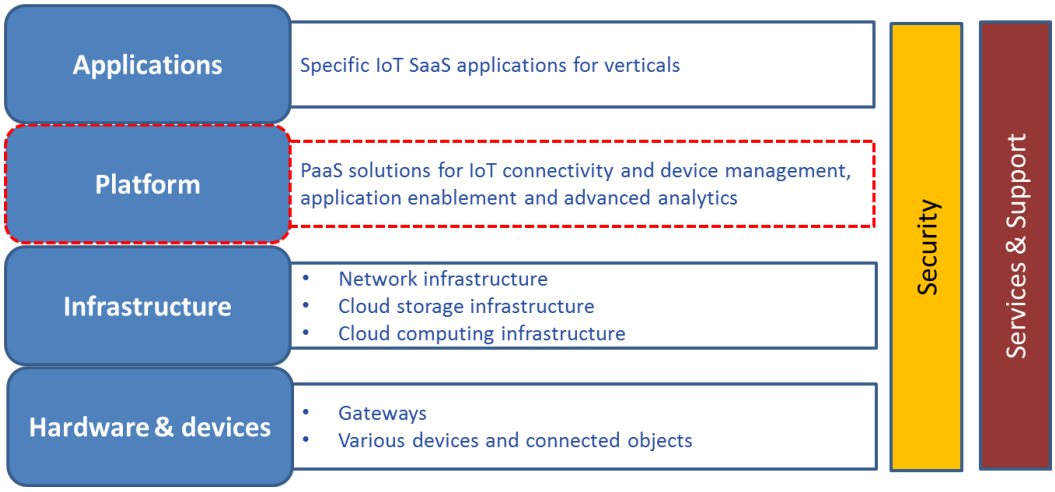

Figure 9: Role of IoT Platforms in the IoT Ecosystem (Source: IDATE Digiworld)

The IoT ecosystem consists of four major layers:

- devices and hardware,
- network and cloud infrastructure,
- IoT middleware
- Software applications that vary depending on the industry and on the use case.

IoT platform thus operates as a connector between devices, hardware and vertical applications.

IoT platform is a **complex structure** comprising multiple elements that can be **adjusted to clients' needs**. However, the most important modules that are usually included in the platform architecture can be defined as showed at the image below.

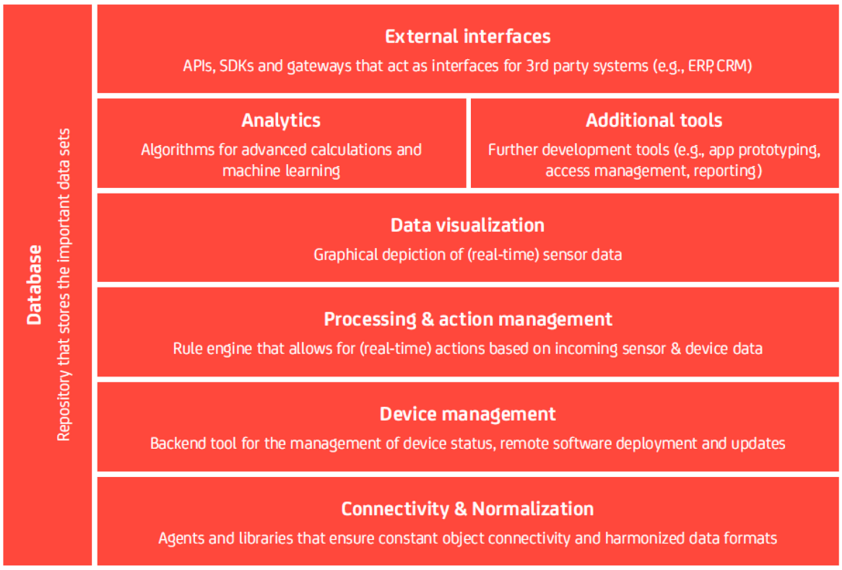

Figure 10: Components of an IoT Platform (Source: IoT Analytics)

IoT Platform Classification

There is still **no unique and clear definition of IoT platform** types. However, based on functionalities, it is possible to distinguish types of platforms that focus on one or several building blocks:

- IoT Application Enablement Platforms
- IoT Device Management Platforms
- IoT Cloud Storage Platforms (IaaS)
- IoT Analytics Platforms
- IoT Connectivity Backend (Platforms)

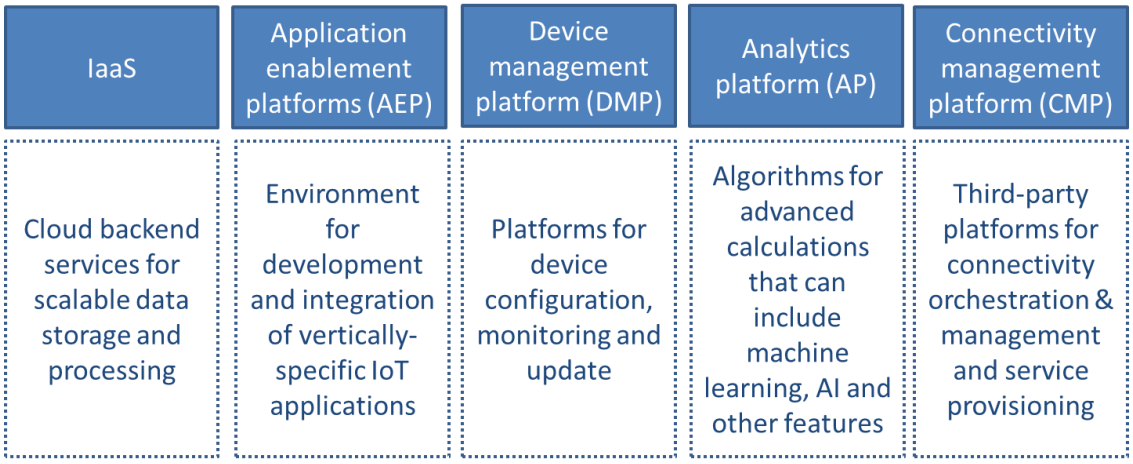

Figure 11: IoT Platform Types and Description (Source: IDATE Digiworld)

Integrated IoT platform solutions from key vendors often **combine different types of functions**. Traditionally, the majority of leading IoT platform vendors come from **IT** and are represented by companies like IBM or Microsoft. However, large **industrial groups** such as Siemens, Schneider Electric or GE have been rapidly including IoT platforms in their offerings. On the other hand, there is a range of **niche companies** specializing mostly on several particular elements.

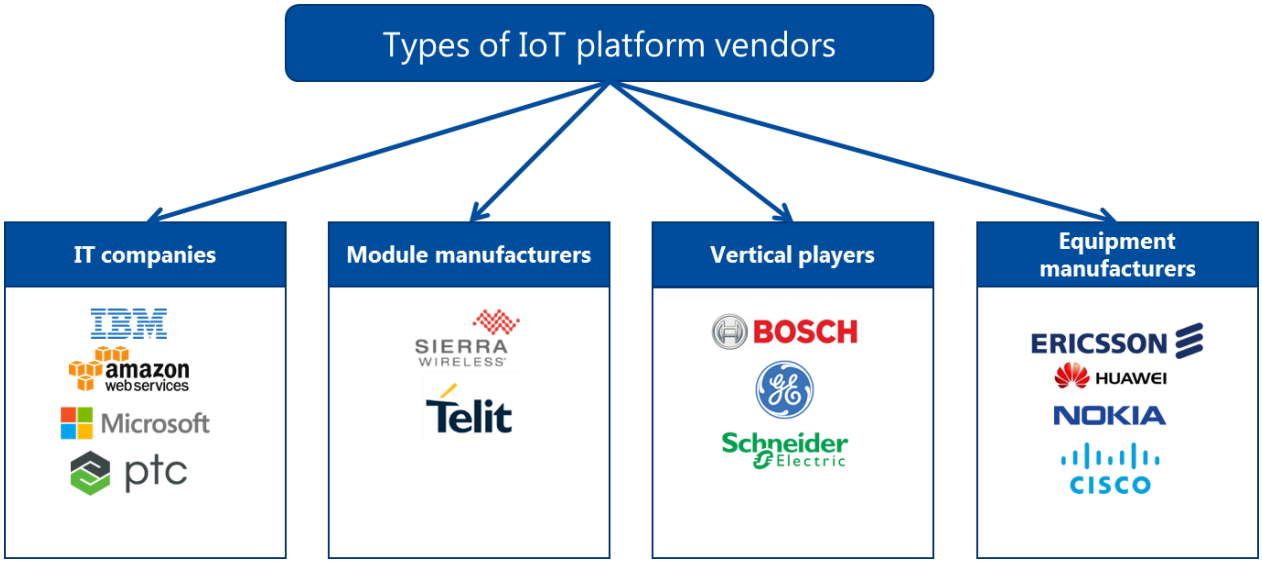

Figure 12: Types of IoT Platform vendor companies (Source: IDATE Digiworld)

4.2.2 Cloud backend IoT platforms (IaaS)

Platform description

Infrastructure is a **starting point** for any IoT platform as they provide other IoT platforms with **scalable data storage and processing**. This layer provides essential resources to platforms as a service.

Table 1: Strengths and weaknesses of IaaS IoT Platforms (Source: IDATE Digiworld)

Strengths	Weaknesses
Outsourcing of IaaS significantly **reduces potential investment** in cloud infrastructure and **accelerates time-to-market** for IoT platform vendors	IaaS is only a **basic layer** in the IoT platform ecosystem that needs to be accompanied by **other platform functions** such as connectivity management, advanced analytics etc.

Business Model and strategies

Contrary to other IoT platform vendors, companies operating in this segment serve also as **infrastructure providers and host other platforms**.

That means that they target not only companies looking for an IoT platform to manage their devices, get analytics and build industry-specific applications but **also other platform vendors** who needs their solutions to be hosted on a third-party infrastructure.

IaaS vendors become then simultaneously **suppliers and competitors** to other companies on the IoT platform market as they also provide other IoT platform functions such as advanced **IoT data analytics and device management**.

Cloud infrastructure can allow on-premises, public and private cloud deployment and their combinations. Cost of an IaaS service depends on the amount of data, memory, network and storage use.

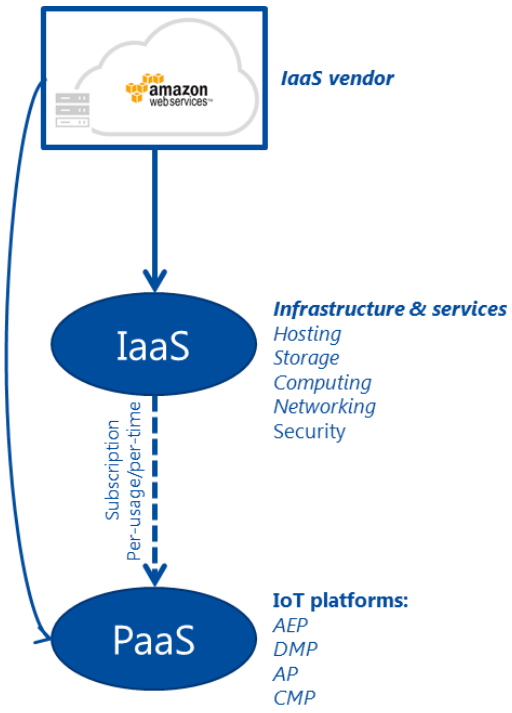

Figure 13: Example of an IaaS (Source: IDATE Digiworld)

4.2.3 Application enablement platforms (AEP)

Platform description

Application enablement platforms (AEP) are **central to the IoT platform ecosystem**. Their role in the value chain and its functionality are rather well-defined comparing to other types of solutions that are broadly called "IoT platforms".

AEP is a technology-centric, often industry-agnostic middleware that enables creation, tests and deployment of multiple software solutions for various vertical markets. Such platforms can also comprise other building blocks such as connectivity or device management capabilities. At the same time, AEPs often allow integration of third-party elements including advanced analytics tools or vertical software applications. They can be deployed in public or private clouds and on premises.

Table 2: Strengths and weaknesses of IoT AEP (Source: IDATE Digiworld)

Strengths	Weaknesses
Flexible core of the platform. **AEPs are vertical-agnostic and can be applied to any industry's IoT applications.**	**Lack of effective IoT marketplaces** on some AEPs. Lack of **strong analytics capability**.

Business Model and strategies

AEPs relies on a subscription-based PaaS (platform as a service) model: IoT solution developers gain access to a set of application programming interfaces (APIs) and software development kits (SDKs) allowing them to flexibly configure the application by adding various features like device management, analytics and other. APIs are thus a key element of a typical AEP offering; they ensure flexibility of such platforms allowing creation of custom-made vertical-specific IoT solutions.

Another important aspect of AEPs is **a partner network** that includes **technological and commercial partners.** Technological partnerships are important as they serve to complete

solutions with various hardware or software elements and adapt platforms to particular vertical business needs.

On the other hand, business partnerships serve to provide IoT platform vendors with **additional distribution channels** and sales network extension.

Figure 14: Example of an AEP go-to-market strategy from Connecthings.io (Source: Connecthing.io)

Developers are the key target audience for IoT AEPs inside client companies. AEPs are designed to simplify and to accelerate the process of application design for clients' development teams.

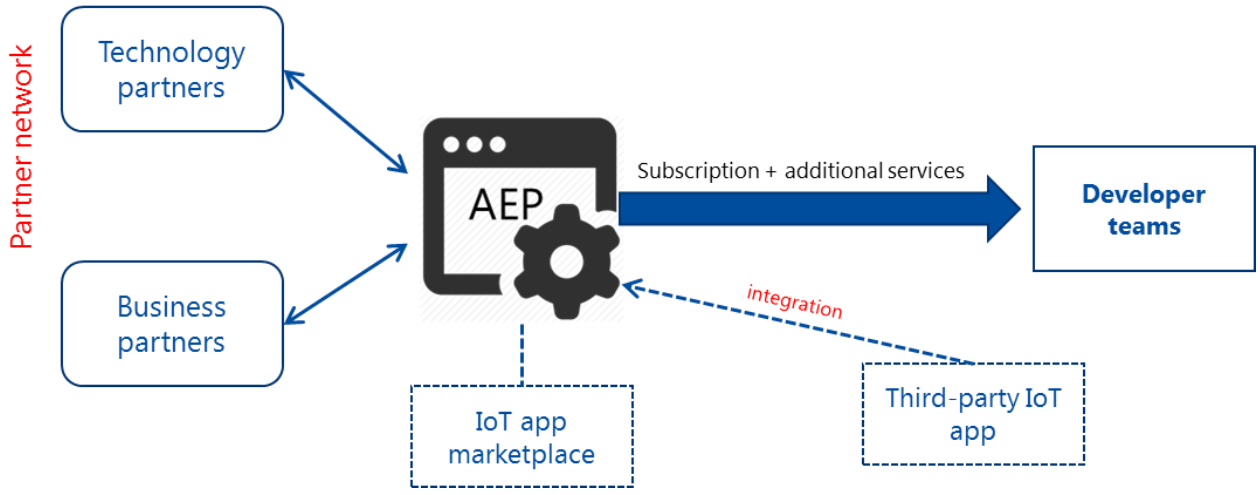

Figure 15: AEP model (Source: IDATE Digiworld)

4.2.4 Device management platforms (DMP)

Platform description

Device management capability of an IoT platform (DMP) concerns the entire **lifecycle** of multiple devices such as gateways, industry-specific devices and equipment.

Main features of IoT DMPs are associated with **provisioning, configuration, monitoring and remote access & control** of the device fleet as well as troubleshooting and firmware/software updates.

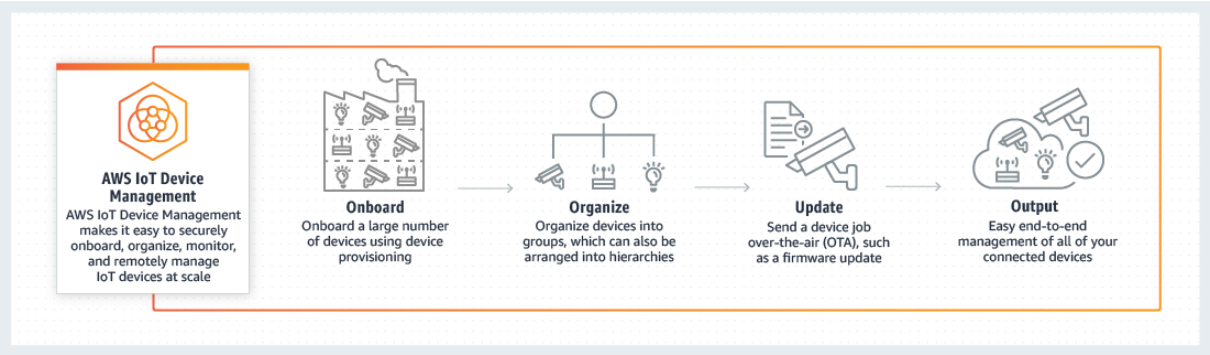

Figure 16: Example of an IoT DMP by AWS (AWS IoT Device Management), (Source: Amazon)

Table 3: Strengths and weaknesses of IoT device management platforms (Source: IDATE Digiworld)

Strengths	Weaknesses
Reduces maintenance and operational costs of devices	Lack of **effective management** for some platforms. Lack of cloud-to-cloud or machine-to-machine **integration with external applications.**

Business Model and strategies

DMPs are platforms as a service (PaaS) that can be provided on-premises or in a cloud. Platform services are **subscription-based with monthly or annual billing**. DMPs can be distributed either **directly by the vendor or through official distributors.**

Figure 17: IoT DMP deployment options (example of the Telit IoT platform), (Source: Telit)

Partner network ecosystem is also an important element in the DMP business model as it helps platform vendors enrich their products with **additional technological building blocks** and find new clients thanks to **business partnerships** with system integrators or cloud providers. Telit has, for instance, one of the largest partner networks among IoT platform providers of all types. Their partner network comprises industry partners (Qualcomm, ZigBee), technological partners (AWS, Intel), network partners (AT&T, Swisscom) and system integrators. The company has also launched its proper deviceWISE Ready partnership program to "**promote interoperability between devices**".

4.2.5 IoT Analytics Platforms (AP)

Platform description

Advanced analytics is another building block of an IoT platform that is often included in the offering of other platform types.

Main features associated with such middleware are AI/machine learning capabilities, real-time streaming analytics as well as historical, predictive and prescriptive analytics.

APs can be deployed on-premises, in public or private clouds.

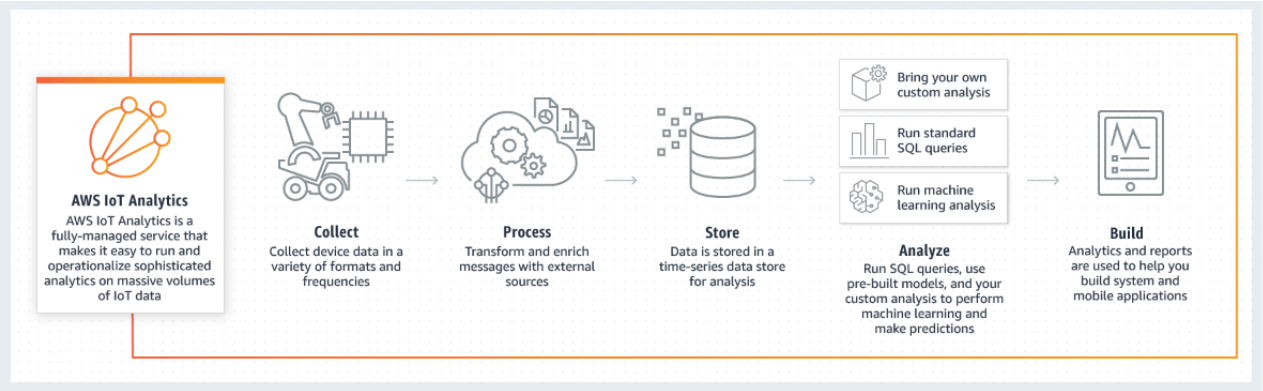

Figure 18: Example of the AWS IoT Analytics suite (Source: Amazon)

Table 4: Strengths and weaknesses of IoT analytics platforms (Source: IDATE Digiworld)

Strengths	Weaknesses
Offering based on **advanced technologies**: AI, deep learning.	Other platform functions are **sometimes less developed.** Lack of **precise information regarding AI/machine learning functioning mechanism.**

Business Model and strategies

Most APs rely on a consumption-based licensing model which implies regular billing based on actual use of the platform or its elements.

Partner networks play an important role for APs: they provide resources needed to offer complete IoT solutions.

Partnerships can be established in order to benefit from non-core technological expertise, to assure **interoperability between devices and platforms**, to solve connectivity issues or to create additional distribution channels.

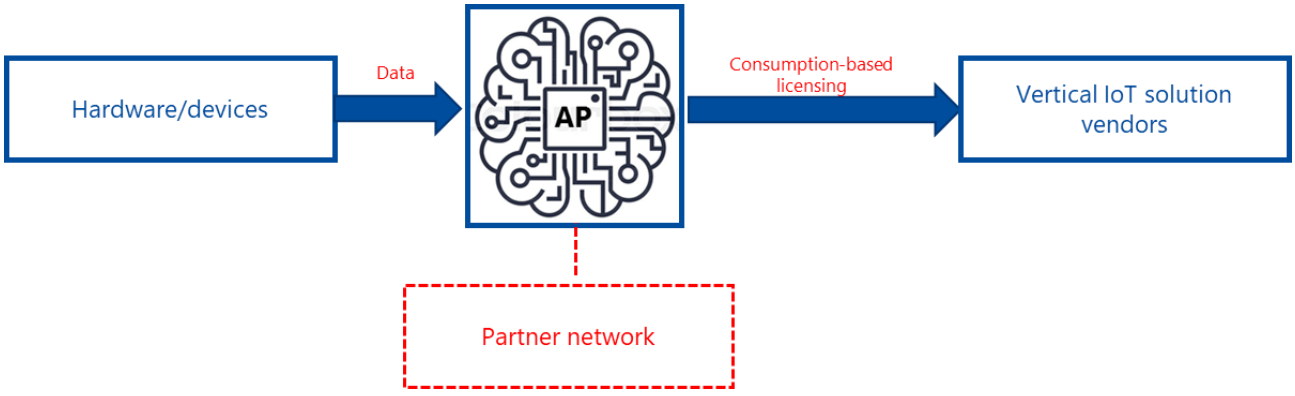

Figure 19:Ecosystem of IoT analytics platforms (Source: IDATE Digiworld)

4.2.6 IoT Connectivity Management platforms

Platform description

This type of platform concerns **IoT connectivity provided by connectivity players** including **MNOs** like AT&T, Telefonica and others and **MVNOs**. They serve as a **bridge between IoT connectivity and higher layers** in the IoT architecture such as application enablement.

Main features of such platforms are connectivity orchestration, provisioning, billing, alerting and other operational functions related to the connectivity layer.

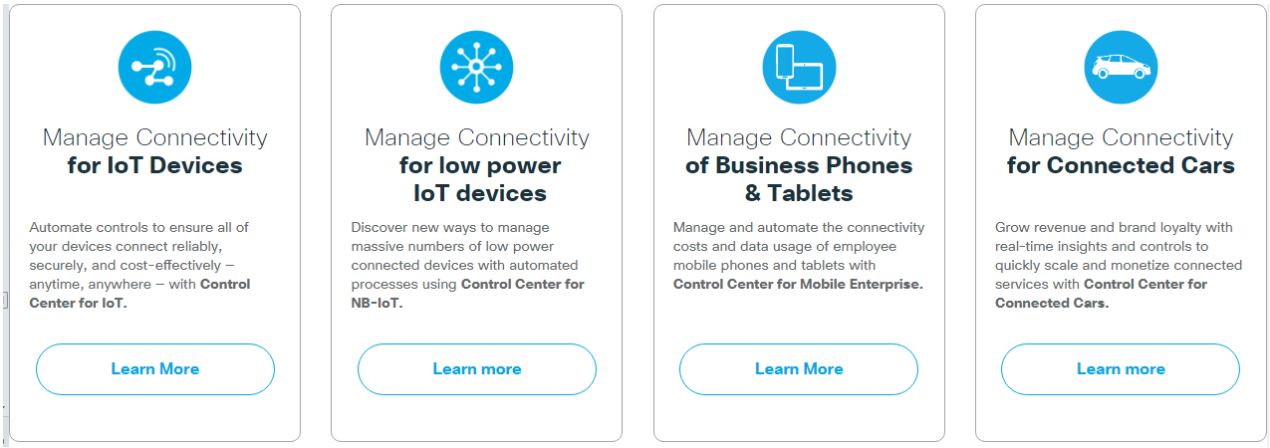

Figure 20: Jasper Control Center – example of an IoT connectivity management platform by Cisco (Source: Cisco Jasper)

Table 5: Strengths and weaknesses of IoT connectivity management platforms (Source: IDATE Digiworld)

Strengths	Weaknesses
Help CSPs **outsource platform development** to reduce CAPEX and OPEX. Reduce **go-to-market time.**	Lack of **technology-centered offering.** CSPs do not have **full control over the connectivity management process.**

Business Model and strategies

Connectivity management can either be **offered as a self-standing business** for a company or to extend **companies' current operations**, for example, to switch from hardware-centric activities. An example of such a business model improvement is a platform by Sierra Wireless that combines **connectivity management and device management functionalities.**

CMPs can be distributed by companies themselves or via a **partner network**. Service integrators are usually represented by **mobile operators**.

Figure 21: Cisco Jasper partner network - service providers (Source: Cisco Jasper)

4.2.7 Ecosystem analysis

IoT platform ecosystem has a **complex structure** that still lacks clear and well-defined classification given a **large variety of products offered under the name "IoT platform".** This term is widely used by vendors of numerous software applications and vertically oriented solutions for IoT but in fact it can be hardly applied to all of them.

Four general types of IoT platforms, building upon cloud infrastructures

However, **it is possible to identify a general hierarchy** in this multiplicity of IoT solutions. **Cloud infrastructure** and service around it is a base for any of them and in most cases is provided to IoT platform vendors by technological giants like AWS and Microsoft (if the platform is not hosted in a private cloud). Then, there can be distinguished four broad types of IoT platforms that may have a particular focus on one or two major elements (**connectivity & device management, analytics, application enablement**) or combine all of them.

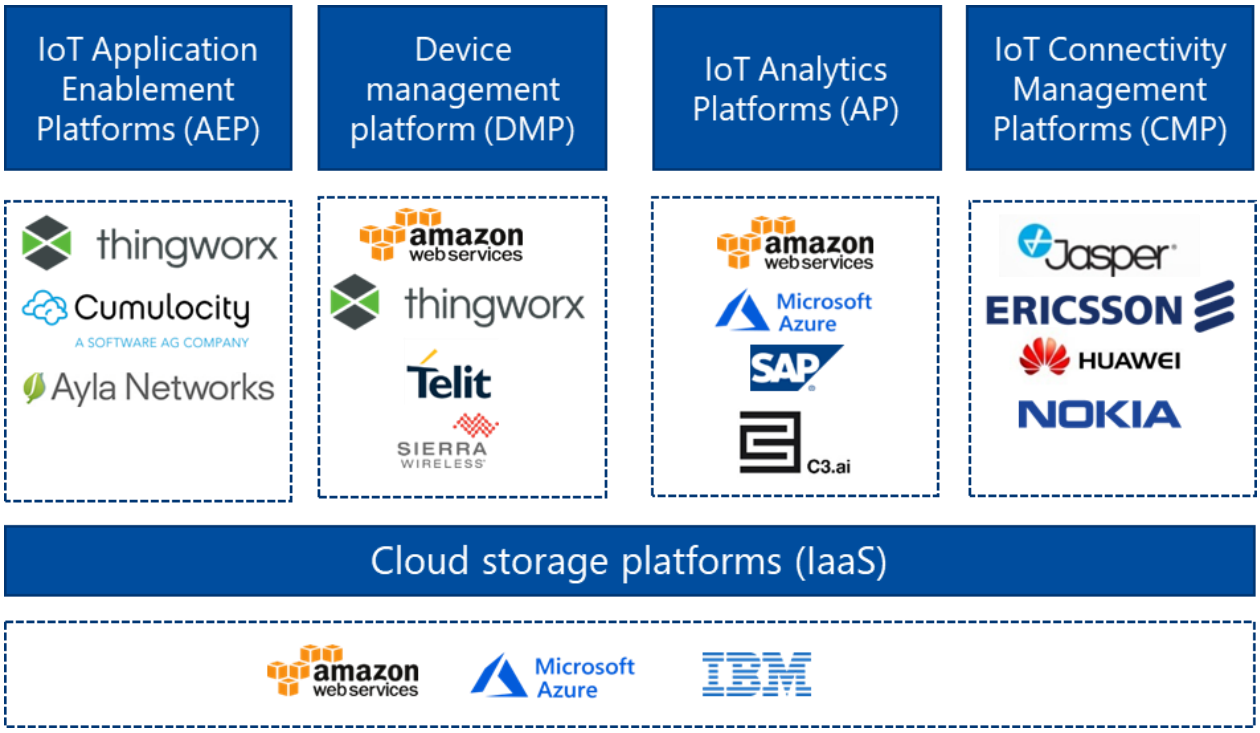

Figure 22: Major players in the IoT platform ecosystem (Source: IDATE Digiworld)

Key partnerships

Technological partnerships are crucial to all IoT platform types and especially for those who operate in a public cloud or have a particular technological focus and want to extend their product functionalities. Such collaborations are launched with hardware/device manufacturers, connectivity providers and various technological companies providing cloud services, extensive analytics, machine learning & AI, edge services etc.

Business partners also play a significant role in the IoT platform business model as many vendors prefer multiple distribution channels including sales of their products via partners.

Market leaders and niche players

IoT platform market counts **more than 450 companies** all around the world. At the same time, there is a huge difference in market presence and therefore in revenues: **IoT platform market leaders** such as IBM, Microsoft, PTC and others have **enough resources to dominate in all or almost all platform segments**. That is why all other smaller firms have to find **an appropriate niche** based on particular platform functions or vertical industries covered.

Market leaders have a **strong offering** comprising **all the most important building blocks** of a full-scale platform adapted for multiple use cases. Moreover, Companies such as AWS, Microsoft, IBM and Software AG have by far **the largest partner networks** that include technological and business partners. Partnerships allow them to **efficiently delegate part of expertise** to specialists while focusing on core business as well as to benefit from **extended sales networks and multiple distribution channels**.

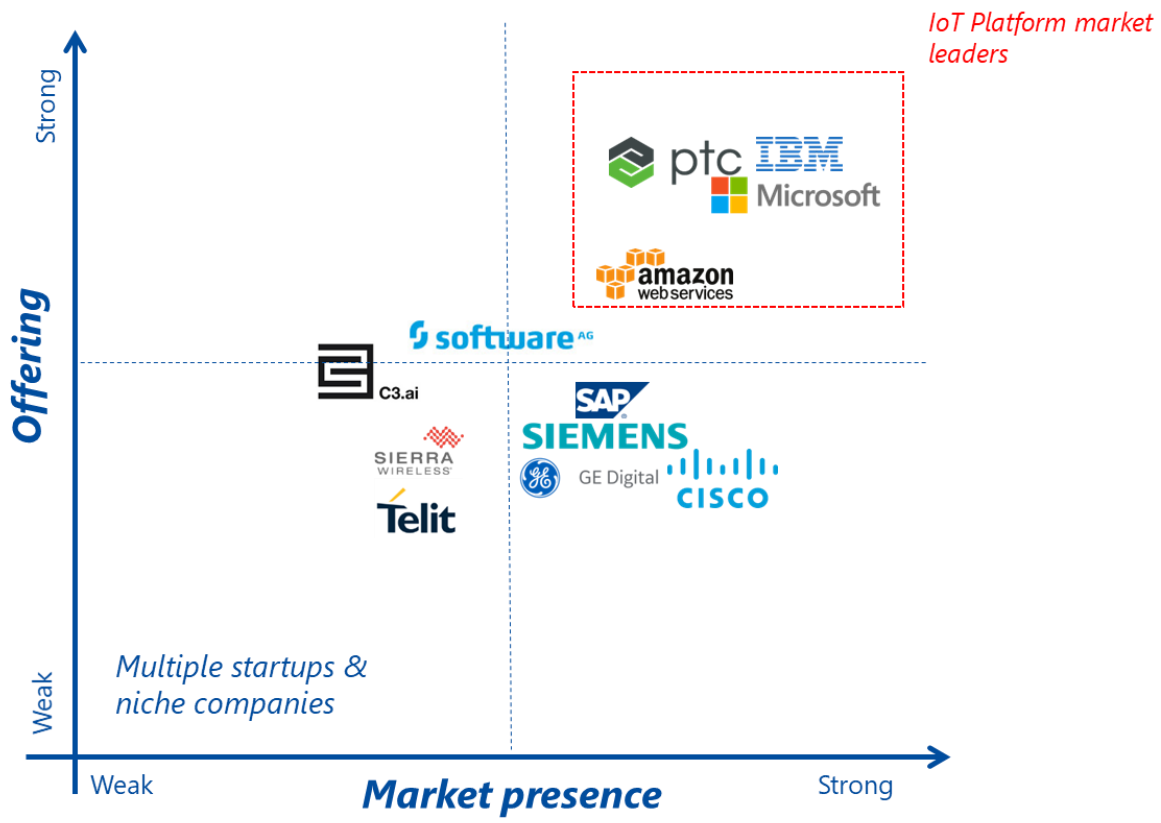

Figure 23: IoT platform market leaders (Source: IDATE Digiworld)

4.3 IoT and Servicization

The development of the Internet of Things implies potential shift in business models, with the development of more service-oriented business model that complement or replace traditional product offerings. We present here a perspective on this transformation, illustrated over 3 applications domains: Agriculture, Automotive and Manufacturing.

4.3.1 Concept

Data will play central role in the nearest future as many player strategies aim to leverage the data collected from the connected objects, for business reasons chiefly. That is the reason why players from all the segments of the IoT value chain are looking forward to changing their strategy by introducing more value-added services around their usual product offerings.

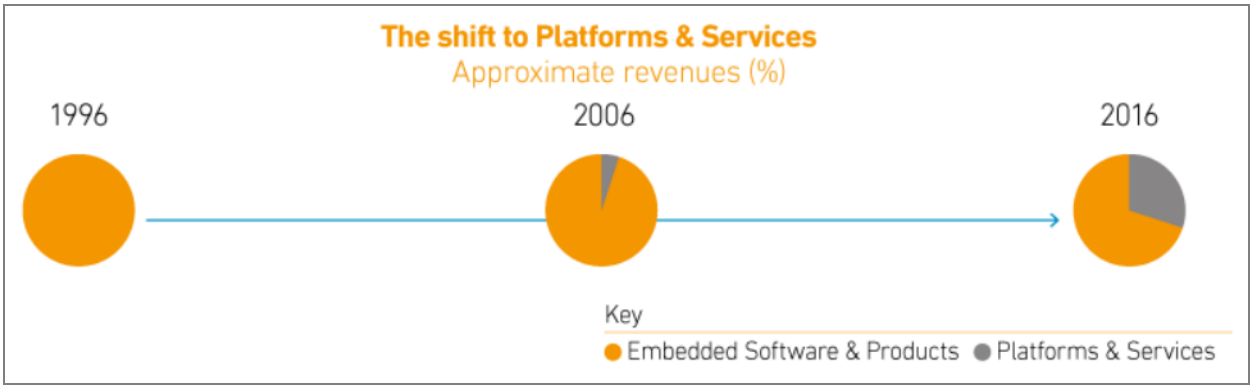

Figure 24: Gemalto's strategy shift towards more services (Source: Gemalto)

Instead of simple on-time purchases of products or solutions, customers are offered subscription-based services that are paid per use. This would allow companies to distinguish themselves in the most competitive sectors where pricing formulas are key to market survival. This type of pricing is an integral part of the new services that IoT enables, such as real-time pricing that makes it possible to implement occasional promotions remotely. Several options are available while transforming a business model into a service-oriented one.

Pay-as-you-go (Product as-a-service)

This model is based on the substitution of the product bill by charging a service. Pricing is based on usage and no longer on the product acquisition. The end user does not pay for a product at all but for a service solution. This configuration is also gaining traction given that, for key businesses; product acquisition (aka the total cost of ownership - TCO) could be a financial issue, especially for premium products.

Players in some industries – transportation is one such – are already using it, with a model based on the basis of per kilometre or time units.

Pay-per-outcome

Emerging and innovative business models are entering the scene. To better meet their client expectations such as in terms of cost optimisation, in addition to related services, some industrial players provide a model where the client is charged only if the contracted expectation is completed. For instance, the Michelin EFFIFUEL solution charges its clients only when the fuel cost savings are achieved.

Effects of servicisation on customer relationship

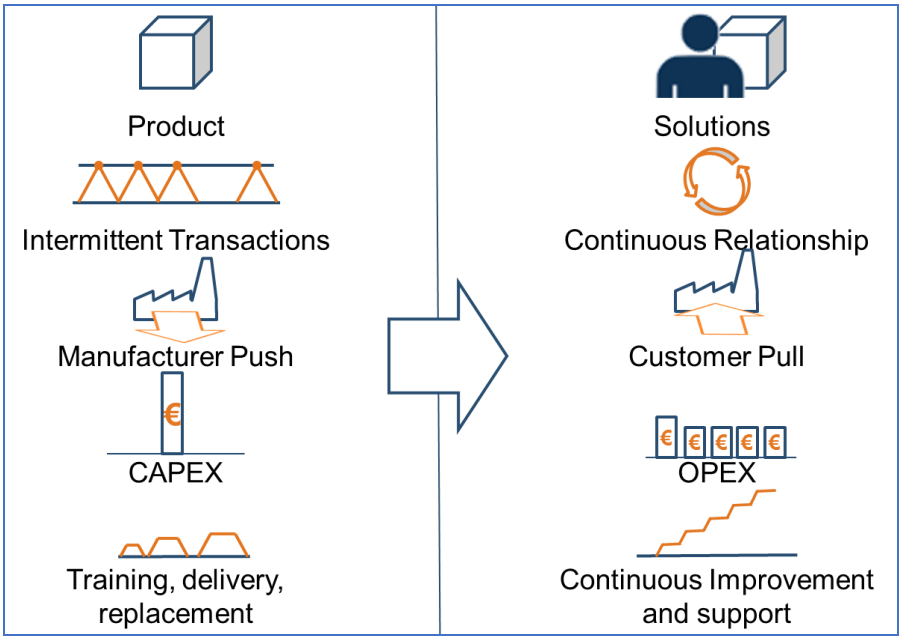

Figure 25: Effects of servicisation on customer relationship (Source: IDATE DigiWorld, The Industrial Internet, *May 2017)*

- **Products to solutions**. The manufacturer does not sell a product but solutions including products with additional (paid) services.
- **Transaction to relationship**. A 'one-shot' purchase is transformed into a recurrent relationship between supplier and client. On the merchant side, it is the opportunity to introduce a lock-in configuration.
- **Manufacturer push to customer pull**. Servicisation reinforces the focus on the management of the customer relationship as the solution could fit customer demand if it could evolve over time.

- **Capex to Opex**. Users could also benefit from this shift as depending on their financial situation, they would prefer an Opex model (based on recurrent costs referring to service billing) rather than a capex model (one-shot costs, even via amortisation referring to the product acquisition). This could lead to a more flexible model, which could stimulate a higher adoption of these connected products.
- **Continuous improvement and support**. The customer relationship evolves from ownership of products over a definite lifespan (with necessary training periods and replacement) to continuous usage of a solution with regular improvement and support by the provider.

4.3.2 IoT and Servicization in Agriculture

Service proposed

Adoption of connected services in agriculture is still limited comparing to other larger markets for IoT such as utilities or logistics. However, in the recent years agritech solutions have been gaining traction and it is expected that by 2025 the market will grow at a CAGR of around 30% namely due to livestock-related applications. The key driver in this sector lies in improved productivity for farmers: they can optimise their plant and livestock yields, and thereby significantly save costs. In addition, they could potentially generate new forms of revenue such as in improved dairy production for cattle applications.

The main hurdle is the huge total of investment and the high cost levels of comparable solutions, resulting in a return on investment which is hard to make attractive. Another aspect which should be mentioned is the relative lack of education on the part of farmers: few of them as yet are very "tech-savvy" and have little IT knowledge in their toolbox although this is noticeably changing over time.

Today, IoT products and services offered to farmers can be divided into three main categories:
- Plant-related applications
- Livestock-related applications
- Connected agricultural machinery

Even though the use of IoT-related services in farming is still relatively low, some of the largest players from all the segments of agriculture have started to expand their offerings with data-driven solutions. For example, the leading machinery manufacturers offer telematics services and are developing self-guidance systems. The cattle market today is highly saturated with the milking robots' providers and in the long term, it seems certain that all cows will be equipped with an RFID collar, just to get into the milking machine. At the same time, the market for plant-related applications is highly fragmented with a multitude of hundreds of different types of players with the major focus on soil and plant measurement systems.

Case studies:

Case study - Telematics service by John Deere

John Deere is one of the world’s largest providers of machinery and it has been rapidly integrating connected services to its agricultural offering in the recent years.

Today, John Deere does not simply provide farming equipment but also offers additional data-related functionalities such as machine telematics, remote diagnostics and programming, antitheft and other services.

The company has developed a telematics system JDLink that can be installed as an additional option to John Deere’s tractors and other agricultural machines.

This solution allows farmers monitor location and condition of the equipment as well as remote diagnostics and maintenance. All the information regarding the state and location of the machines is visualized in the related John Deere app or via the web interface.

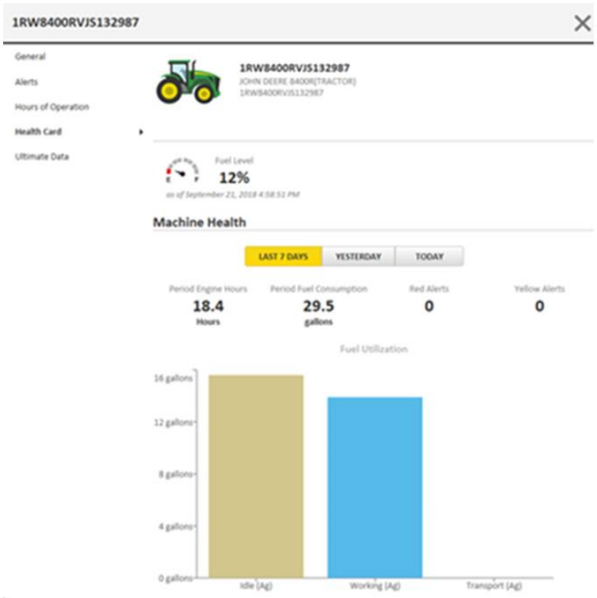

Figure 26: Dashboard of the JDLink telematics service by John Deere (Source: John Deere)

JDLink is a subscription-based service with an additional access fee. For some machines, John Deere offers a pre-built JDLink system with free five-year subscription. Customers also choose among pre-defined embedded JDLink kits of hardware to be installed on a compatible John Deere machine.

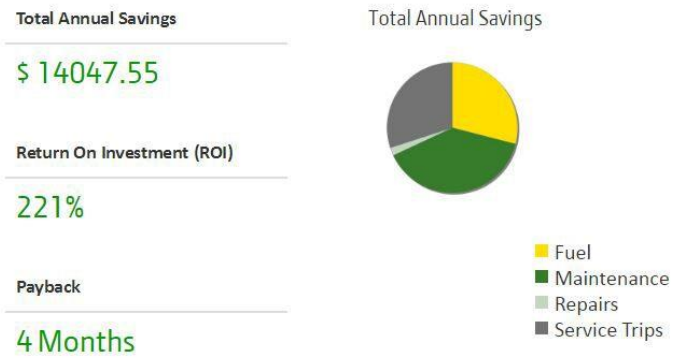

Figure 27: Example of returns from the use of machine telematics by John Deere (Source: John Deere)

Figure 28: Field Connect station for soil moisture level monitoring by John Deere (Source: John Deere)

In addition to connected agricultural machinery, John Deere has also been very active in smart farming. Beyond the technology applied on its machines, they also provide the Field Connect sensor offering for soil moisture monitoring which allows enhanced irrigation management. The data collected by the Field Connect station can be then visualized in a web-based interface.

Case study - Copeeks

While historical machinery manufacturers have been actively developing additional data-driven services to optimize agricultural production, other segments of the farming ecosystem attract mostly new players offering innovative solutions for livestock tracking and plant-related applications.

The French Copeeks start-up was created in 2016 to provide farmers with remote and real-time monitoring and visual assistance with their livestock management as well as crop production. Positioned thus on both animal and plant-related smart farming applications, the company offers devices connected to sensors gathering weather data like temperature, hygrometry, and pressure within the barn for wellness and behaviour analysis of the animals. Once collected, the data – sometimes including video content — are sent to the cloud for processing, in order to provide insights for farmers. For connectivity, Copeeks makes use of on LPWA LoRaWAN technology, and also on 3G for video transmission.

The business model used by Copeeks is a monthly rental basis, starting from 160 EUR per month. They claim to have deployed 30 sets of equipment to this point of time. They see their growth potential as being primarily in poultry and pigs due to the dairy market being saturated by milking systems providers.

Copeeks has also developped a solution for plants that allows remote monitoring of the culture including real-time data on water stress and soil mosture level as well as pest detection.

Figure 29: Pork tracking with the Copeeks solution (Source : Copeeks)

4.3.3 IoT and Servicization in Automotive

Service proposed

Automobile industry is one of those vertical markets for IoT that has been currently seeing the most dynamic business transformation towards more connected services. Modern cars are becoming a combination of transportation means and gadgets, which has opened the market to new players and business models. Even though car manufacturers still represent the key element

in the automotive value chain, connectivity and IT service providers have been rapidly gaining power.

Today, the vast majority of car manufacturers offer connected cars services that can be grouped into several main categories: emergency and telematics, infotainment, usage-based insurance and anti-theft. All these solutions are most often delivered to end users and to car manufacturers through car dealers. The largest automobile companies acquire technology and software startups and establish partnerships with IT and internet giants. However, some connected car services are offered directly by mobile network operators or other types of players who deliver devices, connectivity plan and mobile applications.

Activation and monetization of connected services has also been subject to change in the automobile industry. The two main modes of service activation are a driver SIM plan that implies smartphone plan sharing (Bluetooth, connectivity) or a specific data plan with connectivity and services are directly integrated by OEM manufacturers. The second option thus allows the latter to monetize directly those services. With the arrival of eSIM drivers will gain more freedom in choosing a communication provider and connectivity plans.

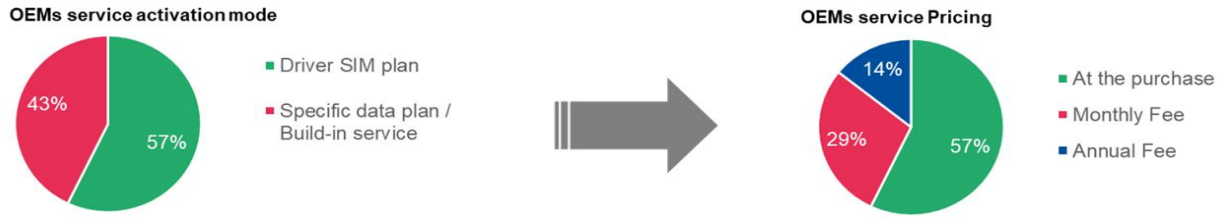

Figure 30:OEM service Activation mode and Pricing (Source: IDATE DigiWorld in Connected cars, October 2019)

Commercial and technological partnerships are another important element of connected car service provision.

Such services usually include voice assistants, cartography & navigation and music streaming. However, other options such as in-car delivery, in-car payments or office software may also be concerned.

Even though some OEM manufacturers choose to develop such services internally (true for voice commands), most often they prefer to collaborate with established service providers such as Amazon (voice assistant Alexa) or TomTom (cartography & navigation).

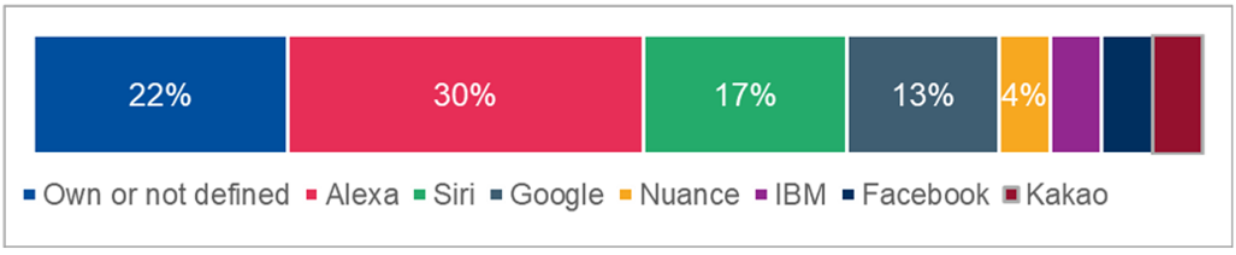

Figure 31: Voice commands providers observed (Source: IDATE DigiWorld in Connected cars, October 2019)

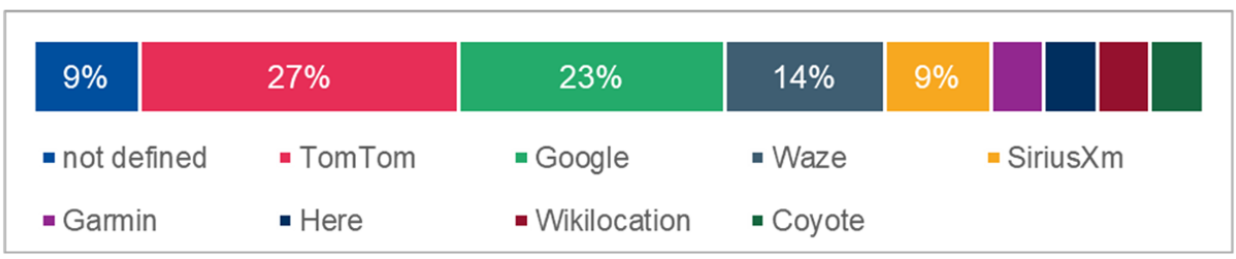

Figure 32: Cartography and traffic providers observed (Source: IDATE DigiWorld in Connected cars, October 2019)

Case studies:

Case study - OnStar services by General Motors

General Motors (GM) has been one one of the most active OEM manufacturers in terms of development of connected services for the automobile and transport industries. Back in 1996, GM in collaboration with two other companies – Electronic Data Systems and Hughes Electronics Corporation – founded OnStar, a special entity to develop connected car services. Today, OnStar as a subsidiary of GM provides two types of services for all the brands of the OEM manufacturer:

- **Safety & security**: emergency crash response service that alerts a trained advisor, emergency and roadside assistance, stolen vehicle assistance (alarms and stolen vehicle slowdown) and navigation provided by an OnStar advisor.
- **Connected service**s: remote control of the vehicle through a mobile app (remote locking/unlocking, lights and engine control), in-vehicle navigation or navigation through a mobile app, vehicle diagnostics as well as unlimited access to third-party infotainment apps and in-car Wi-Fi hotspot with 4G data plan by AT&T.

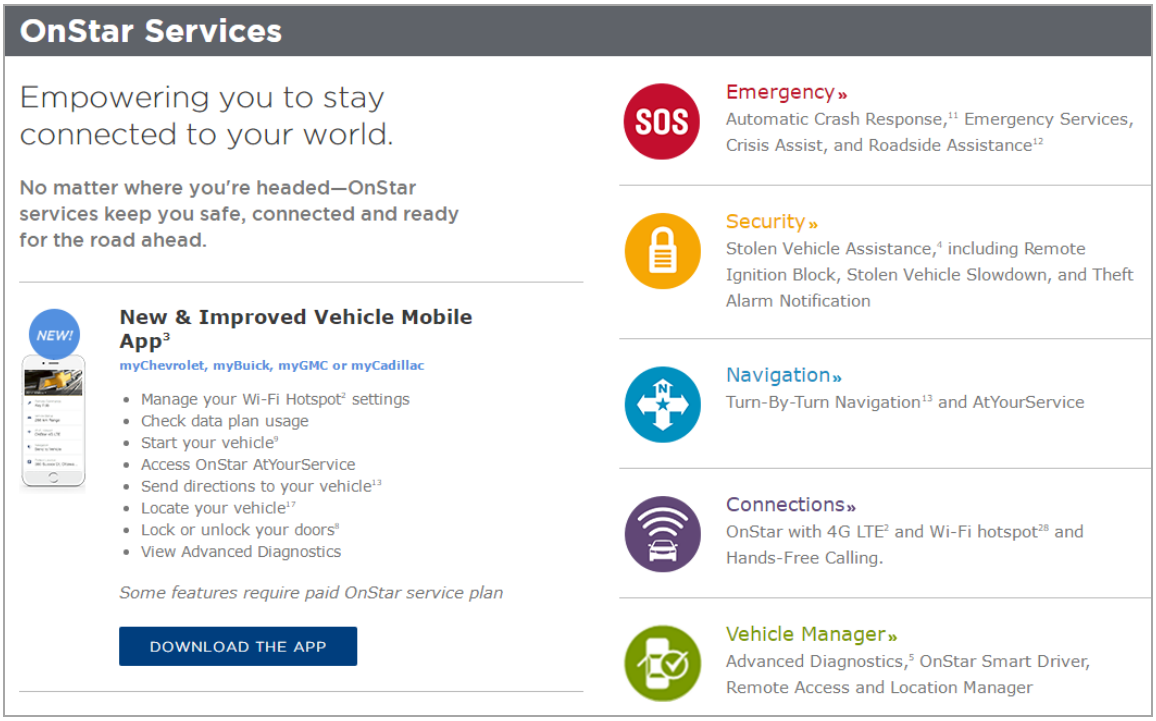

Figure 33: General Motors' OnStar connected car service portfolio (Source : OnStar)

OnStar offers six plans for connected car services depdnding on the number of services included: connected access, remote access plan, unlimited acess plan, safety & security plan, safety & security + remote access and safety & security + unlimited access. The latter bundle comprises the full range of OnStar functionalites.

SAFETY & SECURITY PRICING‡

TERM	PRICE
24 months (RPO: POJ)	$420/Term or $19.99/mo
36 months (RPO: POK)	$578/Term or $17.50/mo
48 months (RPO: POL)	$698/Term or $15.50/mo

REMOTE ACCESS PRICING‡

TERM	PRICE
24 months (RPO: POM)	$210 or $9.99/mo
36 months (RPO: PON)	$330 or $9.99/mo
48 months (RPO: POO)	$450 or $9.99/mo

Figure 34: OnStar plans and pricing (Source : OnStar)

GM also offers temetatics services to enterprise customers under the brand OnStar Vehicle Insights. These offering includes vehicle tracking and real-time diagnostoics. For telematics services, GM has established partnerships with fleet management specialists such as GEOTAB, Fleet Complete (by AT&T) and MapAnything as well as with Verizon Connect.

Case study - BMW CarData

BMW Group has paid particular attention to the use of the data generated by its cars. These data serve to provide tailored connected services to BMW Group customers. The data collected by BMW is strored on the company's servers and can be accessed by customers at any time upon a request.

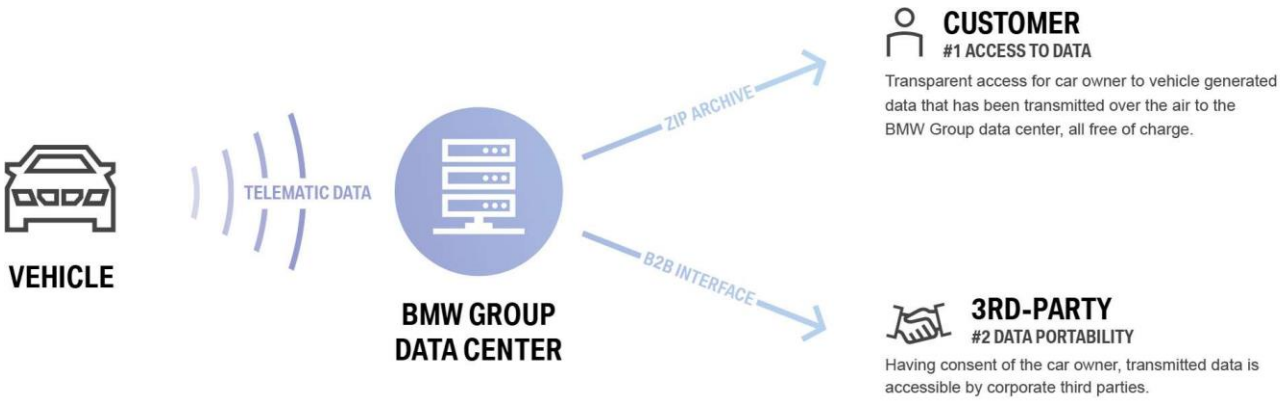

Figure 35: BMW CarData functioning: processing of telematic data (Source: BMW Group)

This CarData includes so-called "telematics data" such as data related to vehicles' condition and position. BMW then provides access to this telematics data to third-party companies who are looking forward to developing personalized connected car services. Customers can always allow or not to share their data with those service providers, as the latter do not have any direct access to it – the BMW Group controls the data access.

Applications for connected car services are then available to BMW customers in the BMW ConnectedDrive Store where drivers can choose one of the ConnectedDrive plans giving access to various connected services such as infotainment or navigation.

	Price
Individual data keys per retrieval[1)]	€0.29*
Individual event keys per retrieval[1)]	€0.09*

[1)] You only pay for the provision of the keys that you have actually requested and received.

Figure 36: BMW CarData pricing for third parties gaining access to the BMW automobile data (Source : BMW Group)

4.3.4 IoT and Servicization in Manufacturing

Service proposed:

Service proposed - Additional revenues from services

The first step in the movement toward servicisation of industry is often to try to bundle additional services to existing product offering. This is currently the main business model, promoted by many industrial heavyweights.

The key applications here are mostly based on predictive maintenance and telematics. Connectivity allows industrial players to send product configuration status over real time.

This status and the related services around the optimised usage of the product can then be charged.

Indeed, two types of generic services will emerge thanks to the connected product:

- Connected-product life-cycle management provides new insights into product usage, which can be leveraged to make servicisation much more efficient for the supplier—for instance, by using remote condition monitoring instead of costly on-site equipment checks.
- New digital services could create completely new service models, in which a predictive maintenance solution can be used to sell improved service-level agreements (SLAs) with greater guaranteed uptime, for example.

In addition to the service revenue for the industrial player (product manufacturer), the customer also optimises the use of the product, achieving cost savings through, for example, breakdown prevention or optimal fuel consumption. This win-win situation thus provides benefits to each player.

Service proposed - From ownership to usage: innovative pricing models

With more services and less product-dependent revenue, the industry sees a tremendous opportunity for deep business shift. Indeed, the module brings a new value to the device/machine, with valuable and monetizable data. It allows the company to develop **subscription-based models**, as is already the case with some selected industries or verticals such as security.

It could even develop advertising/marketing services. Indeed, in variety of cases, the IoT can make it possible to create **new pricing solutions based on real usage** (pay-per-use).

This would allow companies to distinguish themselves in the most competitive sectors where pricing formulas are key to market survival. This type of pricing is an integral part of the new services that IoT enables, such as real-time pricing that makes it possible to implement occasional promotions remotely.

Service proposed - New businesses for industrial players, outside of verticals

With the IoT, manufacturing industrial players could also transform their own activities, by going beyond their vertical business and by being more horizontal (or cross industries). This will enable some actors of the manufacturing industry to shift their business model (partly or entirely) to other sectors with higher margins.

Insurance business:

By connecting end products, manufacturing players can start to provide insurance services as they have access to data on usage patterns. More generally, the insurance industry will be strongly impacted by the IoT wave – with greater security leading to less need for insurance cover – even though they can also seize opportunities in, for instance, fitness and healthcare.

This opens more opportunities for manufacturing industry to further increase the share of financial services – already significant - in their revenues.

Platform business:

In this case, many industrial players are attempting to promote their own industrial IoT platform, enabling their client to monitor and manage their own products. Such platforms are usually designed to optimize industrial processes by connecting machines, devices and applications and providing advanced analytics.

Some industrial players consider in the long term to become a software/service company, as they anticipate the decline of the manufactured market.

Case studies:

Case study - Bosch

Bosch has been actively developing its new Internet of Things business in the last ten years. The company focuses on providing connected solutions for its key markets including connected mobility, connected manufacturing, and connected leaving which stands for consumer goods.

The Bosch Group has also established a special IoT entity Bosch.IO that is relatively independent but also supports the main Group's activities by providing technology and expertise. Bosch.IO specializes in developing IoT software and providing professional services such as IoT consulting, education and support. Its strategy is to provide end-to-end solutions that are often offered in partnership with third-party companies for particular elements of such complete solutions (devices, analytics etc.). These end-to-end offering has been developed for a limited number of vertical markets including agriculture, Smart Building, energy and retail.

Figure 37: Bosch.IO IoT portfolio (Source : Bosch.IO)

The core element of Bosch IoT solutions is the IoT platform Bosch IoT Suite. This cloud-based platform has been developed internally and is offered to Bosch customers as a separate solution or as a part of end-to-end solutions designed for particular use cases. IoT Suite has a modular structure making it a flexible environment for building an IoT solution. Key fonctionalities of the platform comprise device management, data analytics and digital twins and allows integration of use case-specific applications.

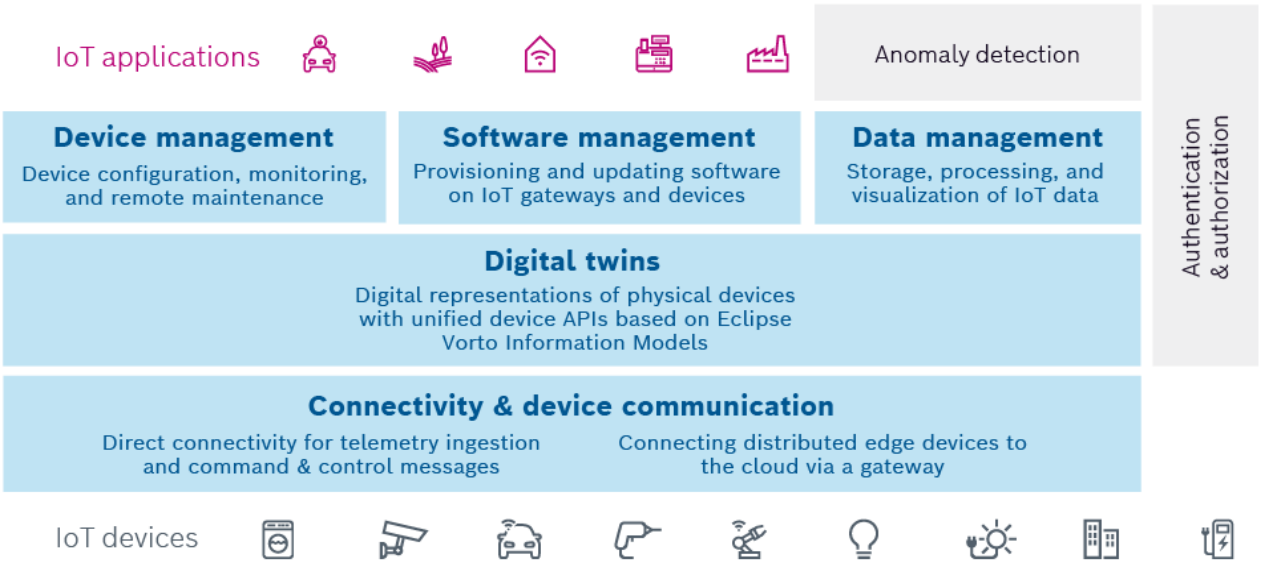

Figure 38: IoT Suite – IoT platform by Bosch (Source: Bosch.IO)

Case study - EcoStructure by Schneider Electric

Schneider Electric is another notable example of a large industrial company that has significantly reviewed its traditional business model and now provides digital transformation services to other

manufacturing companies, utilities and to players from other markets. The central element of the digital offering is Schneider's EcoStruxure industrial IoT (IIoT) platform that interconnectes connected devices and applications designed for particular use cases. Contrarily to industry-agnostic IoT platforms offerd by IT companies such as IBM or Microsoft, these solutions by Shneider Electric address a limited number of vertical markets such as manufacturing, smart grid and smart building.

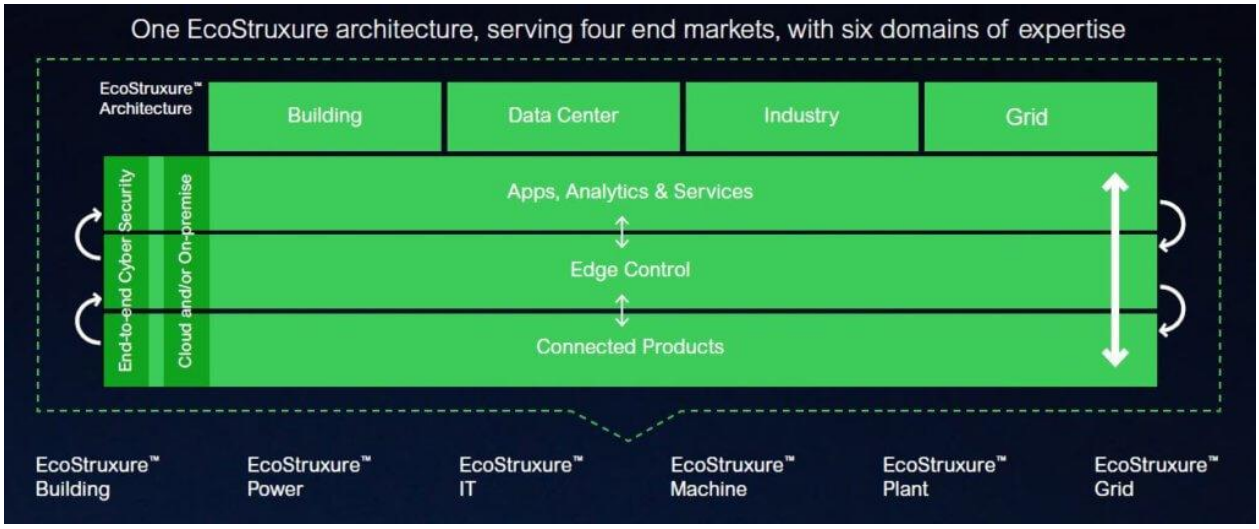

Figure 39: Architecture of the EcoStruxure IIoT platform by Schneider Electric (Source : Schneider Electric)

Schneider Electrric's IIoT solution is an end-to-end offering that compbines connected products and software applications developped by the company, as well as the platform to provide interoperability of all those products and centralize the control over all the industrial operations.

Shneider Electric has not only developped an IIoT portfolio to demonstrate its strategic shift towards more digitalization and more data-related services but also shows a number of real-life implementations of its EcoStruxure solutions. Thus, EcoStruxure has been deployed at the large companies's facilities such as Saint-Gobain, UPS, Veolia and others.

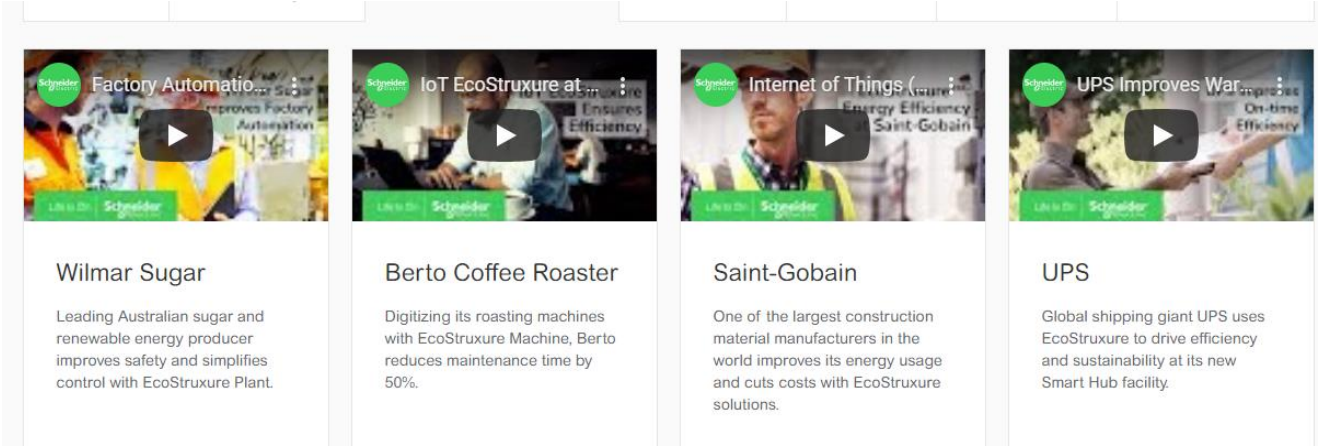

Figure 40: Customers of the EcoStruxure Plant & Machine solution by Schneider Electric (Source : Schneider Electric)

5. LSP APPROACHES TOWARD EXPLOITATION

This section presents the approach taken by the LSP to exploitation. The different approach taken by each project, their key results as well as an analysis of the commonalities and differences between these exploitation models.

5.1 Commonalities in Exploitation Models

This section presents the approach to project exploitation in the context of LSPs. The activities related to exploitation lie into the ability to anticipate the impact of each project beyond its completion. They ensure that results are taken up and that the continued form of the LSP is in reflexion.

5.1.1 Two visions to exploitation

According to the nature of the LSPs and their result, the approach to exploitation varies and can take different paths; but, actually, LSPs also share common issues. Thus, we provide here the commonalities identified between all programmes, which have been translated in two distinct exploitation models:

- Exploitation by use case.
- Exploitation by assets.

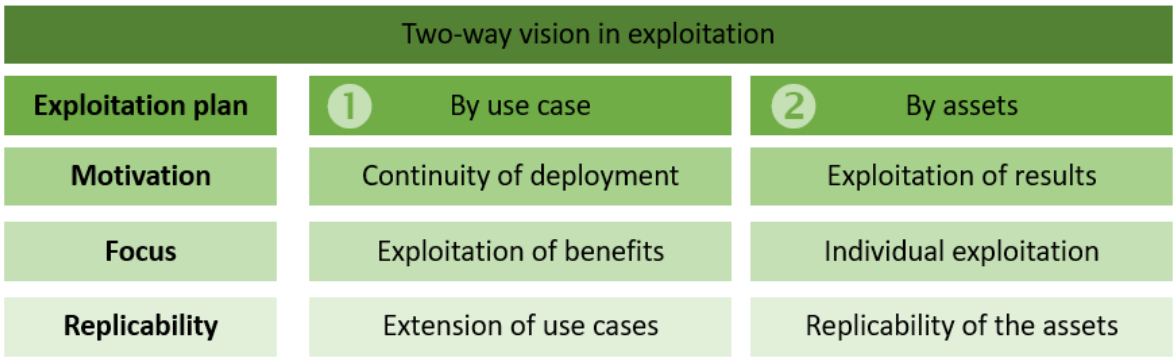

Figure 41: Two-way vision in LSP exploitation (Source: IDATE Digiworld)

Exploitation by use case

A first approach is to look at the project use case and ensuring its economic viability and business impact in order to replicate.

Exploitation by use case - Motivation and focus

This approach by project use cases derived from pilots' sites is business oriented. The motivation of this approach is to ensure that initial benefits and value of the use case can be continued in their own context and that the value brought by the project through these experiments can be continued and expanded.

This approach aims at ensuring a continuity of service for the partners and end users that have benefited from the technology deployment. When adopting this approach, LSPs wanted to make sure about the economic self-sustainability of each use case.

Some LSPs has refined a Minimum Viable Product for each use case. This also means that for each use case an exploitation plan and roadmap are defined for a large-scale deployment

including time-to-market program and identification of new markets, partners, customers. Cost and benefits analysis are used to define business models.

Exploitation by use case - Replicability

In a long-term perspective, the exploitation of benefits as well as lessons learned during the LSP aims to be reusable for other use cases or for other sites. The upscaling from pilots' sites is supported by adapting an implementation plan, making the applications to run smoothly and sought by project. The replicability is thinking independently from local context, done by design for all sites:

- Same data models.
- Same methodologies.
- Same basic reference.

Exploitation by assets

The other direction of the exploitation is to focus on the project production, and to look, asset by asset and result by result at how they will be continued beyond the project completion.

Exploitation by assets - Motivation and focus

The initial motivation for this approach is to ensure a completeness of the exploitation and thus to maximize the project impact. This exploitation approach focusses on the availability of the project asset beyond the end of the project.

This can be achieved in several ways. In the case of LSPs, it can be technical assets like IoT framework, applications or services but also knowledge assets (know-how, experience, results being captured in reusable format as best practices and other formats). It is usually defined in link with one or several partners of pilots' sites.

The key part for LSPs here lies in the identification of exploitable assets individually rather than the whole project. The focus of LSPs for exploitation is to provide a framework to facilitate individual exploitation using the results generated by the pilot sites.

Exploitation by assets - Replicability

In this approach, replicability of the assets demonstrated during the pilots to other sites is a focus. A common framework or model of implementation is used for the replication. It is important here that experimentation are interoperable but not developer for a site.

Some LSPs have launched open calls as part of their exploitation strategy in order to extend to other sites, bring additional stakeholders, test the replicability of the assets and the model of implementation.

5.1.2 Common interest between LSPs

A common objective of exploitation approaches between all LSP is to ensure the dissemination of knowledge and the take up and adoption of the project results by the scientific and industrial community.

Thus, a key point is about transferring all the knowledge developed during LSPs in documents and sharing the experience to keep learning. From LSP perspective, the knowledge should be distributed in a common transferable format including all the best practices resulted from pilots including setting technology, recruiting people, training people.

Also, part of exploitation of project, this aspect can be materialized through the creation of entity like an exploitation hub allowing the connection between stakeholders. The creation of this kind of community can help to foster the innovation ecosystem.

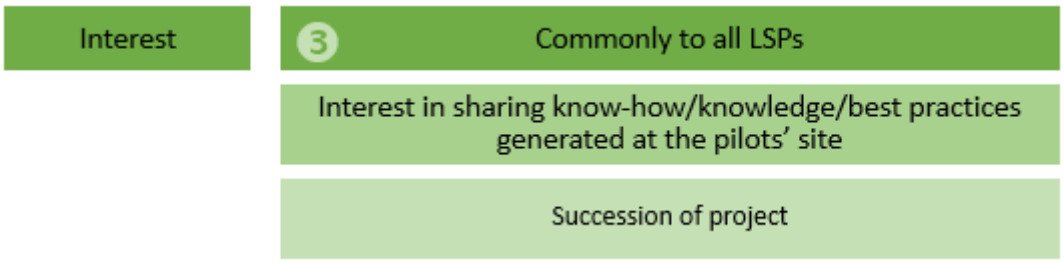

Figure 42: Common interest in LSP exploitation (Source: IDATE Digiworld)

5.2 AUTOPILOT approach to Exploitation and Sustainability

5.2.1 Introduction

AUTOPILOT [6] aims at creating an eco-system that exploits the potential of IoT for automated driving, while also making data from autonomous cars available to the Internet-of-Things.

By bringing IoT into the automated driving world, AUTOPILOT has speeded up the transformation of connected vehicles into highly and fully automated vehicles.

5.2.2 Exploitation and Sustainability Results and Opportunities

According to the proposal that establishes the framework of the project, the last reports were described the following objectives and focus regarding "business exploitation":

- Define KPIs for the dependability, robustness, resilience, adaptability, and sustainability of the piloted technology.
- Validate business processes and models with the KPIs in relation to the pilot sites and use cases.
- Enhance the viability and sustainability of the existing business processes and models in the context of the pilot sites.
- Subsequently, facilitate the large-scale uptake of these business solutions across different cities in Europe.
- Develop a business exploitation strategy for transferring the selected IoT demonstrations to permanent installations.
-

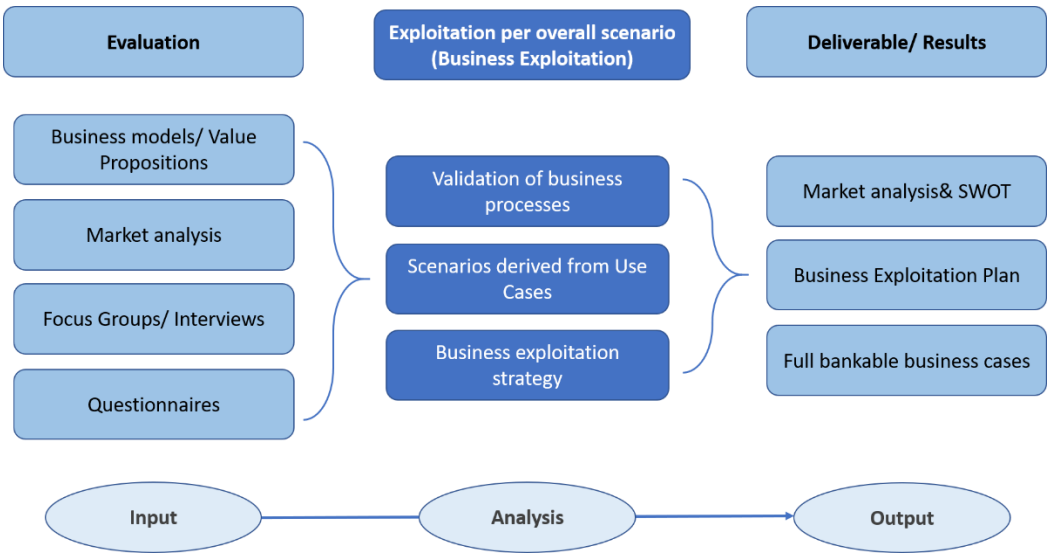

Figure 43: Methodology for exploitation in AUTOPILOT (Source: The AUTOPILOT project)

Regarding to the latest "Final Business Exploitation" report (D5.6) this action will include three main parts: Firstly, presentation of the methodology for upscaling and exploiting project results into business ideas and strategies. Secondly, the document will show a collection of applicable business cases in the IoT and Intelligent Transport Systems (ITS) domains that shall be considered in the further development and discussions within the AUTOPILOT and follow-up projects. Thirdly, the deliverable presents the analysis of the market implementation gaps.

Step 1: Input and Information gathering

During the first phase of exploitation, information was gathered with different evaluation methods. The general market research was conducted to give an overview and an introduction to the different use cases.

Step 2: Applied methodologies for business exploitation

This phase is divided in three parts as following:

- Validation of business processes in relation to pilot sites (KPIs):
  - Service Definition: This part refers to an IoT service for automated vehicles.
  - Sustainability: Long term operation and follow up initiatives for the service (not involve the environmental friendliness of the solutions).
  - Robustness: The quality and condition of the service, (the ability to prevent system failure).
- Scenarios derived from the Use Cases:
  - Use Cases deriving from AUTOPILOT (are services and/or driving modes previously tested within the project).
  - Associated business cases (are applications of services that are outside the initial scope of the project).
- Business exploitation strategy and lessons learnt.

Step 3: Results

- Automated Valet Parking - Highly Automated Parking including manoeuvring in a limited area with limited speed to and from most parking spaces. The driver can leave the vehicle and initiates the manoeuvring to the parking space and the parking itself by smartphone or key. The driver does not have to monitor the system constantly and may initiate the parking-out manoeuvre in the same way when coming back.

- Automated Highway Pilot - The speed of Conditional Automated Driving can reach up to 130 km/h on motorways or motorway similar roads. It includes entrance to exit, on all lanes and overtaking. The driver must deliberately activate the system but does not have to monitor the system constantly. The driver can override or switch off the system at all times. In case of a takeover request to the driver from the system, the driver has sufficient time reserved to orientate himself and take over the driving task. In case the driver does not take over, the system will go to a risk reduced condition, i.e. bring the vehicle to a safe stop.

- Automated Car Sharing - When the speed of Highly Automated Driving reaches up to the limitation in urban and suburban areas, the system can be activated in the shared car enabling different IoT services on defined road segments. The driver can override or switch off the system at all times.

- Interoperability for Automated Driving - Compared to the connected car per se, the self-driving car is more dependent on the connections to the outside. Apart from the operator's network (currently 3G and 4G for connected cars), there is a greater need to communicate with other autonomous cars (vehicle-to-vehicle, V2V), with infrastructure (V2X), traffic facilities and central. For example, the stop-and-go mode for a congested traffic situation relies on communications with other vehicles, facilities, and central ITS station. To meet the wider communication demand, ITS is being developed. The goal is to create standards and

specifications for the use of information and communication technologies (ICT) in future transport systems.

Finally, after the last project meetings, the consortium has established the key preliminary conclusions affirming the importance of numerous actions to provide such as:

- Shifting markets and revenue pools - This action will be driven by shared mobility, connectivity services, and feature upgrades, new business models could expand automotive revenue pools. And also, despite a shift towards shared mobility, vehicle unit sales will continue to grow.
- New competition and cooperation - Within a more complex and diversified mobility industry landscape, incumbent players will be forced to simultaneously compete on multiple fronts and cooperate with competitors. Newmarket entrants are expected to initially target only specific, economically attractive segments and activities along the value chain before potentially exploring further fields.

The work on business models considered the previous work done in [11] on IoT business models framework. The IoT business models reproduce the content, structure, governance of technology and business transactions designed to create value through the exploitation of IoT opportunities through autonomous driving applications.

Source: https://autopilot-project.eu/, *Contact with Julie Castermans (Ertico)*

5.3 SYNCHRONICITY approach to Exploitation and Sustainability

5.3.1 Introduction

The ambition of SynchroniCity [8] is to create a global market for Smart Cities in alignment with the goals of the Digital Single Market, as conceived by the European Commission. Why a digital single market for Smart Cities is so important? The realization of such a concept would imply that:

- Any company with smart city solutions would be in a position to roll out the solution in any city and would not be restricted to operate with the cities the company knows well (this is currently due to the diversity of infrastructures, data models, protocols, etc). Consequently, this would **widen the market for any smart city provider** with an obvious benefit for the supply side.
- At the same time, the demand side would also find enormous benefits, since any city could check which solutions are being deployed by their peers and if they wished so, they could deploy the same solution in their own cities. This environment would clearly **enhance creativity and innovation while reducing vendor lock-in**.

In both cases (supply and demand) there would be a **reduction of time and deployment costs**, leading to the **acceleration in the adoption of smart city solutions**.

But that is a vision and getting close to it is not a straightforward task. Synchronicity has made the first, yet very relevant part. It has generated as major asset of the project the so-called **MIMs (Minimal Interoperability Mechanisms)**, which are technical mechanisms that provide incremental interoperability levels to cities implementing them. MIMs relate to context information management, shared data models, ecosystem transaction management (marketplace), security and storage. MIMs are vendor-neutral and technology-agnostic, meaning that anybody can use them and integrate them in existing systems and offerings. The first three MIMs were adopted by the OASC Council of Cities on January 16, 2019, meaning that they have reached a level of credibility and acceptance that expands the cities of this consortium. During these years

Synchronicity has put in place the elements needed to realize the vision of a global market for smart cities.

- A detailed architectural work leading to the MIMs.
- Reference implementation of such framework, with different options by several vendors and deployments in the cities of the consortium (i.e. their infrastructures have become MIMs-compliant)
- Development of a high amount of services and applications that have been deployed, in all cases, in a minimum of two cities to validate interoperability. This has included:
  - The creation of a catalogue with a series of atomic services, reusable SW components that encapsulate different functionalities and can accelerate the development of applications.
  - A series of applications internal to the consortium aligned with the cities' needs.
  - A series of 16 pilots resulting from the Open Call process.

But this validation work was not a goal in itself. It was intended to provide the basis for the commercial roll-out of MIMs in many other cities, once frontrunner cities (those of the SynchroniCity project) could show the path and performance of the proposed approach.

5.3.2 Main target audience/customers and value proposition

Main value proposition of MIMs for cities and providers of smart city solutions (industry) is as follows:

- **Cities**: avoid vendor lock-in, thanks to solutions based on open standards where all companies can contribute and become compliant with. Cities have the capacity to make this happen by incorporating these mechanisms in their public procurement processes, encouraging suppliers to move towards more open solutions. Since higher degree of interoperability will make possible that solutions implemented in one city can be deployed in another one, cities will widen their possibilities by having access to the full catalogue of compliant solutions. More availability of solutions will enhance competition, ultimately leading to more creative and performing applications.
- **Companies (IT providers, suppliers of Smart City solutions)**: accepted open standards will mean more certainty about operational environments, promoting investments. Scalability of solutions will make possible the moto of "develop once, deploy many times", reducing risks and costs, as well as opening new markets.

5.3.3 Sustainability approach

The sustainability approach defined by SynchroniCity revolves around the creation of the infrastructure and organizational structures needed to **scale from pilots to real-life deployments**.

We refer to these areas of work as Strategic Implementation Chapters or SICs and they will be led and coordinated by the Open and Agile Smart Cities Alliance (OASC), a legal entity (under Belgian law) that will take over the responsibility of bringing the outcomes produced by SynchroniCity to a business environment. In fact, OASC went through the process of becoming a legal entity in the last year precisely to achieve that goal and was included as part of the SynchroniCity consortium.

Cities/municipalities are at the center of the OASC ecosystem. OASC has nowadays +140 cities from +30 countries and regions in Europe, Latin America and Asia-Pacific. Most recent cities that have joined OASC include: Ameghino, Berisso, Carlos Casares, Coronel Suarez, La Plata, Lobos, Ramallo and Puan in Argentina; London in UK; Métropole Nice Côte d'Azur and Métropole Européenne de Lille in France; Heidelberg and Kiel in Germany; Fukuoka and Tokyo in Japan and Novi Sad and Subotica in Serbia.

Infrastructure/Data/Technology

Two elements should be highlighted here: the catalogue of IoT solutions and the IoT Data Marketplace.

The IoT catalogue [12] is a catalogue providing complete transparency on how cities are solving problems so that any city in the world can procure and/or replicate those services. Solutions per city will be broken down into partners, hardware, components, services, data, data models, protocols, etc offering complete knowledge on the solution and its ecosystem. It will take the IoT Catalogue developed in the context of the IoT-LSP program as basis and will become a Global repository of certified, implementable solutions by cities for cities. Since solutions will be compliant with MIMs, cities that are MIMs-compliant will be sure that solutions can be replicated in their environment).

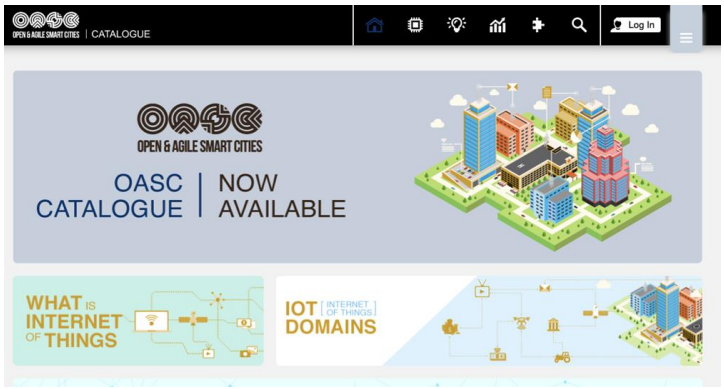

Figure 44: SynchroniCity Catalogue

The IoT Data Marketplace intends to be a one stop shop for Urban IoT data enabling simple access to IoT data from all OASC/MIMs-compliant cities around the world via a single platform. It will not necessarily keep data in a centralized manner; on the contrary, it is based on federated access to OASC compliant smart city data platforms. As in the previous case, it builds on top of the experience and learnings from SynchroniCity but looks at a business exploitation phase. It can be accessed through IoT Data Marketplace [13].

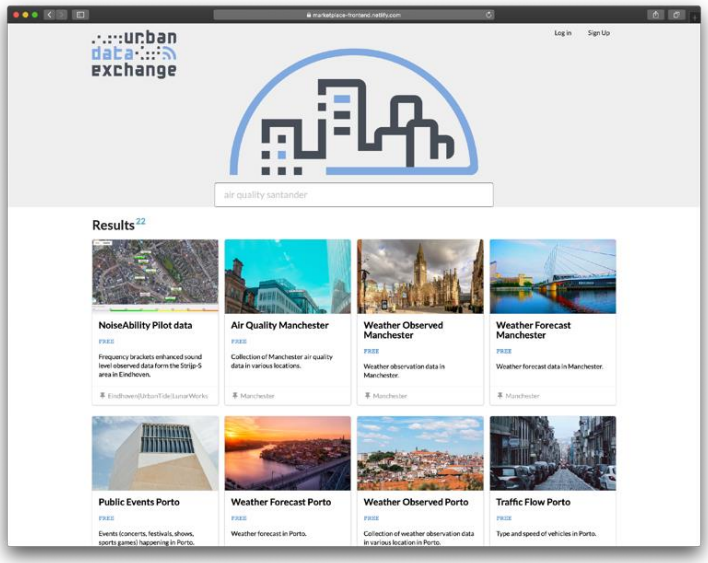

Figure 45: SynchroniCity Marketplace

Certification

The certification programme will provide a way for cities to identify solutions that will technically work with their infrastructures, and for companies to demonstrate compliance and

address the market more easily. Roadmap of certification activities is already available and engage a number of industrial partners.

Training and professional skills

Proving neutral guidance is very important and that is why services around training and professional skills will not only target technical companies (supply side) but also cities (demand side), so that they can be fully knowledgeable and take informed decisions that better fit their needs.

Partnerships

OASC has already started a campaign to establish partnerships with trusted global partners who can help, at scale, in one or more of the Strategic Implementation Chapters described in this document. The OASC partnership agreement includes the conditions for collaborating with different parties, including corporates. Some of the partners of the project are in the process of signing such agreements as part of their engagement in business activities under the OASC umbrella.

Marketing and communications

In the last phase SynchroniCity has worked on a reviewed branding for the "beyond SynchroniCity" phase, as it can be appreciated by the new website and communication material recently released (we encourage you to check the recent publication "A guide to SynchroniCity", available through the project website [8]). A roadmap of events already exists for 2020 in order to keep and even grow the momentum around Digital Transformation for Cities and the role of MIMs in it, being a major tool to foster adoption and community engagement. Some of them are the SynchroniCity LIVE Summit (16-18 June 2020, Copenhagen); World Government Summit (October 2020, Dubai) and future editions of the Connected Smart Cities Conference (organized in the context of the project in the last three years); great presence at the Smart City Expo World Congress can also be expected.

5.3.4 References

The source of this description is D6.6 SynchroniCity Sustainability Plan. In D6.6 readers can also find an updated market research, reflections on the current European context with regard to platforms or data sharing, among other concepts, a detailed description of all the outcomes and exploitable assets generated by the project and the complete description of the overall Sustainability Plan that has been depicted in this document.

In addition, D6.7 can be consulted by those people that are interested in understanding additional exploitation plans by individual partners as a contribution to the overall sustainability plan or as additional actions outside the OASC ecosystem.

We also encourage readers to check the SynchroniCity website, where all deliverables can be accessed.

Source: https://synchronicity-iot.eu/ , *Contact with Nuria de Lama (ATOS)*

5.4 ACTIVAGE approach to Exploitation and Sustainability

5.4.1 Introduction

ACTIVAGE project is a European Multi Centric Large-Scale Pilot on Smart Living Environments, which has the main objective to build the first European IoT ecosystem across several European cities in different countries.

The main project result is a developed AIOTES, an Internet of Things for Active and Healthy Ageing Ecosystem Framework, which integrate technologies along the full stack of IoT standard architecture. It provides interoperability across IoT platforms and services, end-to-end privacy and security management, software tools for developers and deployers making easier the integration of ACTIVAGE in data analytics capabilities with any legacy infrastructure, and a marketplace related for marketing and sales of compliant Active and Healthy Ageing applications and services worldwide.

ACTIVAGE has rolled out Internet of Things infrastructures and AIOTES in 12 cities and regions in the EU enrolling more than 8.000 users and produced empiric evidence of the value on the QoL for senior people and economical business-related benefits for all stakeholders in this domain.

High-level exploitation aims are clearly defined within the core objectives of ACTIVAGE project. The next is an excerpt from the text in that document: "…, ACTIVAGE project is aiming to support IoT business models irrespective of their revenue orientation … or targeted customers (Businesses and End-Users). In this manner, ACTIVAGE is aiming to form not only a standardization and interoperability framework but more importantly an exploitation and commercialization hub that supports the fast, effective and safe deployment of solutions accelerating their path towards products that are viable in the global market and address specific issues of AHA."

Taking into account the clear commitment for exploitation, one of the major challenges of ACTIVAGE project was to define with the support among partners, build and make operative the "Exploitation Vehicle" that will take care of the ownership of ACTIVAGE legacy and impulse the evolution of the ecosystem after the end of the project for the next 5 years. The consortium members have adopted the decision of creation of ACTIVAGE.ORG – a non-for-profit association - as the exploitation vehicle, to assume the ownership of all project's assets produced, to scale up the Active and Healthy Ageing market enlarging the initial ecosystem and allowing project members to maximise the ROI for their contribution to ACTIVAGE values, in the coming years.

5.4.2 Mission and Vision

- The Mission of ACTIVAGE.ORG is to create the first European Digital Market of Solutions and Services for the independent living, active aging, and wellbeing of Senior People, leveraging on ACTIVAGE Ecosystem globally.
- The vision if to be the trusted sale point where any single senior people can access personalised services for getting their life longer, safer and happier.

5.4.3 Business model and implementation plans and sustainability.

The model of ACTIVAGE.ORG is of a multisided platform of services aggregation that facilitate and add value to transactions across stakeholders in the supply and demand sides of the ecosystem. ACTIVAGE.ORG will create a network of local/regional AHA service providers and technology suppliers covering as much as possible the EU territory, leveraging on the Deployment Sites and project's partners implantation. The aggregation platform, i.e. the ACTIVAGE MALL will enable the encounter between demand (seniors and caregivers, service providers, social care agencies, insurances and more) and supply (IoT /cloud service providers, IoT/ wearable manufacturers and vendors, system integrators and installers, and more) to make transactions over a rich portfolio of certified services and products. ACTIVAGE.ORG will keep the maintenance and further evolution of all technology assets, i.e. AIOTES within an open-source project model.

ACTIVAGE.ORG intends to be the one selling point where the public administration, public and private operators, insurance companies, technology suppliers, health and social care providers and citizens can find trustable, cost-effective and sustainable solutions to their mission, business, and life quality needs respectively.

The implementation plan is now in progress, led by a team of key industrial members and SMEs, and it counts with the adherence of most of the project members.

Source: https://www.activageproject.eu/ , contact with *Sergio Guillen (MySphera)*

5.5 IoF approach to Exploitation and Sustainability

5.5.1 Introduction

The IoF2020 business support of 2019 restructured by the services and team composition quite significantly. In the final phase of the project were identified new IoF2020 use cases that joined the project through the open call.

For the actual period, 33 use cases and more than 50 products and services in development, the business support decided to take three measures:

- Offer intensive individual business model support.
- Significantly staff up the individual business model expert team.
- Offer 6 webinars with various business topics.

In terms of business models, IoF2020 continues with the vision by the implementation of use cases to the software-as-a-service (SaaS) model with monthly or yearly subscriptions. At the same time, the platform model is getting stronger and became actually in many sectors a key enabler for distribution, interoperability and accelerated product development. The team has observed the launch of the Data Connect initiative at the Agritechnica in 2019 where Claas, John Deere, CNHi and 365FarmNet declared to use common cloud API to make data available to smart services, but also the launch of the enterprise platform of Connecterra to monetize the data exchange with third-party services. Learn in the first section about the successes and challenges in the business model development of the IoF2020 use cases and discover the positive influence of our business support team.

Another important issue of the project is related to sustainability. Next to the overall objective of developing competitive and sustainable business models for the products and services of our IoF2020 use cases, the business support addresses the challenge as well of making part of the IoF2020 ecosystem and infrastructure self-sustainable after the end of the project in 2020.

With this purpose, the IoF2020 project team has identified two major shortcomings in the current innovation ecosystem of agrifood. One is the lack of innovation programs of larger corporates to integrate third-party innovations into their distribution catalogue or to use external innovations to transform their business model. However, many corporates in the IoF2020 consortium are very interested in this opportunity to source innovation and stay ahead of the international competition. Therefore, the business support team started mapping the current landscape of accelerators and digital innovation hubs to identify trending topics, potential partners and to unite the different local initiatives into a network offering acceleration as a service

5.5.2 Next Steps.

Focusing in the last year of the project lifetime the consortium team has established numerous objectives for 2020 such as:

- Business support on bringing as many services and products out to the market as possible.
- Validation of key performance indicators of the use cases and to arrive at a proper overview of the actual IoT impact.

- Infrastructure into a sustainable test farm network and to ignite the establishment of further corporate innovation programs based on an acceleration of a service approach.

Additionally, a part of these key objectives, IoF2020 project is to work on the preparation of a proper knowledge transfer to other stakeholders like digital innovation hubs and accelerators.

The business support will also further elaborate in the final version of this evolutionary document on the business model development of the 14 open call use-cases and complement some missing details for the old IoF2020 use cases.

Source: https://www.iof2020.eu/ , Contact with *Alexander Berlin (Berlin Thinking)*

5.6 MONICA approach to Exploitation and Sustainability

5.6.1 Introduction

The MONICA project is a large-scale demonstration of new and existing IoT applications for smarter living which will be involved in numerous cities in Europe.

To demonstrate how these challenges can be met through the use of technology. MONICA team has developed, deployed and prepare a demonstration of three IoT ecosystems on security, acoustics, and innovation, addressing real user needs. The MONICA project follows an exploitation roadmap that goes from the identification of exploitable results, analysis of market and business to the formulation of exploitation and business plans which detail the utilization of results after the project ends.

5.6.2 Step 1: Identification of results

Results cover both tangible and intangible output of the project. For the tangible output or assets, Intellectual Property Rights (IPR) are determined. The MONICA consortium follows the EU IPR Helpdesk recommendations for EU projects, and IPR management is handled according to the Grant Agreement with specific rules set forth in the Consortium Agreement. The process includes identifying beneficiaries who have contributed to the assets and negotiating ownership of these using a tool called the IPR Identification Sheet.

At the moment of writing, 26 exploitable (tangible) results have been documented within crowd & capacity monitoring (11), sound monitoring & control (6) and IoT platform & interfaces (9). They are described in the public deliverable D1.5 Final Report on Innovations and Use and Dissemination of Knowledge which will be available on the project website Q2 2020.

The results are part of seven MONICA solutions for crowd & capacity monitoring, crowd management and communication, sound level monitoring, adaptive sound field control, quiet zones, visitor experience, and citizen engagement.

5.6.3 Step 2: Market analysis

To position the results on the market, market analysis and segmentation is performed. The market segmentation is performed according to the relevant MONICA assets and their benefits and comprises a definition of the MONICA value proposition, market characteristics and drivers, market size and competition.

5.6.4 Step 3: Business analysis

Based on the output from the market analysis, the business opportunities are analysed in order to establish an optimal positioning strategy. This includes the formulation of unique selling points, technology benchmarking, development of business models and conducting a cost-benefit and SWOT analysis.

The result is ten business models for smart open-air events that are made available in an online reference book, planned for launch in March 2020 via the project website.

The market & business analysis and business models are also available in the public deliverable D11.5 New Markets segmentation and Sustainable Business Models which will be available on the project website Q2 2020. The document also contains a description of the emerging markets of hearables and data-driven behavioural approach to urban planning which are results from the three hackathons organised by the project in 2018 to promote new market openings for start-ups through the use of MONICA data.

5.6.5 Step 4: Business and sustainability plans

All of the above supports a decision on an optimal positioning strategy and the planning of individual and joint exploitation both for industrial project partners and academic partners (supply side) and the creation of sustainability plans for the pilot partners (demand side).

5.6.6 Facilitating the use of MONICA results by others

Exploitation is also facilitating the use of MONICA results by others. To do so, the project is producing an online reference book and roadmap for replication of MONICA solutions as well as an open software development toolbox with generic enablers, tutorials, and guidelines.

The online reference book is available on the MONICA website at the end of March 2020 and will detail several aspects of each solution targeted the smart city operator, event organizer, and solutions developer: features, benefits, technologies, implementation, regulations, ethics and replication. As such, it provides a roadmap for market replication.

The online version is built on the public deliverable D9.3 Replication Reference Book and Roadmaps for MONICA Market Replication, accessible Q2 2020.

The development of toolbox is available at https://monica-project.github.io/. The reference document is D7.6 The MONICA Development Toolbox 2, accessible online Q2 2020.

Additionally, MONICA project partners have produced more than 25 scientific publications, most of which are available as open source. See the project website for scientific publications [14]. Finally, a list of all public deliverables can be accessed also at the project once approved by the Commission [15].

Source: https://www.monica-project.eu/, Contact with *Louise Birch Riley (In-JeT ApS)*

6. SUSTAINABILITY MODELS FOR LARGE SCALE IOT EXPERIMENTATION PLATFORMS

This section presents views on how to ensure the long-term sustainability of large-scale experimental deployments (i.e. the type of experimentation created by the LSP programme) and how to ensure continuation of the LSP dynamics and exchanges between deployment sites and testbeds beyond the completion of the projects.

The section extends the information presented in Section 5 around LSPs sustainability models and approaches, elaborating further on the information gathered during interviews and workshops with LSPs, with special focus of the sustainability workshop of 27 February 2019 in Lisbon, Portugal.

6.1 Commonalities in Sustainability Barriers and Models

Based on the many interactions between CREATE-IoT and the different LSPs, we have been able to collect enough information that allows us to draw a map of barriers and challenges to sustainability and the models or approaches that the different LSPs have considered to ensure sustainability.

We have grouped challenges and approaches along three conceptual dimensions:

- Technological sustainability, meaning:
  - Is the technology fit for purpose?
  - Can it operate in a real market deployment?
  - Is it mature, acceptable and scalable?
- Sustainability of pilot deployments, meaning:
  - Is the pilot deployment financially sustainable?
  - Is it scalable?
  - How can its operation and purpose be extended?
- Ecosystem sustainability, referring to the many existing relationships among pilot actors, their external stakeholder communities, and relevant elements such as market forces and regulation. Under this category we have grouped the insights corresponding to the following questions:
  - How can your ecosystem be nurtured and extended?
  - What market forces are essential for sustainability?
  - What role does the public sector have in large scale experimentation?

The figures below provide a map of the findings of our work with LSPs. Even if many of the barriers are somehow common to all LSPs, there are interesting insights and specificities in some of the projects that will be explained with more detail in Section 6.2.

Interestingly, many of the barriers and approaches identified by LSPs pertain to the ecosystem dimension.

Our interpretation of this is that large-scale pilot experimentation may provide good results in terms of technological validation, but may as well suffer from barriers coming from forces out of their direct control, such as regulatory uncertainties or the lack of a critical mass of demand pull.

Sustainability dimension	Challenges / Barriers in LSPs identified by CREATE-IoT
Technology	Lack of interoperability
	Lack of standards (or too many standards)
	Lack of maturity of supply-side offer
Pilot Deployment	Financial continuity of pilots
	Moving from use case demonstration to proving scalability
Ecosystem	Regulatory uncertainty
	Market fragmentation
	Lack of demand-side pull
	Ecosystem complexity (many different stakeholders involved)
	Insufficient coordination between public and private actors
	Lack of expertise or innovation agility in public procurers

Figure 46: Challenges and barriers to pilot sustainability identified in LSPs

Sustainability dimension	Sustainability approaches identified by CREATE-IoT
Technology	Commitment to interoperability and standards as a must
	Demonstrate technological scalability
Pilot Deployment	Generating evidence of ROI and acceptability (and economic scalability if posible)
	Continuity through transferring pilot ownership to a specific player
	New (public funded) projects to ensure continuity of pilots
Ecosystem	Engage all necessary stakeholders and actors from the start
	Early demand generation
	Creating value for existing players
	Attracting new actors
	Nurturing and growing the ecosystem: hackathons, start-up community
	Importance of public sector as driver for innovation through regulation and procurement
	Procurement harmonization / Standards-based procurement
	Aggregation of demand to tackle market fragmentation

Figure 47: Sustainability approaches in LSPs

6.2 Specific Insights on Sustainability from LSPs: AUTOPILOT and ACTIVAGE

In this section, we want to offer deeper details of the insights gathered during the sustainability workshop of 27 February 2019 in Lisbon from two of the projects that provided more inputs to CREATE-IoT. The projects AUTOPILOT and ACTIVAGE are relatively diverse in terms of ecosystem configuration, and have dealt with some specific barriers, and therefore their experience and insights become valuable food for thought for future large-scale pilot deployments.

6.2.1 AUTOPILOT

The main barriers preventing sustainability identified by AUTOPILOT are:

- The take-up of automated driving faces a rich variety of challenges that include technology innovation but go well beyond (such as regulation and legislation). Encompassing progress in all dimensions is a challenge in itself, as many of them are intertwinned and feed back amon themselves. For example, technology readiness is useless if no proper regulation is in place, but this is unlikely to happen unless there is a clear demand from industry (and society). And even if technology and regulation are ready, there are still investments in infrastructure adaptation that need to be made, which require a clear market case.
- On the connectivity plane, IoT providers need yet to prove their technology is useful, safe and worth the investment. Technology push is not enough in the automated driving arena.
- Etablishment and embracement of standards by all stakeholders is necessary. No sustainability can be achieved without common or interoperable technological ground.

The approach to nurture sustainability followed by ACTIVAGE considers a number of key elements:

- The final goal of having fully automated driving deployed massively is still far away (see figure below), and much cumulative progress must be achieved until then. Therefore, the concept of sustainability for AUTOPILOT involves the need of ensuring the legacy of existing pilots by building new innovation and deployments opon thouse through new projects and pilots.
- The public sector is, in general, unfit for innovation. Despite the necessary involvement of public administrations (as procureres and users), the internal dynamics, decision making process and procedures are not mature for a full engagement in innovation efforts.
- The complexity of the stakeholder community calls for a necessaryly sustained (long-term) cooperation among all of them throughout the entire innovation and market take-up process.

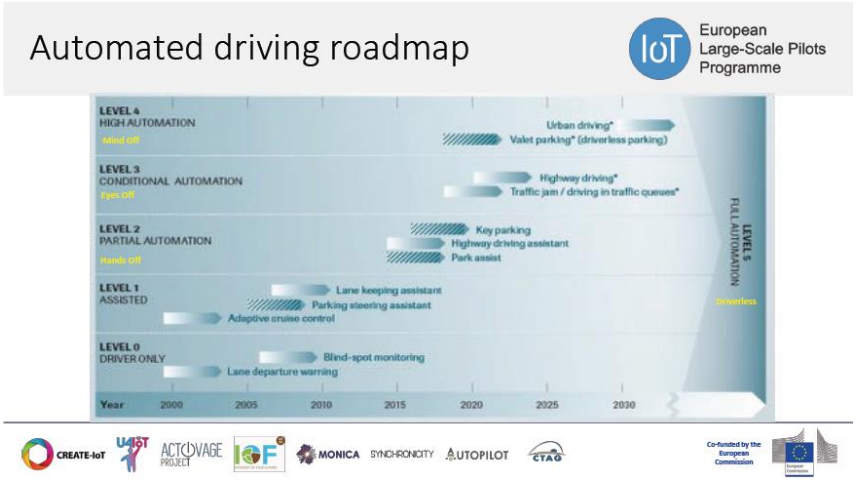

Figure 48: AUTOPILOT: Roadmap towards the take-up of automated driving

Figure 49: AUTOPILOT: challenges of connected automated driving

The IoT stakeholders applying the technology to enhance autonomous driving capabilities have operated within the existing business models that reflected the distinctive competencies at the core of each group. The new IoT applications for autonomous driving is pushing the boarders between the existing business models and the emergent concepts put forward by new players and start-ups. In this context, the intelligent infrastructure providers, software/hardware and network stakeholders have to re-think their strategies and consider including new ways to address data sharing and provide and use common marketplaces.

6.2.2 ACTIVAGE

The main barriers preventing sustainability identified by ACTIVAGE are:

- Moving from a successful use case demonstration towards demonstrating scalability
- Market fragmentation: healthcare and telecare present a very atomized market
- Technology push is not enough. A clear driving pull from the demand side is needed to ensure investments, critical mass and therefore, sustainability. This driving pull from the demand side is far from becoming a reality, and will like be triggered when there will be enough motivation for change (on service delivery, care models, etc.) on the demand side.
- The public sector is, in general, unfit for innovation. Despite the necessary involvement of public administrations (as procureres and users), the internal dynamics, decision making process and procedures are not mature for a full engagement in innovation efforts.

The approach to nurture sustinability followed by ACTIVAGE considers a number of key elements:

- Engagement of all necessary stakeholders in the innovation process and pilots (see figure 47 and 48).
- Combine a rich diversity of native use cases (both geographical and application-wise) with open calls as a multiplier of the LSP footprint.
- All use cases must demonstrate an economic case

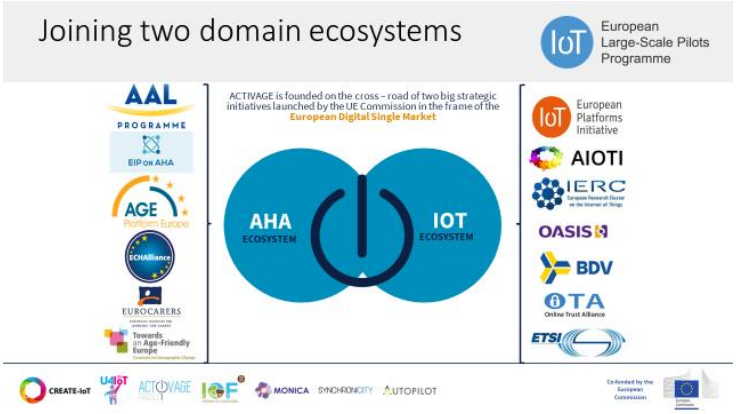

Figure 50: ACTIVAGE: Getting two ecosystems to work together

Figure 51: ACTIVAGE: Example of functionalities and stakeholders involved in a use case

7. REFERENCES

[1] Slama, D., Puhlmann, F., Morrish, J., and Bhatnager, R.M. *Enterprise IoT*, O'Reilly. Online at: https://www.oreilly.com/library/view/enterprise-iot/9781491934258/ch01.html

[2] *Automated Driving Roadmap*, version 7.0. ERTRAC Working Group – Connectivity and Automated Driving, May 2017. Online at: https://www.ertrac.org/uploads/images/ERTRAC_Automated-Driving_Public%20Consultation%20April%202017.pdf

[3] *Automotive revolution – perspective towards 2030*. McKinsey & Company, January 2016. Online at: https://www.mckinsey.com/~/media/McKinsey/Industries/Automotive%20and%20Assembly/Our%20Insights/Disruptive%20trends%20that%20will%20transform%20the%20auto%20industry/Auto%202030%20report%20Jan%202016.ashx

[4] The MONICA project. Online at: https://www.monica-project.eu/home/about-monica/

[5] *EBF detailed recommendations for an EU framework of experimentation*. European Banking Federation, EBF_033346, December 2018. Online at: https://www.ebf.eu/wp-content/uploads/2018/12/EBF-recommendations-on-framework-for-experimentation-in-the-EU.pdf

[6] The AUTOPILOT project. Online at: https://autopilot-project.eu/about-autopilot/

[7] *Digital transformation Monitor - Autonomous cars: A big opportunity for European industry*. European Commission, January 2017. Online at: https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Autonomous%20cars%20v1_1.pdf

[8] The SYNCHRONICITY project. Online at: https://synchronicity-iot.eu/

[9] The IoF2020 project. Online at: https://www.iof2020.eu/

[10] The ACTIVAGE project. Online at: https://www.activageproject.eu/

[11] *IoT Business Models Framework* (D02.01), Revision 1.0. The UNIFY-IoT project (H2020-EU), July 2016.

[12] OASC Catalogue, Open and Agile Smart Cities. Online at: https://oasc.iot-catalogue.com/

[13] SYNCHRONICITY, IoT Data Marketplace. Online at: https://iot-data-marketplace.com/

[14] The MONICA project, public deliverables. Online at: See https://www.monica-project.eu/publications/

[15] The MONICA project, public deliverables. Online at: https://www.monica-project.eu/public-deliverables/